THE GOTLAND PAPERS

Selected Papers from the VII International Conference on Easter Island and the Pacific

Migration, Identity, and Cultural Heritage

Gotland University, Sweden
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Editors: Paul Wallin and Helene Martinsson-Wallin
Gotland University

in Collaboration with

Easter Island Foundation

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Title page drawing of Släbro Runic Stone from Sweden, back cover drawing of fragmented moai with inlaid eye from ‘Anakena, and drawing of moai in Rano Raraku on page 9 all by Paul Horley.
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Introductory Material and Keynote Address
Opening Remarks

Dave Rose
Easter Island Foundation

Ladies and gentlemen,

On behalf of the Easter Island Foundation, I would like to welcome you to the VII International Conference on Easter Island and the Pacific. I think we are all looking forward to an interesting and informative meeting that will introduce new and exciting ideas on migration, identity and the cultural heritage of the Pacific Island people. The meeting should give you the opportunity to meet colleagues you may only know as references in academic papers and to renew old friendships and to begin new ones.

The Easter Island Foundation is proud to be a sponsor of this conference along with the Gotland University, and to be a participant in the communication of the latest developments in Polynesian archaeology and anthropology to the most knowledgeable academic and field researchers on this subject. The Easter Island Foundation not only supports conferences such as this one, but we also provide grants for research on Rapa Nui, some of which may be presented at this very conference.

We have always supported research activities but ever since our formation about twenty years ago with the goal of establishing the William Mulloy Library, we have had the additional goal of helping the Rapa Nui people directly. Especially in recent years our activities have included scholarships to worthy Rapa Nui students to support their college education and hopefully to bring their learning and experiences back to Rapa Nui to bring additional benefits to the greater Rapa Nui people. In fact our largest single funding item this year has been our scholarship grants. Additionally, we have recently expanded our activities into the growing ecological problems on the island and to the increasing issues related to sanitation and waste control.

The Easter Island Foundation also publishes the Rapa Nui Journal and books on Polynesia and Easter Island. We have an extensive list of available publications which were provided in your registration material and I also invite you to browse our website <www.islandheritage.org>.

We believe the Easter Island Foundation is a significant contributor to the discovery of new knowledge about Rapa Nui and the Rapa Nui people and we would like to continue that process into the future. To this end I would like to invite you to be a part of this process by supporting these very worthwhile efforts by contributing to the Easter Island Foundation. The benefits you will receive will be not only the Rapa Nui Journal, which goes to contributors meeting a minimum level, but in being part of the research and preservation of Rapa Nui and its archaeological treasures. If you would like to contribute to the Easter Island Foundation, please see me or any board member during the conference, or visit <www.islandheritage.org>. I hope everyone takes full advantage, not only of the activities at the conference, but also I hope you take the time to explore some of the amenities available on this beautiful island. There are many archaeological treasures to be explored across the island including Medieval city walls and ruins, burial grounds from the Stone, Bronze, and Iron Ages, and Viking treasures.

So, once again, welcome to the conference. Thank you very much.

August 2007
Opening Address

Leif Borgert
Gotland University

"No Man is an island", they say.

The concept of Island is often understood as a symbol of isolation. Therefore, it is a pleasure for me to note that academics on the island of Gotland and Easter Island over the years have connected to each other in a way that is no less than impressive. The geographical distance between the sites is great, but the collegial curiosity of sharing knowledge about Man and Society is even greater.

One of the main academic profiles of Gotland University is the study of archaeology. Already in the childhood of the University, connections between Gotland and Easter Island were created. Inger Österholm, archaeologist and former pro-rector of Gotland University, took a leading role in those efforts. Today we offer a highly qualified educational program in International Archaeology, attractive to many students from Sweden and abroad.

Research conferences are important arenas for exchange of ideas, methods and results. The current 190 conference delegates are from 27 countries and, for the first time on European ground, take the opportunity to share their insights from a cultural perspective on topics concerning Easter Island and the Pacific.

I wish you all the best during your stay on Gotland!
Welcome Speech at Visby Strand Congress Hall

Helene Martinsson-Wallin
Gotland University

Iorana Korua, Pehe Koe?

Welcome friends and colleagues to the VII International Conference on Easter Island and the Pacific. Special welcome to our young students and researchers from Rapa Nui, Samoa, Tokelau, New Caledonia, and New Zealand, and our friends attending from Zanzibar. You have come far to participate in this gathering. You are the future of your islands and it is your task to bring the research results presented here back to your island communities. You are the future and now we “old folks” can retire and finally enjoy a tropical setting without thinking about finding potential prehistoric sites, looking for Lapita sherds, basalt adzes, or obsidian flakes. However, it is doubtful if we can be stopped in our eagerness to carry out further research, but maybe we should, instead take up the position as supporters in the background!

You might all be wondering what a conference on the Pacific is doing in a place like this; in the Northern Hemisphere close to the North Pole; but an Island is an Island — and, in a sea of islands, Gotland actually has more in common with the Pacific Islands than first meets the eye.

Gotland Island was formed in a tropical sea c. 450 million years ago at the time of the great continent of Pangea, when the equatorial line was situated here. Remains of a coral reef are to be found as stone pillars on the coast of Gotland. We also find many fossils of animals and plants on Gotland beaches that are currently and commonly discovered living in tropical waters.

And the Gotlandic Saga tells us that:
Tjelvar was the first man who found Gotland, but it was hidden and dark. During the days it disappeared in the sea and during the nights it rose up again, but Tjelvar brought fire and light to the Island and from that day, it never sank in the sea again. Tjelvar had a son named Havde. He and his wife, White Star were the first to reside in Gotland. She had a dream of three snakes appearing from her bosom and Havde’s interpretation was: all are connected in circles and this land should be settled by our three sons and their names should be Gute, Grajper and Gunfjaun.

Since the time of Tjelvar major changes have occurred especially changes of the landscape. The place where Gotland University is located was once under water. The people who populated Visby c. 5,000 years ago could use this place to fish for huge cod or go further in their canoes to trade with South Scandinavian tribes to obtain precious flint or, aiming for the Baltic shores, to get a hold of the amber that probably was considered the gold of the time.

Later on, c. 1,000 years ago, Viking ships sailed towards the east and some of them subsequently returned home with large amounts of silver coin which was stashed away in the ground. Now and then Gotlandic farmers come across small (and sometimes large) hoards of silver coins. The largest silver hoard in Europe is the Spilling’s Hoard of 68 kg found in the north of Gotland in 1999. It is now on display at the magnificent Historical Museum which also houses the unique picture stones displaying the sagas of the Vikings from Gotland. During medieval times trade ships belonging to the trading union of the Hanseatic League anchored in the Visby harbor and the city was a wealthy place protected by a wall. The land is still rising on Gotland and, in the former harbor area, a meeting place and center of knowledge — Gotland University and the Wisby Strand Conference Centre — has been created on reclaimed land. Close by, in the Almedalen Park, is a political meeting place where every important Swedish politician has spoken since the late Prime Minister Olof Palme initiated the politician week on Gotland several decades ago.

The themes of the VII International Conference on Easter Island and the Pacific are Migration, Identity, and Cultural Heritage — from island perspectives. We have never experienced such an extensive migration movement than today, especially south to north movements of people who are seeking better living conditions for themselves and their families. With globalization and growing environmental problems, we might also see other types of migration from areas at risk of turning into deserts or islands and coastal stretches that might disappear into the sea. The migrations in the Pacific area have been and are extensive. In the past the people moved around with the aid of the canoe, the “vaka”, and, with the skills from the master navigators who relied on
the stars, the sun, and the moon, they managed to populate every little island in the great Pacific Ocean. How, when, and why this happened are issues to be discussed at this Conference.

Identity (or belonging) and cultural heritage are two themes closely connected that will be discussed and experiences on this topic will be shared in the Three Worlds Meet workshop. In a way, the participants of this Conference, who represent 28 different nations, really speak for themselves and show us that the Pacific or the Oceanic area really is a multicultural place. As such it also carries a "backpack" which deals with the concept of origins and what is original, colonial, and post-colonial. This raises issues of creolization and multiculturalism and the problems and possibilities that all of this implies.

Initially I referred to the notion that an Island is an Island is an Island and, in the Sea of Islands, Gotland has many issues in common with Rapa Nui, Samoa, and Zanzibar. Especially in that they are remote and exotic but at the same time tourist places populated by people who are struggling to keep their identity and cultural heritage while also struggling to develop their islands as modern states to fit into our globalized world.

Editors Preface

Paul Wallin and Helene Martinsson-Wallin
Gotland University

When Gotland University in collaboration with Easter Island Foundation arranged the VII International Conference on Easter Island and the Pacific in Sweden we sometimes thought that it was maybe too far from the focus of the conference; Rapa Nui. However, as organizers, it was fantastic to see so many colleagues and especially the young participants of Polynesian decent coming to our little island in the Baltic Sea. The focus was as usual set on Rapa Nui archaeology, anthropology and history, but broader Pacific perspectives including East and West Polynesia, as well as Melanesia and American contacts were also discussed. - And nothing felt “far away”.

Since the general theme of the conference concentrated on issues of migration, identity and cultural heritage, the keynote speaker Professor John Flenley therefore opened the conference with a speech on how the Pacific was settled from his paleobotanical point of view that showed how human impacts change the islands landscapes. This perspective was of course a broad introduction to questions on migrations and identity. It was our intention that these issues came to be discussed, to open up views concerning contacts and interactions in the Pacific area and of course with the intriguing focus on the fantastic prehistory of Rapa Nui.

It is now a pleasure to be able to release the proceedings of the submitted papers that were presented at some of the 15 sessions. The papers in this volume are not following the sessions, but have instead been sorted into 6 Chapters following geographical areas, and the Rapa Nui papers are divided into three different categories ranging from prehistory to the present. The third theme concerning cultural heritage was especially discussed in the workshop called “World Heritage and Identity - Three Worlds Meet” where representatives of three World Heritage sites (Zanzibar, Visby and Rapa Nui) exchanged ideas on their experiences living in close connection to such sites. This Workshop will be published in Gotland University Press as a separate volume.

We will also take the opportunity to thank all the participants who came to the conference and made it all possible, as well as, the sponsors of the conference: Gotland University, Easter Island Foundation, Swedish Research Council, The Wenner-Gren Foundation and Gotland Municipality. Finally, we hope that the participants to the conference, as well as, those who could not partake, in this way will enjoy and take part of the papers presented in this volume.

Visby, 2010-10-20

Paul Wallin and Helene Martinsson-Wallin
Keynote Address:

A Palynologist Looks at the Colonization of the Pacific

John Flenley
Massey University, New Zealand

Abstract – The paper considers palynological evidence for Late Holocene vegetational change in Polynesia, with special reference to human impact. It relates this evidence to archaeological dates of colonization. Summary pollen diagrams are shown from Tonga, Cook Islands, Society Islands, Easter Island and New Zealand. It is concluded that there is a surprising level of agreement between pollen data and archaeology, though there is still dispute regarding Easter Island and New Zealand. In general, the hypothesis of migration into Polynesia via Tonga is supported, with a slightly later spread to Central Polynesia. Movements to Easter Island and New Zealand may be related to climatic changes. The long chronology is supported.

Introduction

It is appropriate that I should be giving this lecture in Sweden, since that is the country where Lennart von Post founded palynology in 1916, by being the first person to count fossil pollen grains from peat, and to relate the results to vegetational change (von Post 1916). The earliest recognition of signs of human impact in palynological data was also in Scandinavia, where Iversen (1941) recognised Neolithic forest clearances. Now palynology has spread around the world and has at last reached Polynesia. In this account I have attempted to adhere strictly to scientific principles, especially Ockham’s Razor (William of Ockham 1285 - ?1349) (Hypotheses are not meant to be multiplied beyond necessity) and the need to avoid the Affirmation of the Consequent (Aristotle 384 – 322 BC) (Absence of Evidence is not Evidence of Absence).

So how can we hope to distinguish in pollen diagrams between natural changes and anthropogenic (human-induced) ones? Occasionally, we are lucky enough to find pollen of crop plants or of human-associated weeds. In the absence of these, we may still detect disturbance in the vegetation. This may show itself in the form of secondary forest trees (e.g. Macaranga, Trema), but the disturbance may not necessarily be caused by people. We are fortunate, however, that natural fires are not at all common in Polynesia, so if disturbance is accompanied by charcoal, we may suspect human activity. Also, over a large area, changes resulting from climate are usually nearly synchronous, whereas human impact is usually patchy or progressive. However, if climate change were to trigger a human migration, then the effect could be synchronous. We need to understand something of where our pollen is coming from. Studies (Jacobson and Bradshaw 1981) have shown that in a small site (say a lake or swamp up to 100m diameter) most of the pollen is derived from the local area, perhaps 100 – 200m from the site. At the other extreme, a large site (say over 300m diameter) will give a generalised accumulation from the entire region, probably a 10km radius or more. Thus by deliberately choosing sites of different sizes, we can discover whether we are looking at local or regional changes.

This paper looks at the palynological evidence for Late Holocene vegetation changes on some of the islands of Polynesia, with particular reference to human impact, and the correlation of that with archaeology. Polynesia is defined anthropologically: it is the region of the Pacific where the Polynesian people traditionally lived. It is roughly triangular (Figure 1), with the apices of the triangle marked by New Zealand, Hawai`i and Easter Island. Archaeology suggests (Figure 2) that the first colonists of the region, the Lapita culture, entered via Tonga at around 2600 - 3500 BP and then spread to Samoa. There was then a movement into Central Polynesia (Cook Islands, Society Islands, Marquesas Islands). Migration to the three vertices of the triangle is thought to be later, perhaps only within the last 1300 years or less. The actual dates of this last phase are hotly disputed (Spriggs and Anderson 1993; Hunt and Lipo 2006). Before looking at the pollen evidence, we should try to get some idea of possible climatic changes during the time people have been present. The most significant climatic influence appears to be ENSO, which brings drought to the tropical Pacific periodically. The area likely to be most affected is shown in Figure 3. We now know that the frequency of severe ENSO events has varied in the past (Allen 2006). The evidence for this comes from the measurement of erosion rates into Laguna Pallcacocha in the high Ecuadorean Andes (Moy et al. 2002).
The variation is very striking (Figure 4). The present rate is about 3 severe events per century. But in the past two millennia there have been three periods when the rate has exceeded 20 per century. These periods peak at c. 1600 BP, c. 1200 BP, and c. 750 BP. In between are periods with rates as low as or lower than the present. We must expect these extreme variations to have had drastic effects on the movements and survival of people.

The paper will now proceed to consider the palynological data from some of the island groups for which data are available. This does not attempt to be a comprehensive review. I have chosen to use data with which I have some connection, and can therefore speak with more confidence.
Tonga

Since Tonga is the island group nearest to Fiji, and reputedly the first part of Polynesia to be settled, it is appropriate to consider the evidence from this group first. There are two relevant pollen diagrams from Tonga.

The first diagram is from Finemui swamp on the tiny (2 km diameter) coral island of Ha’afeva in the central Ha’apai sub-group of islands (Flenley et al. 1999). The pollen diagram (Figure 5) covers a time back to before 5770 ± 90 BP and is divided into five zones. A mixed, fern-rich rainforest assemblage shows incipient disturbance from near the top of zone FM 3. The boundary between zones FM 3 and FM 4 is dated to 2080 ± 60 BP. A further change, the rise of Cocos nucifera to abundance, is the start of zone FM 5, dated to 1220 ± 60 BP. The swamp is only 700m from the excavated Lapita site of Mele Havea, which dated back to c. 2600 BP (Burley 1997), so the c. 2080 BP date seems very reasonable as a minimum age for the start of human disturbance of the swamp area. The later date of c. 1220 BP may represent the changes caused by a volcanic ash shower which fell on the island (S. Cronin, pers. comm.), or could indicate an intensification of agriculture.

A further pollen diagram from the northern sub-group of islands, Vava’u (Fall 2005) shows forest disturbance and charcoal from 2620 ± 80 BP, which is concordant with the date of the Lapita culture in Ha’apai at c. 2600 BP. Some Lapita data from Tonga are earlier than this (Burley et al. 1999), so the pollen dating is quite conservative.

Cook Islands

Several islands in the Cook group have been investigated palynologically. They include Rarotonga, Atiu and Mangaia. On Rarotonga, Karekare Swamp, an infilled lagoon on the north east coast, was cored to 9 m depth, representing over 8000 years of deposits. The pollen diagram from borehole KK4 (Peters, 1994) showed a sharp rise in particulate charcoal and Pandanus in the topmost zone, at a level dated (calibrated) to 2730 (2353) 2157 B.P. As, however, a level only slightly above this gave a date of 1133 (958) 791 BP, and there was a date inversion slightly further down the core, inwash of old carbon is suspected, and the date must be viewed with caution.

From the island of Atiu we have a clearer picture provided by the diagram from a small lake, Te Roto (Parkes, 1997). At a zone boundary dated to 1420 ± 45 BP, there is a sudden and dramatic replacement of Cocos nucifera by Gleichenia (syn. Dicranopteris) linearis, Cyperaceae and Gramineae, along with Casuarina equisetifolia. Even the pollen of Ipomoea batatas (sweet potato), which rarely preserves, was present in one sample. As the date is reasonably concordant with others in the sequence, it may be accepted as indicating the start of forest clearance of Atiu. Earlier changes in the diagram are considered to be natural.

An earlier date for human impact is revealed by the work on Mangaia. Mangaia is (like Atiu) one of the ‘makatea’ islands in which uplifted coral limestone surrounds an ancient volcanic core. Between the two are extensive swamps, and even a lake, Lake Tiriara. This was investigated in relation to a rockshelter excavation 1km away (Kirch et al. 1991, 1992, 1995). Lake coring yielded a 15m core dating back to 5810 ± 100 BP. Five other dates were concordant with this, suggesting no inwash of old carbon, and the δ13C values did not suggest that ancient carbon from the coral limestone was incorporated into the sediment. The pollen diagram is summarised in Figure 6. It shows striking changes at the start of Zone III about 1600 BP. Trees decline, ferns increase and weeds show a peak. The ferns include Dicranopteris (syn. Gleichenia) which now dominates large areas of the deforested basalt core of the island. There are also geochemical changes, such as the rise in iron (Fe) derived from the basalt, suggestive of disturbance. The decline of trees had (apart from a single peak point) actually begun somewhat earlier, perhaps from a date of 2450 ± 80 BP. Marginal cores confirmed that soil inwash had begun by 2400 BP, but material did not appear to have contaminated the lake core dates. A subsequent investigation by Joanna Ellison (Kirch and Ellison 1994) involved coring other swamps around the island. Those showed the regular inwash of soil materials from the basalt, as well as the presence of particulate carbon, all within the last 2400 years. Interestingly, particulate carbon was absent before that date, suggesting that natural fires had not occurred on the island during the mid-Holocene.

The dates of 1420 BP and 2400 BP are both earlier than the dates from the rockshelter, which appears to have been in use from c. AD 1000 to c. AD 1650 (Kirch 1997). Nevertheless, it seems that the palynology and charcoal records are more likely to indicate the age of initial human colonization of Mangaia, which may therefore be taken as c. 2400 BP.

Figure 4. Frequency of severe ENSO events over the last 10,000 years. Data from erosion rates in Laguna Pallcacocha, Ecuadorian Andes (After Moy et al. 2002).
Figure 5. Pollen diagram from Finemui Swamp, Ha’afeva Island, Ha’apai, Tonga. Only selected taxa are shown. After Flenley et al. (1999).
Pollen diagrams are available from Tahiti and Mo’orea. The Tahiti diagram is from Lake Vaihiria, an inland, upland lake formed by a landslip in one of the interior valleys. Perhaps because of the steep and slip-prone terrain, the radiocarbon dates from the two cores are confused, though a maximum age of c. 500 years may be suggested for the sequence (Parkes et al. 1992). The palynology is striking for the prevalence of Pteridophyte spores throughout, no doubt reflecting the abundance of ferns in the forest which surrounds the lake today. Despite this, some reduction of primary forest trees is evident in the central zone of the core (? c. 17th and 18th centuries AD) perhaps indicating human activity inland, for which there is archaeological evidence (Orliac 1997). Towards the surface, in the uppermost zone, there is some recovery of the woody vegetation (especially Urticaceae/Moraceae, Trema comp., Freycinetia sim. and Pandanus), which probably corresponds with the post-contact shift of the human population to the coast in the 19th century. Although this site is of no relevance in terms of human colonization date, it serves to show that even shifts of population may be registered in the pollen record, with historically verifiable dates.

The Mo’orea site (Lac Temae) is a piece of former lagoon which has become cut off and is now a brackish-water lake. The bottom half of the 15m core obtained is highly calcareous, with a rapid accumulation rate. The oldest date obtained is 1540 ± 100 BP at 11.5m depth. The pollen sequence (Figure 7; Parkes 1994, 1997; Parkes and Flenley 1990) can be interpreted in terms of human disturbance. The lower half of the sequence (Zone Tp I) shows a strong dominance of trees, especially Pandanus which is both wild and cultivated in Polynesia. There is nothing here which requires interpretation as human disturbance. Starting with zone Tp II, however, there is a peak of fern spores, along with degraded pollen of upland forest elements, suggesting disturbance of inland forests. Most remarkable is the presence of Colocasia esculenta (taro), an introduced cultivar. This surely suggests the presence of people. The date of 1210 ± 90 seems not unreasonable, though it may be queried on the grounds of possible incorporation of old carbon, from soil or coral limestone.

The zones above this seem to represent changing land use, under continuous human presence. Pandanus and Cocos appear to alternate, perhaps in response to local cultivation preferences. Further cultivated trees such as Terminalia, Hibiscus and Casuarina appear, along with introduced shrubs such as Cordyline and Acalypha, and weeds including Bidens, Ageratum, and Mimosa pudica. Colocasia is present again, and eventually post-contact introductions such as Stachytarpheta and Pinus/Podocarpaceae. The suggestion is of continuous human presence for the last 1200 years. There is, however, an interesting recovery of Pandanus and other primary forest elements in zone Tp IV, starting at an interpolated age of c. 800 BP and suggesting a reduction in human impact. One might speculate that this could correlate with ENSO-induced droughts becoming more common at that time.

**Society Islands**

Pollen diagrams are available from Tahiti and Mo’orea. The Tahiti diagram is from Lake Vaihiria, an inland, upland lake formed by a landslip in one of the interior valleys. Perhaps because of the steep and slip-prone terrain, the radiocarbon dates from the two cores are confused, though a maximum age of c. 500 years may be suggested for the sequence (Parkes et al. 1992). The palynology is striking for the prevalence of Pteridophyte spores throughout, no doubt reflecting the abundance of ferns in the forest which surrounds the lake today. Despite this, some reduction of primary forest trees is evident in the central zone of the core (? c. 17th and 18th centuries AD) perhaps indicating human activity inland, for which there is archaeological evidence (Orliac 1997). Towards the surface, in the uppermost zone, there is some recovery of the woody vegetation (especially Urticaceae/Moraceae, Trema comp., Freycinetia sim. and Pandanus), which probably corresponds with the post-contact shift of the human population to the coast in the 19th century. Although this site is of no relevance in terms of human colonization date, it serves to show that even shifts of population may be registered in the pollen record, with historically verifiable dates.

The Mo’orea site (Lac Temae) is a piece of former lagoon which has become cut off and is now a brackish-water lake. The bottom half of the 15m core obtained is highly calcareous, with a rapid accumulation rate. The oldest date obtained is 1540 ± 100 BP at 11.5m depth. The pollen sequence (Figure 7; Parkes 1994, 1997; Parkes and Flenley 1990) can be interpreted in terms of human disturbance. The lower half of the sequence (Zone Tp I) shows a strong dominance of trees, especially Pandanus which is both wild and cultivated in Polynesia. There is nothing here which requires interpretation as human disturbance. Starting with zone Tp II, however, there is a peak of fern spores, along with degraded pollen of upland forest elements, suggesting disturbance of inland forests. Most remarkable is the presence of Colocasia esculenta (taro), an introduced cultivar. This surely suggests the presence of people. The date of 1210 ± 90 seems not unreasonable, though it may be queried on the grounds of possible incorporation of old carbon, from soil or coral limestone.

The zones above this seem to represent changing land use, under continuous human presence. Pandanus and Cocos appear to alternate, perhaps in response to local cultivation preferences. Further cultivated trees such as Terminalia, Hibiscus and Casuarina appear, along with introduced shrubs such as Cordyline and Acalypha, and weeds including Bidens, Ageratum, and Mimosa pudica. Colocasia is present again, and eventually post-contact introductions such as Stachytarpheta and Pinus/Podocarpaceae. The suggestion is of continuous human presence for the last 1200 years. There is, however, an interesting recovery of Pandanus and other primary forest elements in zone Tp IV, starting at an interpolated age of c. 800 BP and suggesting a reduction in human impact. One might speculate that this could correlate with ENSO-induced droughts becoming more common at that time.
(Allen 2006) and inducing out-migration of people, possibly to New Zealand. Mo’orea is outside the zone of extreme ENSO droughts (Figure 3), but not by very far.

Figure 7. Pollen diagram from Lac Temae, Mo’orea, Society Isles. Only selected taxa are shown. After Parkes (1994, 1997).
Easter Island (Rapa Nui)

There has been some discussion as to whether or not Rapa Nui is likely to have suffered ENSO droughts in the past. The present climate, although quite variable, does not exhibit them (Genz and Hunt 2003). Theoretical reasons for them not occurring were given by MacIntyre (2001a, b). On the other hand, Mucciarone and Dunbar (2000, 2003) claim that the oxygen isotope record from Rapa Nui corals does exhibit some degree of correlation with ENSO events. A definitive conclusion on this matter must await further research.

Although there are three good crater swamp/lakes on the island the upper deposits in two of them are disturbed so that the details of human impact are, at least partially, obscured. The third site, Rano Kau, appears to be less disturbed, however. It is the largest site of the three, a circular lake 1km in diameter, largely covered with floating mats of vegetation. The crater in which it sits is a steep-sided caldera affording a micro-environment very protected from the wind (cf. van Steenis 1935), and therefore possibly favoured by early settlers bringing tropical crops. Terraced slopes were reported there by Heyerdahl and Ferdon (1961). Coring near the centre of the lake has yielded a 20.63m core (KA02), consisting of a 3m floating mat, above an 8m water gap, with lake sediment beneath from 11m to 20.63m. Initial dating of this core using bulk sediment samples was not very satisfactory. Later, more dates were obtained by pollen extraction in our laboratory, using apparatus that we now suspect of having caused contamination. These dates were anomalous (Butler et al. 2004) and will not be used further. Recently, we obtained further dates, using aerial macroscopic remains (fruits and culms) of Scirpus californicus, the totora (nga’atu) reed, which dominates the floating mats today. The dates are shown in Figure 8. They suggest an initial period, c. 10,000 to 9000 BP (calibrated), c. 20m to 18m depth, when sedimentation rate was around 1m in 500 years. On the pollen diagram, Figure 9, this coincides with peaks of Gramineae and shrubs. This could indicate a drier and cooler phase (Flenley et al. 1991). There then follows a long phase of dominance by forest from c. 9000 BP to c. 1900 BP (c. 18m to 14m depth) with a sedimentation rate that was rather slow, c. 1m in 1500 years. This apparently represents the warm, moist Holocene climate.

From about 14m depth (c. 1900 BP calibrated) there is a great increase in herbs (grasses), accompanied by charcoal. There is also a large decline of trees, with an increase of shrubs, which may well include Broussonetia papyrifera (paper mulberry, formerly cultivated according to Métraux 1940). The most striking tree disappearance is that of Palmae, apparently the tree Paschalococos disperta which was related to the Chilean wine palm, Jubaea chilensis. The fruits of P. disperta have frequently been found on the island (Dransfield et al. 1984). These changes coincide with a massive increase in sedimentation rate to c. 1m in 170 years (Figure 8), which probably represents an increase in productivity of the lake as a result of eutrophication caused by the blowing in of wood ash from forest fires.

![Figure 8. Calibrated AMS radiocarbon dates on aerial parts (fruits and culms) of Scirpus californicus (totora reed) from core KA02, Rano Kau, Easter Island. After Flenley et al. (2007).]
It is quite difficult to explain these changes in any other way than by human activity, possibly accompanied by the activities of the introduced rats. It is, however, just possible that these changes resulted, at least in part, from climatic change, leading to major droughts and natural fires. I therefore regard the date of 1900 BP (calibrated) as a maximum age for the presence of people on the island. The charcoal values are still under investigation and may include some long distance particles. The possibility of volcanic fires also exists.

Figure 9. Pollen diagram from core KA02, Rano Kau, Easter Island. Only selected taxa are shown. After Butler and Flenley (in press).
The new dates from the floating mat still show inversions, so we conclude that the floating mat deposits could have been disturbed. A possible cause of this would have been their use for cultivation of taro. This usage of swamps, which is well known in Melanesia (Serpenti 1965; Golson 1977) and in Polynesia (Spriggs 2002), would be a further example of the intensification of agriculture on the island, and the possibility is currently under investigation. It is also possible that the disturbance could have been caused during the harvesting of the totora (Scirpus/nga’atu) reeds which were much used in thatching, and as mats and floats (Métraux 1940). A marginal core, KA01, does not conflict with these findings, and shows deforestation to be virtually completed between dates of 1040 ± 60 BP and 1000 ± 70 BP. Being near the edge of the lake, soil carbon inwash might be suspected here, but in fact sediment chemistry shows that soil inwash did not begin until after these dates (Flenley et al. 1991). This might seem to conflict with the dates from KA02, where total deforestation appears to have been completed later. It must be remembered, however, that a core taken near the centre of a large site yields a regional record, whereas one near the edge gives a local record (Turner 1965; Jacobson and Bradshaw 1981). It is likely that the slopes inside the caldera were deforested to completion earlier than other parts of the island.

These dates conflict seriously with archaeological dates for colonization of c. AD 1200, proposed by Hunt and Lipo (2006). Their dates come, however, from three separate localities, which seems to suggest established and dispersed settlement rather than first colonization. Earlier archaeological dates for colonization are proposed by Flenley and Bahn (2003), Orliac and Orliac (2005) and Martinsson-Wallin and Crockford (2001). The latest survey by Vargas et al. (2006) concludes that the island was probably occupied by the late first millennium AD, possibly c. AD 800.

**New Zealand**

New Zealand (also known as Aotearoa) differs significantly from other parts of Polynesia not only in its larger size, but also in its higher latitude, which leads to relatively severe winters. One significance of this to early settlers was the difficulty which it caused for the growth of tropical crops. Only kumara (Ipomoea batatas) could be grown on both main islands, and that with difficulty on the South Island.

The date of colonization of Aotearoa is the subject of fierce argument, regarding both the archaeological and the palynological evidence. This seems surprising, given that there are numerous excavations and c. 200 papers dealing with palynology (Tinkler 2005). Up to 1990, archaeology favoured a colonization date of c. 1000 BP (Davidson 1984) and as early as 1400 BP was proposed (Sutton 1987). Anderson (1991) however applied a process of ‘chronometric hygiene’ to radiocarbon dates and eliminated many as unreliable. This brought forward the date of colonization to c. 800 BP. Palynology followed suit, by eliminating early dates for forest clearance from lowland lakes, on the grounds that soil inwash could have brought in old carbon (McGlone and Wilmshurst 1999). This was questioned by Flenley and Todd (2001). The currently approved paradigm is, however, arrival of people at c. 800 BP, leading rapidly to widespread burning and deforestation with replacement of forest by the bracken fern Pteridium esculentum. This species has come to be regarded as a key indicator of human activity, since its maintenance (apart from in its natural habitat of coastal dunes – Wardle 1991) requires regularly and frequently repeated burning. As McGlone and Wilmshurst (1999) wrote:

> “the persistence of short-lived seral vegetation that can only be maintained by fire disturbance (for instance, bracken, Coriaria and some grasslands) is a good indicator of regularly and frequently repeated fire. We can be confident that the widespread destruction of rainforest by fire is highly unlikely without human intervention. If destruction of any forest type is accompanied by repeated fire and the spread and persistence of short-lived seral vegetation, human agency is virtually a certainty.”

Before proceeding to test the present paradigm, it is desirable to consider evidence for climatic variation over the last few thousand years in Aotearoa. Palaeotemperature estimates suggest that warmer postglacial mean annual temperatures had fallen to present values by 3000 BP, and showed minimal (<1°C) variation after that (Cook et al. 2006; Wilmshurst et al. 2007). Variations in precipitation are more difficult to reconstruct, but the fine-resolution record of erosion (based on palaeomagnetic susceptibility) provided by a core from Lake Pupuke (Auckland) may answer this problem, at least for northern New Zealand. The record (Figure 10; Striewski et al. 2009) goes back to 9500 BP (calibrated) and shows that the period up to c. 3000 BP (interpolated date) was one of considerable fluctuations in climate. After this date, however, exceptionally low erosion rates suggest a uniformly placid climate, lacking in extreme events, until the dramatic changes brought about by the Rangitoto eruption (c. 638 BP) and the immediately following human disturbances. This is important, because there has
Figure 10. Fine-resolution record of magnetic susceptibility for Core P4 from Lake Pupuke, Auckland, New Zealand (After Striewski et al. 2009). The dates are those of tephra.
been a tendency to attribute disturbances between 800 BP and 3000 BP to natural events, such as windstorms or lightning fires (Ogden et al. 1998). Apparently these were not occurring, at least in the Auckland region. The relative rarity of lightning at the present time in Aotearoa (and, incidentally, also in the small Pacific islands) is affirmed by the World Lightning Map (Doswell 2002).

The Short Chronology for the colonization of Aotearoa (starting c. 800 BP) no longer seems satisfactory for various reasons. Firstly, some pollen diagrams show increase of Pteridium spores well before the c. 800 BP date. Thus Chester (in Prior and Chester 2001), by carefully choosing a site (Round Lake) near the coast (a likely early dwelling area), near enough to the Volcanic District to permit tephrachronology, but far enough away to make volcanic fires unlikely, found evidence of intermittent Pteridium peaks, with charcoal, some even before the Taupo tephra, dated to c. 1718 BP (see Figure 11). There was even a hint of human-related bacterial DNA present (Matisoo-Smith et al. 2008). Further north, in the Northland peninsula, Elliot et al. (1998) found in Lake Tauanui (a small lake with no inflow stream) oscillations of tree pollen back to c. 3000 BP (Figure 12). Although attributed to storm damage at first, it now seems more likely that these oscillations represent shifting agriculture similar to that recorded in pollen records from Sumatra (Newsome and Flenley 1988; Flenley and Butler 2001). Similar oscillations, accompanied by charcoal but not by Pteridium, were found at Tiniroto Lakes near Gisborne by Li et al. (unpublished), around a date of 2300 BP. The absence of Pteridium is concordant with the idea that shifting cultivation was being practised, rather than repeated burning of the same area. To obtain a more regional record, one needs to look at evidence from a large site (Jacobson and Bradshaw 1981). The largest site available is the sea, and an offshore core obtained east of Hawke’s Bay (Figure 13; Elliot et al. 2003) showed a continuous curve for Pteridium and charcoal from at least 2500 BP.

Figure 11. Pollen diagram from Round Lake, Hawke’s Bay, New Zealand. Only selected taxa are shown. After Prior and Chester (2001).
Figure 12. Pollen diagram from Lake Tauanui, Northland, New Zealand. Only selected taxa are shown. After Elliot et al. (1998).
Figure 13. Pollen diagram from Marine core MD97-2121, collected east of Hawke’s Bay, New Zealand. Only selected taxa shown. After Elliot et al. (2003).
This core was also well dated by tephrachronology and $^{14}$C of Foraminifera (with a marine correction). Evidence of charcoal before c. 800 BP has often been written off as the result of natural, probably lightning-ignited, fires (Ogden et al. 1998). Although natural fires undoubtedly occur in Aotearoa, Flenley (2004) showed that in recent times they have been rare and usually burn a very small area. Furthermore, Butler (2008) showed that some early occurrences of charcoal were accompanied by pollen of Casuarina, an Australian tree, suggesting that the charcoal (which was of small grain size) had blown from Australia. Thus the overall conclusion which may reasonably be drawn from the Pteridium and charcoal evidence is that before c. 3000 BP there were rare, natural fires; after 3000 BP there were progressively more fires which were local and not explicable in climatic terms, but could be explained as the result of shifting agriculture; after 800 BP there were very numerous and widespread fires explicable as human deforestation, perhaps for the encouragement of Pteridium as a food. GIS mapping of Pteridium and charcoal frequencies shows a progressive increase of these from c. 4000 BP, in a localised, patchy manner. Significantly, the Auckland region is late to show either (cf. Strieowski’s data above). The patchy pattern is more suggestive of human impact than of climatic change. See Sutton et al. (2008) for an elaboration of this argument.

A second reason for questioning the c. 800 BP date for colonization is the finding, at several sites, of bones of Rattus exulans, a human commensal, dating to c. 2000 BP (Holdaway 1996). Although these dates have been seriously questioned (Anderson 1996), they appear to be genuine (Beavan-Athfield et al. 1999). Interestingly, the DNA of Rattus exulans populations in Aotearoa shows variability suggesting multiple introductions including one from Fiji (Matisoo-Smith et al. 1998). A recent attempt to revise the arrival of Rattus exulans as being at c. 800 BP (Wilmshurst and Higham 2004; Wilmshurst et al. 2004) by dating of rat-gnawed tree fruits/seeds shows considerable promise, but is currently inconclusive (Sutton et al. 2008).

A third reason to consider an earlier arrival of people relates to the DNA of moas, the several species of extinct large flightless birds in Aotearoa. The DNA variability, interpreted in terms of population size, shows a strong reduction in population starting about 1500 BP (Gem mell et al. 2004). The authors attribute this to an attack of bird flu, but present no independent evidence for it. Since the Maori people are well known to have hunted moas (Anderson, 1989), an earlier presence of people would provide a simpler explanation.

It is, of course, possible to argue that the rise in frequency of ENSO events caused severe droughts in Central Polynesia (Cooks and Society Islands) and thus stimulated large scale migration from those islands to Aotearoa around 800 BP. The pollen diagram from Mo’orea appears to support the idea (see above), but further work is needed on this possibility. Even if it were true, the evidence above suggests that there was already a population here when the immigrants arrived. It must also be remembered that Pteridium rhizome became an important food staple according to Cook (1777) in the South Island, where kumara was difficult to grow. It may be that the rise of Pteridium represents the spread of the knowledge of how to use the (otherwise poisonous) rhizome as food (Flenley and Todd 2001).

Studies of human DNA may also be relevant. Analyses of mitochondrial DNA (inherited down the female side) do not seem to conflict with the idea of a single migration from Central Polynesia with a minimum of 70 females (Murray-McIntosh et al. 1998). But studies of the Y chromosome (inherited down the male side) suggest that there is a small proportion of Melanesian genes among the Polynesian ones (Underhill et al. 2001). Further studies in this area are needed.

Taken all together, the evidence seems consistent with a small initial colonization before 2000 BP, probably augmented by a larger immigration around 800 BP.

Conclusions

1. Palynology gives clear indications of disturbance in vegetation of the past.
2. It is usually possible to distinguish between natural and human-induced disturbances.
3. These disturbances may be dated by radiocarbon dating and tephrachronology, etc.
4. Palynology integrates information from the surrounding area, so might be expected to detect earliest human presence more easily than archaeology, but there is little evidence for this in some Polynesian sites.
5. Palynology does, however, differ significantly from archaeology in Rapa Nui and New Zealand, where the Short Chronology is not supported.
6. Minds should be kept open, and further research should be undertaken in all areas.
Acknowledgements

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References


Chapter 1

Easter Island Archaeology
Re-dating Ahu Nau Nau and the Settlement at ‘Anakena, Rapa Nui

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Abstract - The building phase and early use of Ahu Nau Nau have been re-dated by nine charcoal and rat bone samples. The new dates in comparison with earlier data suggest that the ahu was constructed around 650-550 BP. It is also suggested that a settlement dated to c. 950-900 BP preceded the ahu-building phase. A new question in light of recent research might be raised: Is the earliest settlement on Rapa Nui found at ‘Anakena or should we look elsewhere?

Introduction

The ‘Anakena site is located in a protected bay with a sandy beach on the north coast of Rapa Nui. Oral traditions indicate that the site was the residence of high chiefs of the Miru clan, and it is mentioned as the landing place of the first high chief, Hotu Matu’a (Métraux 1940:133). The last high chief, Nga’ara, who died just before the Peruvian slave raid in the 1860s, had his residence at ‘Anakena (Routledge 1919:241-242). Subsequent chiefs lived at a place named Ahu-akapu, located near Tahai, which is close to the present village of Hanga Roa (Métraux1940:132).

This paper discusses temporal issues in relation to the ahu structures and settlement sites at ‘Anakena, especially focusing on dated charcoal samples and their provenance. Excavations in the area have been carried out mainly under the leadership of Arne Skjølsvold and Thor Heyerdahl in 1986-88 (Skjølsvold 1994). In 1991, David Steadman, Patricia Vargas, and Claudio Cristino carried out minor excavations on the seaside of Ahu Nau Nau (Steadman et al. 1994), and in 2004-2005 Terry Hunt and Carl Lipo excavated in the sand dunes closer to the sea (Hunt & Lipo 2006). All dates referred to in this paper are calibrated using CALIB (Version 5.0.1.) with the SHCal04 calibration data set.

‘Anakena 1986-88 Excavations by Arne Skjølsvold and Thor Heyerdahl

Skjølsvold’s excavations revealed that the earliest cultural remains at ‘Anakena, were found close to the bedrock below three meters of erosion soil on the inland side of the main Ahu Nau Nau. According to Skjølsvold these remains were dated to “somewhere around AD 1000” or the primary settlement could not be “older than AD 800 or younger than AD 1000” (1994:107). He concluded (1994:107) that “a date around AD 1200 or a little earlier should be justifiable for the primary phase” for Ahu Nau Nau. These interpretations were based mainly on results of the excavation of the main trench (C1) located on the south side in front of the restored Ahu Nau Nau (Figure 1 & 2). The analyzed charcoal samples originated from a dark brown clayey cultural layer found at the bottom of the trench close to the bedrock at a depth of ca 2.6-3.0 m from the present surface level as well as from selected contexts dating the building phases of the ahu structure. The samples listed in Table 1 below have been dated at the Trondheim 14C laboratory and at the AMS 14C laboratory at Uppsala.

The sample provenance tied to Ahu Nau Nau shows that the latest phase at Ahu Nau Nau (called phase III) is dated by a sample collected just at the top of the ahu of the primary structure (phase I ahu), level with the plaza floor of the present and restored ahu. The sample (Ua-617) is dated to 610 ± 85 BP (AD 1272-1478 cal. at 2 Sigma). Here small fragments of charcoal were found among a concentration of yellowish stone powder that probably originated from the dressing of the moai.
The charcoal is therefore suggested to be contemporary with this activity. The sample (T-7347) found on the plaza floor in a trench a few meters to the west of trench C1 was detected in a closed context of gray basalt stone powder and pebbles, indicating stone work on the plaza in front of the wall. The sample gave a date of 720 ± 120 BP (AD 1048-1455 cal. at 2 Sigma) and is interpreted to date the phase II structure (Skjølsvold 1994:28). The charcoal sample is interpreted as contemporary with the stone work activity. The sample (T-6678) found in trench C1 c. 150 cm below the current plaza, in the soil between courtyard stones of the primary ahu, yielded a date of 860 ± 130 BP (AD 992-1396 cal. at 2 Sigma). A second sample of the primary ahu (T-7342) was collected from a feature in the plaza located just in front of the ahu wall. The feature was c. 80 x 40 cm in size, consisting of fist-sized stones mixed with small pieces of charcoal; the sample yielded a date of 710 ± 70 BP (AD 1228-1407 cal. at 2 sigma). These two samples were interpreted to date the courtyard of the primary phase.

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**Table 1. Dates by Skjølsvold (1994:106).**

<table>
<thead>
<tr>
<th>Lab no</th>
<th>Site</th>
<th>Material</th>
<th>BP Value</th>
<th>Age (AD) cal. at 2 sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-6679</td>
<td>Settlement</td>
<td>(Charcoal)</td>
<td>1170 ± 140</td>
<td>657-1180</td>
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<tr>
<td>Ua-3007</td>
<td>Settlement</td>
<td>(Rat bone)</td>
<td>1015 ± 65</td>
<td>967-1214</td>
</tr>
<tr>
<td>Ua-1740</td>
<td>Settlement</td>
<td>(Marine sample)</td>
<td>1290 ± 100</td>
<td>900-1270*</td>
</tr>
<tr>
<td>T-7341</td>
<td>Settlement</td>
<td>(Charcoal)</td>
<td>900 ± 120</td>
<td>975-1390</td>
</tr>
<tr>
<td>Ua-4626</td>
<td>Settlement</td>
<td>(Rat Bone)</td>
<td>710 ± 75</td>
<td>1223-1412</td>
</tr>
<tr>
<td>T-7959</td>
<td>Settlement</td>
<td>(Charcoal)</td>
<td>510 ± 40</td>
<td>1399-1482</td>
</tr>
<tr>
<td>T-6678</td>
<td>Ahu Nau Nau</td>
<td>(Charcoal)</td>
<td>860 ± 130</td>
<td>992-1396</td>
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<tr>
<td>T-7342</td>
<td>Ahu Nau Nau</td>
<td>(Charcoal)</td>
<td>710 ± 70</td>
<td>1228-1407</td>
</tr>
<tr>
<td>T-7347</td>
<td>Ahu Nau Nau</td>
<td>(Charcoal)</td>
<td>720 ± 120</td>
<td>1048-1455</td>
</tr>
<tr>
<td>Ua-617</td>
<td>Ahu Nau Nau</td>
<td>(Charcoal)</td>
<td>610 ± 85</td>
<td>1272-1478</td>
</tr>
</tbody>
</table>

*= Marine calibration
of Ahu Nau Nau. Evaluating the sample (T-7347), interpreted as dating the phase II construction, shows a wider range when calibrated than the sample (T-7342) dating the primary structure. Even if the former sample shows a wider range than the latter, the stratigraphy suggests the former to be tied to an earlier activity. When considering the dates of the samples and their provenance we suggest that it is safe to say the results at least show the primary ahu is dated to sometime before AD 1400 and that the stratigraphy showed at least three different building phases.

The samples from the cultural layer below the primary ahu phase all derived from the dark brown culture layer found at a depth of c. 2.6-3.0 m from present surface. The charcoal samples have not been subjected to botanical identification and show wide standard errors. The rat bone sample (Ua-3007) dated to 1015 ± 65 BP (cal. at 2 Sigma to AD 967-1214) is suggested to be the most reliable sample and the three samples T-6679, Ua-1740, and T-4341 indicate dates around 1000 ± 100 BP. Two of the samples from the bottom layer, Ua-4626 and T-7959, indicate intrusions several hundred years younger. Our final conclusion is that the ahu phases and cultural activities found at ‘Anakena, needed to be re-dated. This paper presents a new dating sequence on material excavated in 1986-88 carried out in 2007 at the Svedberg AMS Laboratory, Uppsala. Additional dating results from ‘Anakena site carried out by other researchers are also compiled and evaluated.

![Figure 2. Drawing of Trench C1, 1987 (from Skjølsvold 1994:15).](image)


Other archaeological projects dealing with the chronology at ‘Anakena also suggest the earliest dated activity be set to around 1000-900 BP. The excavation of a single trench by Steadman, Vargas and Cristino, carried out with the aim to mainly study extinctions among birds, was located at the sea side of Ahu Nau Nau. A stratigraphic sequence with related charcoal samples were dated see Table (Steadman et al. 1994):

<table>
<thead>
<tr>
<th>Lab no</th>
<th>Site</th>
<th>Material</th>
<th>BP Value</th>
<th>Age (AD) cal. at 2 sigma</th>
</tr>
</thead>
<tbody>
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<td>Beta-47171</td>
<td>Settlement Upper</td>
<td>Charcoal</td>
<td>660 ± 80</td>
<td>1236-1445</td>
</tr>
<tr>
<td>Beta-47172</td>
<td>Settlement Upper</td>
<td>Charcoal</td>
<td>170 ± 110</td>
<td>1510-1956</td>
</tr>
<tr>
<td>Beta-47173</td>
<td>Settlement Upper</td>
<td>Charcoal</td>
<td>860 ±100</td>
<td>1023-1386</td>
</tr>
<tr>
<td>Beta-47169</td>
<td>Settlement bottom</td>
<td>Charcoal</td>
<td>900 ± 80</td>
<td>1027-1283</td>
</tr>
<tr>
<td>Beta-47170</td>
<td>Settlement bottom</td>
<td>Charcoal</td>
<td>900 ± 60</td>
<td>1042-1274</td>
</tr>
</tbody>
</table>

Table 2. Dates by Steadman et al. (1994).
The three dated samples Beta-47169, Beta-47170, and Beta-47173 fall in the time frame around 760-980 BP, which support the previous indications of the early cultural layer found in trench C1. The sample Beta-47171 suggests a subsequent activity, probably tied to the building phase of Ahu Nau Nau sometime around AD 1300-1400, which also is in line with the interpretation by Skjølsvold (1994).

Warren Beck of the University of Arizona AMS ¹⁴C dating laboratory, carried out a dating project on coral artefacts, such as statue eye fragments and files found in excavations at ‘Anakena. A total of twenty-seven samples were dated. A marine reservoir correction of 320 years was determined by ¹⁴C measurements on modern pre-bomb-pulse corals (Warren Beck, pers. comm., March 22, 1999; Beck, Hewitt et al. 2003). Seven of the samples were dated to the time frame 1020-901 BP, eight samples were dated around 900-701 BP, four samples were dated around 700-501 BP, and seven to around 500-400 BP. One sample came out considerably earlier at 1325 BP and has been interpreted as erroneous or suggests old coral used to make the artefact. The samples and dates of coral files found at the bottom of the early settlement of trench C1 is shown in Table 3.

<table>
<thead>
<tr>
<th>Cat no</th>
<th>Site</th>
<th>Material</th>
<th>BP Value</th>
<th>Marine cal. Age (AD) at 2 sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>A161</td>
<td>Tr. C Early settlement</td>
<td>Coral file</td>
<td>1010 ± 60</td>
<td>987-1204</td>
</tr>
<tr>
<td>A161</td>
<td>Tr. C Early settlement</td>
<td>Coral file</td>
<td>965 ± 45</td>
<td>1029-1207</td>
</tr>
<tr>
<td>A160</td>
<td>Tr. C Early settlement</td>
<td>Coral file</td>
<td>1020 ± 65</td>
<td>973-1212</td>
</tr>
</tbody>
</table>

Two samples were dated from the same file (Cat. no A161, Figure 3) one to around 1000-950 BP and the second to around 1000 BP, which again support previous dating results of samples from the cultural activity in the bottom of trench C1. The most recent excavation project at ‘Anakena was carried out by Terry Hunt and Carl Lipo (Hunt & Lipo 2006; Hunt 2006). They excavated five units in an area about 30-60 m to the north of Ahu Nau Nau towards the sea. The excavation in the sand dune recovered several horizons that were dated from unit 1 and 5, by the following charcoal samples shown in Table 4.
The top six samples in the table above, reflect a time frame of around AD 1300-1400. The two samples at the bottom of the list reflect an earlier activity quite in line with the 900 BP (c. AD 1000-1300) dates presented by Skjølsvold (1994) and Steadman et al. (1994). In evaluating dated samples from early human activities in Rapa Nui, Hunt and Lipo (2006) suggest chronometric hygiene be used. Accepted samples included samples from their 'Anakena excavation, but only three previously dated samples from 'Anakena are, according to Hunt and Lipo, approved by the hygiene protocol. In addition three samples from an agricultural site were used, making up a total of eleven accepted samples from early contexts. Using this method Hunt and Lipo (ibid.) estimated the earliest Rapa Nui settlement so far to be around AD 1200. They are not dealing with the dating of the ahu structures in 'Anakena, but Hunt (2006:419) argues that “it also appears that the Islanders began building moai and ahu soon after reaching the island”.

Results of the 2007 Re-dating Project

In an effort to solve problems relating to the dating of the earliest ahu and settlement at 'Anakena we selected nine new samples from previously excavated dateable material stored at the Kon-Tiki Museum, Oslo. The samples were submitted to the AMS laboratory at Uppsala University, which was involved in the dating of some of the earlier samples carried out from the same trench. The newly submitted samples were mainly from rat bones and nut shells as well as three samples of unidentified charcoal from secure contexts. The selected samples were expected to solve the following problems:

Problem 1: Dating of Ahu Nau Nau and its construction phase.

Samples Ua-34183, Ua-34184 and Ua-34185 were expected to date the construction and use phase of the ahu structure (Nau Nau I) found below the present Ahu Nau Nau (Nau Nau III), which may have implications for the general temporal status of ahu structures on the island. Sample Ua-34183, consists of a nut shell from the palm tree (Paschalococos disperta), found between two distinct layers, which therefore is of great importance. Sample Ua-34184 is a pelvis from a Polynesian rat (Rattus exulans), also found in the same find context as the above mentioned sample. Sample Ua-34185 is a femur from an adult Rattus exulans, found in the mixed sand and stone layer below the plaza floor of Nau Nau I. This layer is interpreted as being constructed to facilitate drainage during this phase of the ahu. These three samples are thought to date the construction / early use phase of this ahu.

Problem 2: Dating the initial settlement layer at 'Anakena. The layer was labeled the "Dark brown layer" at the excavation in 1987. The layer rested on the bedrock. This might be the earliest settlement activity so far found on the island.

Sample Ua-34189, Ua-34190 and Ua-34191 are expected to date the earliest settlement at 'Anakena. Sample Ua-34189 is a charred nut shell (Paschalococos disperta), found at the bottom of a charcoal concentration, situated in the upper part of the Dark brown layer. Sample Ua-34190 is a general charcoal sample from the upper part of the layer. The wood has no botanic determination, but was used to compare with the former sample. A third and additional sample Ua-34191 is from a nut shell (Paschalococos disperta) found at the bottom of the Dark brown layer.
Problem 3: Investigating the settlement layer located in the sand layer on top of the dark brown layer, and under the drainage layer. This layer was called “Brown Sand Layer” during the excavations in 1987.

Samples Ua-34186, Ua-34187 and Ua-34188 are expected to date an activity in the area just prior to the building of the first *ahu* (Nau Nau I). Sample Ua-34186 consists of general charcoal found in a charcoal concentration indicating a specific activity that took place at the spot in this layer but not identified to wood species. Sample Ua-34187 is a femur from an adult Polynesian rat, *Rattus exulans*, found towards the bottom of this layer. Sample Ua-34188 derives from charcoal found in the layer, but it is not determined to wood species. The results of the 2007 re-dating project are shown in Table 5.
Table 5. The new dates from trench C1 at Anakena.

<table>
<thead>
<tr>
<th>Lab no</th>
<th>Site</th>
<th>Material</th>
<th>BP Value</th>
<th>Age (AD) cal. at 2 sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ua-34183</td>
<td>Ahu use</td>
<td>Nut shell</td>
<td>535 ± 35</td>
<td>1400-1452</td>
</tr>
<tr>
<td>Ua-34184</td>
<td>Ahu use</td>
<td>Rat bone</td>
<td>640 ± 65</td>
<td>1285-1433</td>
</tr>
<tr>
<td>Ua-34185</td>
<td>Ahu Construction</td>
<td>Rat bone</td>
<td>610 ± 50</td>
<td>1300-1439</td>
</tr>
<tr>
<td>Ua-34186</td>
<td>Settlement/Construction</td>
<td>Charcoal</td>
<td>555 ± 35</td>
<td>1330-1452</td>
</tr>
<tr>
<td>Ua-34187</td>
<td>Settlement</td>
<td>Rat bone</td>
<td>915 ± 60</td>
<td>1040-1267</td>
</tr>
<tr>
<td>Ua-34188</td>
<td>Settlement</td>
<td>Charcoal</td>
<td>665 ± 30</td>
<td>1298-1397</td>
</tr>
<tr>
<td>Ua-34189</td>
<td>Settlement</td>
<td>Nut shell</td>
<td>565 ± 35</td>
<td>1326-1448</td>
</tr>
<tr>
<td>Ua-34190</td>
<td>Settlement</td>
<td>Charcoal</td>
<td>665 ± 35</td>
<td>1295-1399</td>
</tr>
<tr>
<td>Ua-34191</td>
<td>Settlement</td>
<td>Nut shell</td>
<td>565 ± 35</td>
<td>1326-1448</td>
</tr>
</tbody>
</table>

Interpretation of Re-dating of Trench C1

The main trench C1 excavated in front of Ahu Nau Nau shows a distinct stratigraphy which we have made an effort to re-date. The result of the re-dating of samples tied to distinct stratigraphic contexts suggests that the stratigraphy is the result of quite rapid actions in the area during the construction and early use phase of the structure. The *ahu* construction and settlement phase found below the *ahu*, show similar dates to the construction phase of the *ahu* except one dated rat bone sample indicating an earlier date. We interpret this as the settlement layer found at the bottom of the trench was disturbed during the building of the first *ahu* with intrusions of later material. During the construction, large stones were moved around and sand and stones were brought in as drainage materials; and on top of this a hard packed earth floor was constructed. One of the re-dated samples Ua-34187, (915 ± 60 BP), shows a date in line with a previously dated rat bone sample found in the dark brown clay and with the coral files found in the same layer. It also shows contemporaneity with two of the dated samples found by Steadman *et al.* (1994) in a trench on the sea side of the *ahu* and two dated samples by Hunt and Lipo (2006) also indicate an early human activity at `Anakena that falls into the time period 800-1200 BP or AD 1000-1300 (calibrated 2 sigma). The construction phase of Ahu Nau Nau is by the re-dated samples suggested to be set to the time period 650-550 BP or AD 1300-1450 (calibrated 2 sigma).

The Island Context

Placing *Anakena* in a wider Island context, the re-dating of the initial phase of Ahu Nau Nau is not exceptionally early, but actually slightly later than a few other newly dated *ahu* sites. The distribution of *ahu* sites dated to the same time frame is found all around the island:

- Ahu Ature Huki (Skjølsvold 1994:106), secondary *ahu* at *Anakena*, N-coast, 2 samples c. 580-510 BP.
- Ahu Heki`i* (Martinsson-Wallin & Wallin 1998:85), primary *ahu* at La Pérouse, NE-coast, 2 samples c. 705-700 BP.
- Ahu Ra`ai* (Martinsson-Wallin & Wallin 1998:85), secondary *ahu* at La Pérouse, NE-coast, 2 samples 570-515 BP.
- Ahu at Viro o Tuki, South coast (Hyuge & Cauwe 2005:8), 3 samples at 650-640 BP.
- Ahu Motu Toremo Hiva (Hyuge, Cauwe, et al. 2006:33), N-coast at Poike, 4 samples 700-630 BP.
- Ahu Vinapu 2 (Martinsson-Wallin 2004:8), SW-coast, 3 samples, 610-570 BP
- Ahu o Rongo (Hyuge & Cauwe 2002), at Hanga Roa, W-coast, 3 samples 715-655 BP
- Ahu Tautira (Martinsson-Wallin and Crockford 2001:252, tab. 2), at Hanga Roa, W-coast, 1 sample dating the crematorium to c. 720 BP.

All samples above derive from controlled stratigraphic contexts and/or from nut shell samples. As we can see, several sites at different locations are possibly as early as around 700 BP. Based on the current dating results the initial date of Rapa Nui *ahu* is suggested to be set to around c. AD 1250-1400. Since early *ahu* structures occur at various locations on the Island it actually opens for that we should consider earlier settlements to be found also outside of *Anakena*. Localities with good fresh water supplies, for example, around the crater lakes would be interesting to explore in terms of early settlement activities (Flenley & Bahn 2007). However, an effort to evaluate an early dated activity in the Vinapu sector, recent excavations by Martinsson-Wallin (2004) showed that no such early settlement activities were indicated to be found in this area. The same goal was also aimed for during the excavations at Hanga Ho´onu, when Ahu Heki`i and Ahu Ra`ai were dated (Wallin & Martinsson-Wallin 2008:127).
| Anakena 1986-88  | 1015±65BP |
| Ua-3007       | 1170±140BP |
| T-6679        | 1290±100BP |
| T-7341        | 900±120BP  |
| Ua-4626       | 710±75BP   |
| T-7959        | 510±40BP   |
| T-6678        | 860±130BP  |
| T-7342        | 710±70BP   |
| T-7347        | 720±120BP  |
| Ua-617        | 610±85BP   |

| Anakena 1991, Steadman, Vargas, Cristiono |
| Beta-47171   | 660±80BP   |
| Beta-47172   | 170±110BP  |
| Beta-47173   | 860±100BP  |
| Beta-47169   | 900±80BP   |
| Beta-47170   | 900±60BP   |

| Anakena 1998, Beck |
| A161, Tr C1   | 1010±60BP  |
| A161, Tr C1   | 965±45BP   |
| A160, Tr C1   | 1020±65BP  |

| Anakena 2004-05, Hunt, Lipo |
| Beta-196711  | 660±40BP   |
| Beta-196712  | 680±60BP   |
| Beta-196713  | 670±60BP   |
| Beta-196714  | 590±60BP   |
| Beta-196715  | 710±40BP   |
| Beta-196716  | 720±60BP   |
| Beta-209903  | 870±80BP   |
| Beta-209904  | 870±40BP   |

| Anakena 2007, this study |
| Ua-34183     | 535±35BP   |
| Ua-34184     | 640±65BP   |
| Ua-34185     | 610±50BP   |
| Ua-34186     | 555±35BP   |
| Ua-34187     | 915±60BP   |
| Ua-34188     | 665±30BP   |
| Ua-34189     | 565±35BP   |
| Ua-34190     | 665±35BP   |
| Ua-34191     | 565±35BP   |

<table>
<thead>
<tr>
<th>Calibrated date</th>
</tr>
</thead>
<tbody>
<tr>
<td>500CalBC</td>
</tr>
<tr>
<td>500CalAD</td>
</tr>
<tr>
<td>1500CalAD</td>
</tr>
</tbody>
</table>

**Figure 5.** Concluding graph of the Anakena dates.
According to traditional history, Anakena was a settlement for high chiefs of the Miru clan and as such of high status. This location is also considered as the landing place of Hotu Matu’a. These accounts might color our present view of this place as “special” and the place for the first settlement of Rapa Nui. Actually, the above could suggest Anakena to be of extreme importance only in the late prehistoric context and as such, surviving in oral traditions. When Anakena’s status declined in proto-historic and historic times, Hanga Roa is mentioned as the most important place on the island (Métraux 1940). Here we see a shift in importance of various places that also could have occurred in prehistoric times as well.

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Ahu Motu Toremo Hiva  
(Poike Peninsula, Easter Island):  
Dynamic Architecture of a Series of Ahu

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Abstract - The work undertaken at Ahu Motu Toremo Hiva (Poike Peninsula, Easter Island) between 2004 and 2006 has brought to light several unexpected elements: the sequential emplacement of ritual platforms, testifying the use of the site that has at least two times been completely rearranged since its initial occupation in the late 13th-14th century AD, the systematic disassembling of pebble pavements before each phase of abandonment, and the recycling of one statue. All these discoveries shed new light on the history of Easter Island ritual platform construction. Now we can recognize that the abandonment of an ahu is not strictly connected with an ecological crisis: recycling, disassembling and reuse of architectural elements and statues also characterize monuments of the 14th or 15th century AD. In other respects, the geomorphologic study of the site allowed us to determine that each ahu abandonment phase was coupled with agricultural exploitation. Evidently, the traditional settlement pattern of villages inserted between the ritual platform and the agricultural land, all functioning simultaneously, must be questioned. In addition, at Ahu Motu Toremo Hiva, each abandonment of an ahu represents an important work requesting manpower and time. We propose to call this process "condemnation". These data ask a change of our approach of the story of the ahu in ruins: is it really ruins or the result of a process of "condemnation"?

Introduction

The Belgian Archaeological Mission, that began in 2000 for the Royal Museums of Art and History of Brussels with the collaboration of the University of Ghent (Vakgroepen Geo-grafie en Archeologie) and the Royal Belgian Institute for Natural Sciences (Laboratory of Human Palaeontology), had as main purpose to understand the oldest ahu of Easter Island. As part of this program, we excavated during three years around an ahu along the northern coast of Poike. This ahu, greatly in ruins, is located on the top of a cliff of 170 m height, near the Tavaka creek. It is located immediately east of Maunga Parehe, the northernmost of the three trachyte domes that characterize the northern slope of the Poike Peninsula. The popular tradition calls this place Ahu Motu Toremo Hiva (Figure 1).

This structure, already listed by Sebastian Englert (2004:268, No. 149), was only known to bear some superficial architectural elements spread out over a length of approximately 32 m. On the base of these remains, it could be suggested that the site consisted of an ahu made up of a central platform of almost 15m long and augmented with lateral wings to the east and the west. The extremities had been truncated or interrupted by broad depressions formed by erosion. There was no obvious trace of a paved ramp in front of the ahu platform (Figure 2).

On the landward side, the wall of the platform appeared relatively well preserved, but was almost completely covered by sediments. Immediately south of this wall, a large, much eroded block of yellowish tuff of Rano Raraku type suggested the presence of a moai at the site. The seaward facade, on the other hand, has largely collapsed. Many of the fallen blocks are still present on the seaward slope leading from the ahu to the terrace-like weathering front of the basaltic bedrock. A few wall elements still in situ today demonstrate that the monument was, along this side, at least 2.5 m high (Figure 3). It had been built with large, irregularly shaped basalt blocks of various dimensions, which had only been very rudimentarily hewn. Between the safeguarded exterior ahu facades, the loose interior fill could be observed (unconsolidated rubble essentially composed of trachyte and basalt fragments of variable size).
Figure 1. Location of Ahu Motu Toremo Hiva (at northern coast of Poike Peninsula).

Figure 2. General view of Ahu Motu Toremo Hiva site (northern coast of Poike Peninsula). On both sides of the remains of the platform, we can see two large depressions formed by erosion.

Figure 3. The seaward facade of the platform of Ahu Motu Toremo Hiva (northern coast of Poike Peninsula). The wall is largely collapsed but a few elements are still in place.
The New Data

The site was excavated during three campaigns between 2004 and 2006, with as a first result, the discovery of a series of three *ahu* (Cauwe et al. 2005; 2006a, 2006b) the last one being partially on the surface. On no account is this accumulation of monuments at the same place a novelty: we know, for example, the same/situation occur at 'Anakena (Ahu Nau Nau) and at Akahanga (Routledge 1919; Metratix 1971; Englert 2004; Skjølsvold 1994; Flenley & Bahn 2002). Some years ago, our team had also discovered the same situation at Ahu o Rongo (Huyge & Cauwe 2002). But in the present case, this phenomenon was found in a coherent stratigraphic context, favourable for some observations about the building, use, modifications and the end of use of the monuments. More than the recurrence of *ahu* on the same site it is possible to discuss about their story. The situation is similar to that of 'Anakena (Martinsson-Wallin & Wallin 2000).

The oldest *ahu* constructed at Ahu Motu Toremo Hiva (called AMTH-II) was built on the eastern part of the site (Figure 4). The boundaries of the actual platform are known, but the extent of its wings cannot be estimated. Part of the monument seems to have been carried off by erosion. Partial cleaning of the flank of the broad eroded depression east of the excavated remains, however, showed that the AMTH-II eastern wing probably projected beyond that point. On landward side, in front of the ramp and the wings of the platform, a construction surface was prepared. The southern extension of this surface is not known. Some *poro* were found in situ on this surface, as well as negative impressions of similar cobbles. Probably, the disappearance of the majority of these *poro* is the result of an intentional act. Indeed, the construction surface into which these *poro* were integrated, however fragile, does not show any evidence of disturbance (no erosion traces, for instance). In other respects, the sediments overlying this surface show no traces of disturbance, therefore the removal of the *poro* must date from about the moment it was decided to abandon the monument.

The second platform (AMTH-I) have at least a length of 5 m (Figure 5). The most part of the *ahu* was also destroyed by erosion. But we know that this monument is 2 m wide. Indeed, the seaward wall rests on a solid foundation substructure. On the landward side, the facade is equipped with a relatively narrow ramp (1.80 m wide), but its incline is rather steep. The third monument (AMTH-III) was built between the two others, and the ruins were partially used as foundations (Figure 6). The landward wall is only preceded by an area paved with small cobbles and powdered with yellow dust (the precise nature of this dust is still to be determined). Here too, negative impressions of *poro* have been observed. The disappearance of these cobbles also seems to be the result of an intentional act, as in the case of the oldest *ahu*.

![Figure 4. The oldest *ahu* (AMTH-II) of Ahu Motu Toremo Hiva (northern coast of Poike Peninsula). In the background we see the remains of landward wall of the platform. In front of the wall, we have found a well preserved ramp and the construction surface.](image)

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Figure 5. The second *ahu* (AMTH-I) built at Ahu Motu Toremo Hiva (northern coast of Poike Peninsula). In the background we can see a wing or a ramp largely collapsed by erosion.

Figure 6. The third *ahu* (AMTH-III) of Ahu Motu Toremo Hiva (northern coast of Poike Peninsula). This last *ahu* was built between the two others, whose ruins were partially used as foundations. The landward wall is preceded by an area paved with small cobbles.
Absence of Moai

After the abandonment of AMTH-III, the area in front of the platform was partially covered by natural sedimentation (sheet wash deposits), but also by a discontinuous distribution of *hani hani* (red scoria). The significance of this deposit, sometimes rather thick (up to 10 cm in certain sectors), is not known at present. It could represent a symbolic condemnation of the monument, the preparation of the surface for an activity unrelated to the earlier *ahu*, or the destruction of *pukao* which may have once capped the statue(s) erected on the site.

The last historical stage of the site is, as far as we know, unparalleled on Easter Island. It consists of the construction of a broad ramp by means of large blocks posed upright and intentionally covered by a large mass of sediments. This ramp, set in an arc of a circle in front of the monument, apparently reached the surface level of the last platform (Figure 7).

**Figure 7.** Plan of the ramp built at Ahu Motu Toremo Hiva (northern coast of Poike Peninsula) in front of the last platform and after its abandonment. We suppose that this big structure in the arc of a circle, reinforced with stones and covered by a large mass of sediments, was intended for the removal of *moai*. Possibly, the two postholes were useful for retaining ropes.

On the chronological level, as indicated by a natural sedimentary interval, this ramp was clearly placed after the use of AMTH-III. Its purpose, however, remains enigmatic. In our opinion, the considerable effort undertaken for its construction and the solidity of the edifice — reinforced with vertically positioned stones — may suggest a ramp intended for the removal of *moai*. This explanation is indeed compatible with the already mentioned removal of *poro* from the terraces of AMTH-I and AMTH-III. With each abandonment phase of the site, the people concerned with a particular monument carried its essence with them, *moai* as well as *poro*.

In this way, no complete statue has been found associated with the monuments of Ahu Motu Toremo Hiva, only one *moai* head remains. The head fragment was integrated into the last ramp, like the other large blocks posed upright. It looks like a fragment of an older statue which was recycled. Examples of the reuse of statues, or fragments of *moai*, are known elsewhere on the island. The most famous are certainly those of Ahu Nau Nau on the beach of ‘Anakena and Ahu Maitaki te Moa on the west coast (a recycled complete statue, its face turned towards the interior of the monument) (Heyerdahl & Ferdon 1961).
The fragmentary head preserved at Ahu Motu Toremo Hiva is atypical in style. The face is extremely broad (1.40 m), the nose is bloated and the hollows of the eyes are too shallow to have contained some kind of ocular insert (coral eyes for instance) (Figure 8). Lastly, the face seems to be completely deprived of ears. Little comparison exists for this type of moai, except for the statue of Pou Hakanononga, preserved at the Royal Museums of Art and History in Brussels since 1935 (Forment 1981). In this case as well, one notices the broadness of the face (nearly 1.35 m), the absence of ears and the very shallow eye sockets. With regards to differences, the back of the head of Pou Hakanononga is completely rounded, whereas the moai of Ahu Motu Toremo Hiva has a flat occipital. The Brussels statue, moreover, has clearly much more pronounced eyebrow arches.

**Chronology of the Site (Table 1)**

The order of the ahu series of Ahu Motu Toremo Hiva has no ambiguity. In one of our trenches, the three monuments are superimposed, but separated from each other by some sheet wash deposits coming from the slope in front of the monuments (Figure 9).

<table>
<thead>
<tr>
<th>Event</th>
<th>Sample</th>
<th>Lab A/o.</th>
<th>Date BP</th>
<th>Date cal. AD (1o)</th>
<th>Date cal. AD (2o)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeleton buried after the use of the platforms</td>
<td>AMTH-2004-2/1 (human bone)</td>
<td>KIA-26483</td>
<td>150 ± 20</td>
<td>1690 (14.5%)</td>
<td>1730 (73.5%)</td>
</tr>
<tr>
<td>West posthole associated with the ramp which closed the use of the platforms</td>
<td>AMTH-2004-1/6 (Charcoal)</td>
<td>KIA-26487</td>
<td>240 ± 20</td>
<td>1650 (23.1%)</td>
<td>1740 (45.1%)</td>
</tr>
<tr>
<td>Colluvium (Sheet wash deposits between the platforms)</td>
<td>AMTH-2004-1/1 (Charcoal)</td>
<td>KIA-26452</td>
<td>675 ± 20</td>
<td>1300 (26.0%)</td>
<td>1375 (16.0%)</td>
</tr>
<tr>
<td>Deforestation layer (beneath the oldest ahu foundations)</td>
<td>AMTH-2004-3/2 (Charcoal)</td>
<td>KIA-26453</td>
<td>675 ± 25</td>
<td>1300 (26.4%)</td>
<td>1375 (15.6%)</td>
</tr>
</tbody>
</table>


Immediately beneath the foundations of the oldest ahu, one can see a layer of deforestation, with burned palm roots. The three dates obtained for this event give us homogeneous results and a good terminus post quem, between 1300 and 1420 cal. AD. Similar dates have been found for deforestation of the southern coast of Poike (Mieth & Bork 2004: 57-58). Consequently, the monuments of Ahu Motu Toremo Hiva have been built during the 14th century AD at earliest.

*A terminus ante quem* could also be determined for the Ahu Motu Toremo Hiva site. On both sides of the ramp, that closed the use of the last ahu, we found two postholes for which we cannot determine the exact function. Possibly, they were used for holding in position two posts retaining ropes for the removal of some statues. In any case, we have found charcoal in one of these postholes, dated between 1500 and 1800 cal. AD. This date, confirmed by two samples, indicates the late state of use of the site.
Thus we can state that the three ahu of this site were built between the 14th and the 17th or 18th century AD. Consequently, the life expectancy of each platform was about one century, probably less if we consider the moments of natural sedimentation that separate the three platforms. Despite the lack of precision, we can say that the Islanders have built, at three times, a large platform only for two or three generations.

**Synthesis of Events**

1. Deforestation, at the end of the 13th century AD or during the next century, of an area on the Poike Peninsula. This sector is more extended than the area strictly necessary for the building of an ahu. Actually, sediments coming from the slope in front of the site recover the three ahu and these layers contain charcoal for which we have $^{14}$C dates. These dates are exactly the same as those obtained for the deforestation layer (Table 1). This fact indicates a transportation of charcoal by erosion during several decades from a sector that has also supported deforestation during the 14th century AD.

2. Construction of the first ahu (AMTH-II). The foundation structures of this ahu are directly built on the deforestation layer.
3. Abandonment of AMTH-II. Some poro of the terrace were removed. No statue was found connected with this platform.

4. Partial covering of AMTH-II by sheet wash deposits. The origin of these sediments is known and their nature indicates the presence of agricultural activities above the site (on the slope of Poike, south of the site). Thus we can note that the abandonment of the first ahu corresponds to an intensification of the agricultural activities of this sector of Poike.

5. Construction of AMTH-I, to the west of the first ahu.

6. Abandonment of AMTH-I. In this case, we have no evidence of the removal of cobbles. We also have an absence of moai.

7. Covering of AMTH-I by sediments, following the same process described for AMTH-II (sheet wash deposits testifying agricultural activities on this part of Poike Peninsula).

8. Construction of the third and last platform (AMTH-III), between the two others.


10. Covering of AMTH-III by sediments, following the same process described for AMTH-II and AMTH-I (sheet wash deposits testifying agricultural activities on this part of Poike Peninsula).

11. Partial covering by red scoria dust (hani hani) of the space just in front of the landward side of AMTH-III.

12. Partial destruction of the hani hani layer by small ditches oriented south-north.

13. Construction, possibly during the 17th century AD, indeed some years before or after, of a large ramp in front of AMTH-III. This ramp was built with large stones and sediments. One of the stones is a head of a moai carved in a tuff of Rano Raraku type. The presence of this head, 120 m above the Rano Raraku level, seems to testify the erection of at least one moai on one of the three platforms discovered at Ahu Motu Toremo Hiva.

14. Burning of the vegetal cover, perhaps for agricultural activities.

15. Development of the contemporaneous steppe.

Discussion

The discoveries made at Ahu Motu Toremo Hiva bring up a series of observations. If we consider only the site itself, we can note that the ahu have supported a complex sequence and a relatively short life expectancy. At each stage, the Islanders have removed some cobbles and probably also one or more moai.

The case of the last ahu is especially interesting and complex:

- construction of the platform using the ruins of the two others as foundations;
- abandonment of the monument two or three generations later and removal of some poro;
- partial covering of the ahu by sediments;
- return of the Islanders to disperse dust of hani hani;
- new abandonment of the site and restarting of the sedimentation process;
- final return of Islanders and construction of a large ramp, perhaps to remove some moai; a moai head is used to build this ramp.

Certainly, this process took place over a period of time, however difficult it is to define. But the small stages of sedimentation between the human activities show that the process of abandonment of the ahu took place during some months or years.

In all, at Ahu Motu Toremo Hiva, we can recognize traces of recycling, dismantling and reuse of some
architectural elements. This dynamic is not only characteristic of this site but similar observations have been made for other monuments of Easter Island, notably at 'Anakena (Ahu Nau Nau) or La Perouse Bay (Ahu Heki'i and Ahu Ra'ai) (Martinsson-Wallin & Wallin 2000:37-38).

In addition, the geomorphological study of Ahu Motu Toremo Hiva has permitted us to determine that each ahu abandonment phase was coupled with agricultural exploitation. Evidently, the traditional settlement pattern of villages inserted between the ritual platform and the agricultural land, all functioning simultaneously (Flenley & Bahn 2002: 93-94) must be questioned, at least partially.

Some consequences can also be established if we consider Ahu Motu Toremo Hiva in the scale of the whole island. First we now can recognize that the abandonment of an ahu is not strictly connected with an ecological crisis, such as a consequence of the collapse of the Rapa Nui culture. It is important to note that some ahu have been abandoned, dismantled or recycled since the 14th or 15th century AD, that is to say at the same time of the construction of other ahu. This fact was also observed at Ahu o Rongo, during excavations made by the same team (Huyge and Cauwe 2002).

The presence of a ramp as terminal stage of use of Ahu Motu Toremo Hiva and the absence of any statue for the three ahu discovered asks the question of the carriage of the moai. Apparently, the statues were not removed only from the source of raw material (Rano Raraku for instance; Lipo & Hunt 2005) to an ahu, but also from an ahu to other places. This fact allows questioning the determination of the "roads of moai".

Finally, the most important point for us is the discovery of complex process to organize the abandonment of the ahu. At Ahu Motu Toremo Hiva, the Islanders never let their platform go to ruin or be destroyed by violence. Each-abandonment represents an important work. This type of process is called "condemnation" by the branch of French Archaeology that studies the Neolithic megaliths (Cauwe et al. in press). As for the megaliths of Britain, Ireland, Portugal, England or Netherlands, this process requires important manpower and time, and the aim is firstly to stop the symbolic or efficient role of the monument, not a destruction. This data, proved by archaeological and geomorphologic evidence at Ahu Motu Toremo Hiva provides a change of our approach of the story of the ahu in ruins: is it really in ruins or the result of a process of "condemnation"?

Notes

1 27°05.683' South x 109°14.920' West.

2 This peculiar toponym derives from the name of a minuscule islet situated a few hundred meters to the east, not far from Cape O'Higgins. It is indicated on the 1:25,000 map published in 1968 by the Servicio Aerofotogrametrico de la Fuerza Aerea de Chile. On the map of Easter Island edited in 2004 by the Instituto Geografico Militar (Carta Regular de Chile, sheet Cl 17 E), however, the same islet bears the name Varinga te Toremo.

3 The three platforms of Ahu Motu Toremo Hiva are respectively called AMTH-I, II, and III. Unfortunately, during the two first campaigns, we believed that the oldest ahu was AMTH-I. But the definitive stratigraphic evidence demonstrates than the oldest is AMTH-II.

4 The anthropogenic character of this layer was recognized by Morgan De Dapper thanks to the observation of the random orientation of the coarsest elements within it, for which no natural phenomena can account.

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Computer Modeling and Visualization of Vinapu Ceremonial Center

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Abstract - During the second half of the 20th century, several ceremonial platforms of Rapa Nui were reconstructed, thus allowing visitors to contemplate their original majestic greatness. At the same time, observation confirmed a more rapid deterioration of the moai once exposed to the action of the elements as compared to statues that remained partially buried beneath the soil or rubble, which postponed further large-scale restoration activities. One of the possible ways to expand the number of sites accessible for viewing in their original form without endangering the original monuments is to use computers to re-create their three-dimensional models from actual measurements, maps and photos. In this paper, a three-dimensional model of the ceremonial center of Vinapu was constructed, basing on maps and photos published by William Mulloy in the Reports of the Norwegian Archaeological Expedition to Easter Island, 1955-56. Fine model geometry adjustment and texturization were performed using photographs taken by the author at the site in 2002. In the framework of the hypothesis that the proportions of the moai obey the golden section rule, the toppled statues were tentatively modeled after the set of their measurements available in the literature. This enabled the conjectural reconstruction of the site following the drawings of William Mulloy. The obtained model of the site was used to perform calculations concerning its visibility from both land and sea, confirming that Yuri Lisyanskiy and other early visitors could have seen the main platform with the standing statues quite well without the aid of any telescopic equipment, if they were within 3 kilometers from the shore.

The picturesque landscapes of Easter Island dominated by the shrines with monumental rows of the towering statues crowned with topknots, so familiar from the drawings and etchings of early visitors became history in the second half of 19th century. Statues still standing on ceremonial platforms were last observed by Admiral du Petit-Thouars in 1838 (Heyerdahl 1961:67); the memory of the islanders preserves the approximate date for toppling the ultimate moai Ko Paro from Ahu Te Pito Kura in about 1840 (Englert 1948:523, Routledge 1919:173, Smith 1961:204). Later visitors, starting from Palmer in 1868, reported that all the images were thrown down from their pedestals and mutilated (Heyerdahl 1961:73), so that the only standing images were those semi-buried in rubble beneath the quarries of Rano Raraku. In 1940s, one statue was set on a freshly constructed pedestal at Plaza Hotu Matua, Hangaroa (McLaughlin 2007:108-9). In the framework of the Norwegian Archaeological Expedition to Easter Island and East Pacific, several statues were restored to vertical position at their original place/ahu, including moai Tukuturi (Skjølsvold 1961:360) and a statue at Ahu Ature Huki (ibid, 372). Large-scale reconstruction were started by William Mulloy and Gonzalo Figueroa in early 1960s, resulting in restoration of Ahu Akivi, Ahu Ko Te Riku, Ahu Tahai, Ahu Vai Uri, Ahu Hanga Kio’e and Ahu Huri A Urenga during the following decade. In 1978 Ahu Nau Nau was restored by Sergio Rapu, and in 1992-96 Ahu Tongariki was reconstructed (under direction of Claudio Cristino with the crane offered by Tadano Company from Japan).

Thus, modern visitors to the “Navel of the World” can contemplate at least in part the splendor witnessed by the early visitors. However, the reconstructed images became more vulnerable under the destructive action of the elements, and special stone stabilization work had to be performed to prevent their further erosion (Friese et al. 2005, Sawada et al. 2005). As the majority of the ahu are situated in the coastal area, the salty spray from the ocean contributes significantly to the erosion, precluding the restoration activities on many sites due to irreparable weathering damage to the statues. In this case, one can use the modern computer facilities to perform a virtual reconstruction of such sites by means of three-dimensional modeling, creating user-navigable virtual environments. This approach also may help to improve the understanding of construction techniques used by the islanders due to easy manipulation, measurements and weight estimation of the individual three-dimensioned objects composing the model; potentially, such models may facilitate future real-world reconstruction activities.

To the knowledge of the author, many of Easter Island sites were modeled, in particular:

- 3D terrain model of Ahu Ra’ai and surroundings (Martinsson-Wallin and Wallin 2000:34; Kon-Tiki Museum research 1999).
• 3D model of *moai* Paro (Van Tilburg 2002; Arnold Animations 2002).
• 3D model of Puna Pau terrain and pukao (Shepardson *et al.* 2004:46).
• High-precision Cyrax 2500 laser scanning of several monuments, including ‘Orongo petroglyphs and the statues located at Ahu Akahanga and MAPSE (Wellman 2003a:40-43), also *moai* Ko Te Riku (Wellman 2003b). The resulting 3D models were characterized with the precision of one point per 6x6mm area (Wellman 2003a:43).
• Large-scale project of ArsVirtual and Fundación Telefónica, resulting in the interactive website featuring the 3D models of Ahu Akivi, Ahu Tongariki, Ahu Nau Nau and ’Orongo village (ArsVirtual 2006). The models have the real textures but are less detailed to ensure moderate file size for fast download over the Internet. Three-dimensional models of the ceremonial platforms allow real-time animation of sun movement with the corresponding re-calculation of the shadows cast by the statues.

Therefore, significant efforts invested recently in the three-dimensional modeling of the unique cultural heritage of Easter Island prove that this research field is of timely interest and high importance. This paper reports the creation and investigation of 3D model for one of the most impressive and famous structures of Easter Island – Ahu Vinapu (Tahira). Featuring superior masonry technique, this site attracted significant attention of the visitors and thus became one of the best documented platforms. Detailed profiling and mapping of Ahu Vinapu and the surrounding terrain performed by William Mulloy during the excavations in 1955-1956, together with the maps of conjectural reconstructions of the site during the different periods of its history (Heyerdahl and Ferdon 1961:Figs.14-18, 128-132) were used as a base for our 3D model.

Computer modeling was performed in 3D editor Blender (http://www.blender.org). The controversial issues concerning the position of individual objects were solved using the kite aerial photography (KAP) by Don and Elaine Dvorak (Flenley and Bahn 2002:Plate 13). Additional fine-tuning and texturing of the model was performed using the photos taken by the author at the site in November 2002. The reference photo set consisting of 30 images was subjected to the correction of camera barrel distortion using panorama stitching software Hugin (http://hugin.sf.net). Each photo was associated with a separate camera in Blender, position and orientation of which were properly adjusted relative to the model. The sample reference photo with superimposed wireframe mesh of the sea wall is shown in the Figure1.

**Figure 1.** A reference photo superimposed with the wireframe model of the sea wall.

Due to the fact that all six *moai* once standing on the platform are either badly broken or covered with stones in the present time, the “idealized” *moai* model based on the golden section proportion (Horley 2006:39) was used to reconstruct their features using the available statue measurements (Mulloy 1961:109; Van Tilburg 1986:611-622; Shepardson 2007). To construct the models of the images in their modern state, the idealized models were separated into pieces according to the recent photos (Shepardson 2007, and also photos taken by the author). Further in this paper, to refer to the individual statues we will use the statue numbers according to the modern survey naming convention (numbers of survey quadrant – site – *moai*, i.e. 02-210-06 for the small statue shown in the Figure 1), or using Englert’s numbers (PSE #626 for the same image).
The resulting 3D model consisted of 50 object groups allowing the visualization of the site during the different periods of its history as a set of separate virtual scenes. Each scene contained about 1.5±2×10^4 faces and thus was suitable for real-time rendering on a PC equipped with a modern graphics card. User-navigable virtual environment was created using 3D engine Irrlicht (http://irrlicht.sourceforge.net). To improve the visual appeal of the image, the photographic celestial dome (Hurbain 2002) was used. The proper lighting of the site for the different periods of the day/year was implemented by a sun position calculation algorithm (Schlyter 2000), allowing proper rendering of the volumetric shadows.

![Figure 2](image.png)

**Figure 2.** Suggested mechanism of Thomson’s breach formation: a) sketch of the undamaged sea wall (after Thomson 1891:Fig. 20); b,c) tentative reconstruction of the wall according to the drawing; d,e) modern state of the wall. The capital letters stand for: A) the upper tier slab; B) locking stone; C) stacked slabs; D) pedestal stone. The roman letters denote the suggested stone dislodging order.

During the creation of the model, special attention was paid to the slabs associated with the seawall breach caused by the Thomson’s exploration party in 1886 (Thomson 1891:511, 512). Concerning the amount of the destruction caused, one can even become doubtful whether a small group of people spending only several hours at the site was able to throw down a slab of the upper tier and a pedestal to create the breach, but the contemporary drawing appearing in the expedition report (Thomson 1891:Figure 20) depicting the undamaged structure proves this possibility (Mulloy 1961:97). The schematic tracing of the latter drawing is presented in the Fig. 2.a; to simplify the analysis, Fig.2.d shows the rendered image of the modern **ahu** model. As one can see from drawing, to-be-dislodged slab A from the upper tier neighbors with a small rectangular stone B followed by the stacked slabs C. One of the most important details in the drawing, to my opinion, is a clear depiction of a large shadow cast by the pedestal D over the slab A, suggesting that the pedestal was overhanging the wall. Knowing that the **Mohican** arrived to the island on December 19, 1886 (Thomson 1891:450), I was able to confirm the presence of a similar shadow with my computer model under the sun illumination conditions characteristic for the second half of December (Figure 2 b,c). Comparing the drawing with the present position of the collapsed stones, it is tempting to suggest that the locking stone B is the rightmost one. Being much smaller than the stones A and D, it could have been dislodged by the efforts of several persons. When forming the wall, the locking stone was exposed by its flat side; in the present position, the stone has a flat side directed towards the wall that may suggest that it was levered from its place and flipped upon falling - arrow I, Figure 2(c). Removal of the stone B made the right side of the slab A free for about a half of its height; clearing the space behind its loose corner will open a convenient access to the back side of the slab for efficient application of the pushing force - Arrow II, Figure 2(c). The overhanging pedestal stone D will be also beneficial in this case, as once the exerted torque will be strong enough to push the slab A from the equilibrium, the weight of the pedestal will cause the slab to collapse on the front face; the pedestal will go next, ending up in its present position resting top side up. The remaining task of removing **ahu** fill from the breach becomes comparatively easy and can be successfully performed by a small group of people. Taking into account these details, we suggest a tentative reconstruction of Ahu Tahira seawall at the time of Thomson’s visit (Figure 2 b,c).
Comparing Mulloy’s map of the excavated site with his reconstruction of the *ahu* (Heyerdahl and Ferdon 1961:Fig. 131), one will find that the locking stone B was most probably considered as a part of a pedestal (together with fragment B1, Fig.3.a), leading to the suggestion that the site bearing only six images featured seven pedestal stones (Fig.3.b), so that the central pedestal (thrown down by Thomson) was either non-occupied (Mulloy 1961:108) or possibly intended for the *moai* half-buried at the seawall of the structure (ibid, 110). On the other hand, introduction of the seventh pedestal made the statues 2-210-01 – 2-210-03 (PSE #625-623) clustered tightly together; the place allocated for the statue 2-210-02 becomes shifted much to the southern part of the *ahu*. As a result, the position of the toppled *moai* deviates by the half width of its base from the position of the corresponding pedestal on Mulloy’s map (Heyerdahl and Ferdon 1961:Fig. 129). The KAP image taken by Dvoraks (Flenley and Bahn 2002:Plate 13) shows good alignment of both statue and pedestal, suggesting that *moai* was falling straight forward. Assumption that the stone B was a part of seawall solves this problem, eliminating the seventh pedestal and allowing more space for the three southernmost *moai* (Figure 3.c).

The site also features many scattered worked stone slabs and slab fragments; the largest of them were included in the model and are marked with asterisks in Figure 3(a). Formerly used in the structure, these slabs were displaced after the toppling of the statues; two slabs were moved to the sides of the *ahu* and placed horizontally, possibly serving as altars or tables (Mulloy 1961:108). But the most important (to my point of view) is the pair of slabs concealed in the vault formed beneath three fallen southernmost *moai*. Figure 4(a) shows a side view of the site reconstructed in accordance to Mulloy’s map (Heyerdahl and Ferdon 1961:Fig. 131) with these two slabs retaining the narrow stone elevation carrying the pedestals, similar to the design of Ahu Akivi (Figure 4(b). The modern position of the same slabs is marked with arrows in the Figure 4.a. Mulloy suggested that the falling *moai* dragged the slab down the ramp to the modern position, maintaining its practically vertical orientation (1961:111). The presence of a *poro* boulder partially covered by retaining slab (Figure 4(a) was considered as a proof of this hypothesis (Mulloy 1961:Fig.18). Despite being generally plausible, this explanation should be viewed with caution taking into account that according to Mulloy’s map the slab traveled almost 1.4 meters while remaining vertical. Such a distance, to my opinion, is not realistic, because the dragging force applied to the top of the slab together with significant friction force applied to its bottom in the opposite direction would form a pair of forces exerting a strong rotation torque on the slab causing it to collapse. Therefore, the author is more inclined to think that the retaining slab most probably was “nailed” into place by the forward-falling statue 02-210-02 (PSE#624), so that it was unable to move significantly even after being hit by the falling *moai* 02-
In this case, accounting for the large number of the similar slabs scattered around the site, it is possible to suggest that they once formed the retaining wall for the sloping statue platform - Figure 4(c) -, similar to that seen at Ahu Tongariki – Figure 4(d) - or Ahu Nau Nau.

The general geometry of the vault formed below three southernmost statues (Figure 5) was modeled after the plan made by Mulloy (1961:Fig.18) and the photos of Carl Lipo (2006). After the statues were toppled, a painting of a scent-shaped boat was made with orange and white pigments on the image 02-210-03 (PSE #623). Nowadays the painting is blurred, but Palmer’s drawing (Van Tilburg 1994:Fig. 35) shows it in better defined state with anthropomorphic figure on the top of the boat. For our model of the vault, moai PSE #623 was textured with a tracing of Palmer’s drawing.
At the present, the fragments of three topknots are associated with the site; a fourth pukao mentioned by Englert was most probably carried away or reused in the recent times (Mulloy 1961:108). George Forster, visiting the site in 1774, supplied the names of the six statues as Ko-Tomo-Iri, Ko-Hu-u, Morahina, Umariva, Vinabu (sic), Vinape and stated that one of the images already “lost its hat” (Forster 1986:256), which suggests that the fallen pukao was still at the site. Taking into account this historical reference, one can assume that all the statues erected on Ahu Vinapu initially had the topknots. Mulloy’s excavations revealed that inlaid coral eyes were also used at this site; a half of an eye inlay was discovered beneath the image 02-210-04 (PSE #622) and described in the expedition reports as a coral bowl (Mulloy 1961:109, 156, Fig.46).

Accounting for these facts, the three-dimensional model of the site was created with topknots and inlaid eyes for each statue standing on the ahu. The dimensions of the topknots were adjusted for the height of individual statues as proposed by Mulloy, so that the pukao for the tallest image appears to be 2.2 meters high (Mulloy 1961:110). The shape of eye inlay and a pupil were modeled after the photos of a moai eye found by Sergio Rapu at ´Anakena. The resulting frontal views of the structure for both types of statue platform designs are shown in Figure 6.

![Figure 6. Frontal view of Vinapu model with the standing statues: a) Mulloy’s reconstruction; b) alternative reconstruction.](image)

The specific position of Ahu Vinapu in the valley opening right after the precipitous cliffs of Rano Kau made the structure easily identifiable in the accounts of early visitors circumnavigating the island – Yuri Lisianskiy (1804), O. Kotzebue (1816) and du Petit-Thouars (1838) (Heyerdahl 1961: 66-67). Investigation of the former account and its navigation map revealed that in the region of Vinapu, the ship Neva under command of Lisianskiy was sailing at about 3 kilometers from the shore (Horley 2004:124), posing a question whether the site allowed clear naked-eye observation from such a distance. Taking into account that the maximum height of the structure was about 11.75m (including the height of the sea wall, the tallest moai and its pukao), one can estimate the vertical viewing angle of the structure for the observer located 3 km away as 13°27’. The corresponding view of the restored site is shown in Figure 7 together with Moon disk displayed in the same angular scale for visual reference. As one can see from the figure, the structure could be seen clear enough to allow the reliable count of the standing statues without any telescopic equipment.

Thomson’s account also mentions another curious detail about the site, saying that the largest statue ever carved on the island and nowadays called “El Gigante” was destined for Ahu Vinapu (Thomson 1891:512). This attribution is usually considered as a beautiful legend, because almost 21-meter tall moai with the estimated weight of 130 tons still remains attached to the cliffs of Rano Raraku, and it would have comprised an exceptionally difficult task for transportation (Mulloy 1961:96). Moreover, the existing statues at Ahu Vinapu do not leave enough space for the image measuring 4.05 meters across the shoulders (Skjølsvold 1961:366). However, in the virtual environment constructed for Ahu Vinapu, the introduction of moai model with the dimensions of El Gigante (Skjølsvold 1961:366, Shepardson 2007) can be used to visualize the tentative appearance of the site for the case when the genius of Rapa Nui people succeeded to make this legend to the reality. Given the size of the statue, it will be logical to suggest that the ceremonial platform will house only a single image similar to Ahu Te Pito Kura with moai Ko Paro, the tallest image ever set on an ahu (Van Tilburg 1994:28). Nevertheless, for scale reference purposes, it was decided to include into the model the southernmost moai 02-210-01, 4.4 meters tall (Mulloy 1961:109). Similar to the other moai of the site, the model of El Gigante was supplied with coral eye inlays and crowned by a four-meter tall pukao (Figure 8). The total estimated height of the structure measured from the base of the sea wall to the top of the topknot thus would be about 28 m.
Therefore, the detailed maps of excavated and reconstructed Ahu Vinapu created by William Mulloy allowed construction of a three-dimensional computer model of the site. Fine-tuning of model geometry was performed using kite aerial photos by Don and Elaine Dvorak and photos by the author. The hierarchy of the model allowed easy switching between the different views of the site, including the modern state and several tentative views.
reconstructions. Detailed analysis of a drawing presented in Thomson’s account helped to suggest a reconstruction of the sea wall before Thomson’s excavations, and also to propose the possible manner of sea wall demolition so that the collapsing stones would fall in the order they are stacked nowadays. Discussion regarding the worked slabs concealed in the vault beneath the fallen moai suggested the alternative design for the statue platform, which may look similar to that of Ahu Tongariki and Ahu Nau Nau. In addition, the 3D model was also used to make a conjectural reconstruction of the site with the largest image El Gigante erected over the platform.

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References


The Easter Island Cultural Collapse

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Abstract - Archaeological evidence for how the hypothesized prehistoric cultural collapse of Easter Island society came about has been virtually non-existent, but rather extensively assumed by much of the scientific community, and mostly by the press. The cultural and ecological collapse of Rapa Nui culture originates from a scenario first presented by Mullloy in the mid 70s. The ecological demise of the island presented by Mullloy, especially its deforestation, has since been well documented. But how did the ahu-building, moai-moving and moai-erection, and the classic culture come to a halt? How did it “decline” into the small-scale warfare and cannibalism found by European explorers? This paper details archaeological data that points to the process of the cultural transformation from a society that appears to have been once somewhat unified, into one that seems entirely and internally antagonistic.

Editors Note:
To be faithful to the unique aspects of this author’s presentation at the Gotland Conference, his paper has been retained in a style and format characteristic of a transcript, with the appropriate and inevitable use of first-person voice.

Introduction

I’m going to start this presentation with a little bit of archaeological humor because we’re all in archaeology or anthropology or related fields. I am myself both a geologist and an anthropologist (and here specifically an archaeologist), which makes the joke more poignant. The joke goes like this: A group of interviewers wants to know how different professionals think and solve problems. And so they put in separate offices an engineer, a geologist, and an archaeologist and ask them the same question: “What is two plus two?”. The engineer, geologist, and archaeologist are each given an hour to come up with the answer.

When the interviewers come to the engineer’s office an hour later, they find him twiddling his pencil and tapping on his desk. He says, “Why weren’t you here fifty-five minutes ago?”

“Well”, they ask, “do you have an answer?”

“The answer”, he tells them, “is four point zero, zero, zero, zero”.

“Fine”.

So the interviewers go to the geologist’s office, open the door, and find the place littered with crumpled paper. Everything is a mess, with waste paper baskets overflowing and the geologist frantically scribbling at his desk. The interviewers say, “Your time is up. Do you have an answer?” And the geologist says, “Well, I think the answer is between three-point-five and four-point-five but I really don’t know where”, and throws up his hands.

Finally, the interviewers bang on the archaeologist’s office door and, when they open it, they find him sitting on the window sill, staring out into space — his paper, pencil, and desk obviously untouched.

“Your time is up”, the interviewers say. “Do you have an answer?”

“Yes I do”, the archaeologist says. He looks out the window carefully from side to side and then closes it. Then he walks over to the door, looks up and down the hallway, closed the door, and turns to the interviewers, looking them squarely in the face. “Now”, he says, “what do you want the answer to be?”

Easter Island Archaeology and Cultural Collapse

With that in mind, let’s talk about the possibility of an Easter Island prehistoric cultural collapse, so I want to shift gears formally and then I’m going to transition to other areas and methods. The first figure is a reference map (Figure 1), showing the various roads along which the early Easter Islanders moved the carved moai out of Rano Raraku. Some of these roads are better documented than others and, granted, there are at least 46 moai that have been moved and abandoned along them (Van Tilburg 1994:28), though that number is negotiable depending on how the “roadways” are defined.
Note that speculation about Easter Island culture having at least two phases began in 1774 when Captain Cook thought that the then present Rapanui could never have constructed or moved the statues that he or his men saw around what was a treeless island, even though it was clear the islanders revered the statues, and even named them (Pickersgill 1969:340).

More than two centuries later, William Mulloy had done enough archaeologic investigative work, along with the results of four modern and historic archaeologic expeditions, to publish a "womb-to-tomb" scenario for Easter Island (Mulloy 1979). In it, he postulated a settlement phase; a classic ahu- and wood-building phase; a collapse phase (which included the destruction of the classic moai-bearing ahu, the building of newer semi-pyramidal ahu, and subsequent warfare and cannibalism); and, finally, Mulloy postulated an historic phase, whereby European explorers and whalers introduced the island's culture to the historical present. All of this is well known but this presentation involves more specific evidence about the stages during the collapse than Mulloy could have known. He correctly speculated, from having found unidentified carbonized root remains during his excavations of Ahu Vinapu and other sites, that the island was once covered at least by shrubs if not by trees (Mulloy 1961). Yet all the historic evidence and traditional legends said the island was always treeless. Trees would have been necessary, Mulloy speculated, however, to move moai along the prehistoric roads, and to prise large boulders into place on classic ahu. Further, he thought the consumption of these theoretical trees precipitated the collapse of the classic culture, from which the abandonment of moai along the prehistoric roadways and elsewhere, let alone the cessation of carving in Rano Raraku, was sudden and catastrophic (Mulloy 1979).

His scenario — the rise and fall of Rapanui culture in a geographically-bound and isolated environment — quickly became a popular journalistic analogy for the world, and its combined use of resources. It is of greater interest today than ever before. And certainly Diamond (2005) has contributed to the journalistic license. Only recently have several investigators begun to question the Mulloy scenario on various grounds. But if, for a moment, we assume there was an actual prehistoric collapse, as opposed to a "sudden transition", then what would the evidence look like? Here's where we get into the thick of it.

Basically, I want to examine evidence for five different ways of looking at the archaeologic record for a "staged" collapse (and by "staged" I mean occurrence in stages). The first line of evidence is a sudden change in religious architecture which I’ve tried to put into some kind of time frame by the use of a series of architectural ahu maps. Here, I hope to be able to show the paradigm under which we all operate one way or another, even though the figure I’m using is so terribly old I must apologize for it’s appearance (Figure 2).
These are obsidian hydration dates made by Stevenson et al. (1984; 1987) and it would be interesting to go back over these same dates with his newer techniques to see if we find a different pattern. My guess is that he might discover different and even new dates, but that the pattern itself won’t change. Each color and each colored pattern represent dates from the same ahu. All of these are from buried, not surface, ahu contexts — i.e., they are from ahu fill, from beneath the foundations of the seaward walls, from underneath pedestals and pavements, including dance pavements that are in the foreground plaza as part of the ahu complex. They are all in an archaeologic context and all of them are from ahu. I have extended this graph to about 22 ahu with 660 dates, but the point is clear because the pattern is the same.

Therefore, when even a cursory examination of the graph reveals that these are in an ahu context it’s reasonable to ask if this is pure scatter. There is one ahu (Ura Uranga te Mahina) and one can see a lot of obsidian samples. Eliminating that as pure scatter (meaning obsidian somehow got in there in a context that wasn’t archaeologic; i.e., it existed beforehand and was then thrown into the fill), then it looks like construction of the ahu is going fine up until about the peak, and this is under a slightly older obsidian hydration rate dating system. Thus, if we increase the hydration rate by even a little bit, we compress this time-line but we don’t shorten the graph very much. So, it appears that people had been on the island for quite some time before they began building a big ahu. And, yes, this is open to interpretation.... I mean, what do you want the answer to be?

Notice how historic circumstances help us out in this interpretation ... because as you know, whalers began to arrive with steel tools, harpoons, fish hooks, knives, axes, and obsidian for cutting tools gradually became unnecessary in the early 1800s (Figure 3).

In order to make several points about a cultural collapse, I need to demonstrate some basic ahu architecture and I’m going to go from the simple to the complex in a hurry. Based on the field map I made in 1980 of Mulloy’s 1960 restored Ahu Akivi, all the rocks, believe it or not, are actually there. It is 80 m long. The central platform is visible, as are the statues and their pedestals as well as the stone slabs forming the back wall. But I want to call attention to the crematory at this site, just off the back wall, with its little complex of carved basalt slabs. These crematory were so named by Mulloy and Figueroa (1978) because there was a lot of burned bone in them, although from my perspective, as a geologist, the crematory was not where the bones were burned because there is no reddening of the basalt slabs by fire, which normally occurs, nor are any other rocks in these crypts reddened by fire. Mainly you also have within the crematoria red scoria (called haniuani by the locals), unburned (meaning uncalcinated) sea shells, pebbles from the coast, obsidian flakes, and a number of other kinds of materials (even moai powder or fragments of the same) in
among the burned human and bird bones, and even some pieces of fishhooks. It's clear the islanders burned the human bones elsewhere, but ultimately placed the burnt bones in these carved, stone-lined "boxes". It's important, in other words, to see the location of the "crematoria" and to understand the problem with labeling these "crematoria". Note, incidentally, that Ahu Akivi is an inland ahu, not the normal coastal ahu, whose plaza is always inland.\footnote{1}

The central platform of Ahu Te Pito Kura is clearly visible in this original field map (Figure 4). The design is fairly simple but it has huge wings on both sides and there is an older construction underneath the left wing. Looking more closely, it appears that an original structure consisting of several courses of semi-fitted, multi-ton boulders had a seaward wall at the level of the ocean on the left side below the wing and several boulders seem to have fallen out. Adjacent to whatever this was, the islanders built the current ahu up on higher ground. There may have been two paleo-tsunamis from the north, the older of which lambasted the main wall of the original platform here at the head of the bay. The second took out the left edge of the central platform of the newer structure with the big moai, which was then re-built (depicted here with stippling). And then we have the 1960 tsunami which slopped inland the veneer of diagramed rocks depicted here, seaward of the main wall. No "crematory" structure survived these events.

The orientation of this section of the original wall, though hard to see here, does not match the orientation of the re-built wall, and there is a piece of an older moai making up part of the newer central platform seaward wall. This tells
us there was an earlier moai, a little one, that may have been there first but whose memory was respected enough to be included in the newly-built central platform wall.

Carlyle Smith, of the Norwegian Expedition in 1955, excavated a trench through a semi-pyramidal ahu that was superimposed on the left-hand wing. The semi-pyramidal ahu over-built the wing and is therefore younger, but it only partially has the classic shape of a semi-pyramidal structure. The difference is that the end of this west wing is squared. I mapped Carlyle’s trench around the foundations of the right-hand wing, still somewhat open.

But what is a semi-pyramidal ahu? This is a paradigm brought on by Catherine Routledge (1919:172), and she saw it as a paradigm because we science-oriented European-derived folks classify everything. If you ask the islanders today, which I did not too long ago, they cannot come up with a label for a semi-pyramidal ahu, they just call it an ahu. For them there is a continuum, between avanga (which is a formless burial structure), a structured semi-pyramidal ahu, and the older, highly structured moai-bearing ahu.

For archaeologists, there is a cultural disconnect caused by the arrival of Europeans, Peruvian blackbirders, and diseases arriving in 1862 and islander removal\(^2\) for Catholic plantations in Mangareva. All of these, but mostly disease, caused a massive die-off from a population roughly estimated at 4,000 or 5,000 down to 110. This had disastrous consequences for the islanders’ collective cultural memory. I suspect they once had a name for the semi-pyramidal ahu because, as will be presented, these structures represent a revolution in religious architecture (Figure 5).

![Figure 5. Field map of Ahu One Makihi as it appeared in 1980 with four crematoria along the coastal cliff and five moai.](image)

Here we have Ahu One Makihi, near Ahu Tongariki, and it's included because things are going to get complicated here in a hurry. There is a central platform, pieces of moai (though one is now in front of the Museo Fonck in Viña del Mar), the crematory near their heads, the coast behind it, another crematory next to the coast behind the other statues, yet another one behind the other right-hand moai, and still another remnant of a crematory way off to the west behind the right wing. There is also a remnant of another one, way off to the west. Note that the “crematoria” are always outside and seaward of the central platform. There is also a ramp structure or what’s left of it with its poro (rounded beach cobbles), which you see here just in front of where the statues stood. And in front and to the right is the dance platform.

This is a depiction of Ahu Hanga Tee where there are 8 statues and the central platform (Figure 6). One statue is buried here, another there, and the dashed area is a pavement. One can see that the right-hand central platform has been over-built by a mass of rocks, an avanga. Notice how this does not have a consistent or recognizable shape.
Figure 6. Field map of Ahu Hanga Tee, also called Ahu Vaihu, as it appeared in 1980. The three pukao (topknots) are no longer in the sea.

Figure 7. Field map of Ahu Parai A Ure in 1980 showing a semi-pyramidal structure superimposed on a classic moai-bearing ahu.
This is a tiny *ahu* called Parai A Ure (Figure 7), a little more than 40 m long, and I wanted to include it because the outline of a semi-pyramidal *ahu* is visible, built over an older central platform typical of a *moai*-bearing *ahu*. You can just barely see the outline in the stones underneath, which are the end of the original classic *ahu* wing on the right. Also visible are the *poro* of the original ramp. Of course the name of the game on Easter Island is recycling, so many elements of the original structure have been carried away. In other words, in the construction of an *ahu*, what we find are vertical slabs or vertically-set boulders that go beneath the pedestals that support the *moai*. The only other vertically-set slabs are used in the seaward wall.

There is no greater example of this than those slabs exposed at Ahu Ura Uranga te Mahina which, incidentally, is the reason that this particular *ahu* should never be excavated, restored, or altered in any way. This one *ahu* gives us more information about what things were like "before" the cultural collapse in that what was planned at the time and what they apparently had resources for, and what happened during and "after" the collapse are evident.

![Figure 8. Field map of Ahu 5-72 as it appeared in 1980, named by McCoy (1974), showing super-positioning of a semi-pyramidal *ahu* over the unfinished structure of a classic *moai*-bearing *ahu*.](image)

Here is McCoy's (1973) unnamed "Ahu 5-72" also located along the coast (Figure 8), and there are visible fragments of an original foundation of what could be called a "classic *ahu moai*". There are vertical slabs on the back wall, the sea cliff is right at the top, but there is also the outline of a semi-pyramidal over-building on that structure. Also visible are whole burial areas, with black spaces denoting open tombs. There are two points to be made here:

- First, the semi-pyramidal *ahu* are always younger and over-build the classic *ahu moai* or their foundations when the two are found together.

- Second, this is evidence of a radical change in how the islanders disposed of their dead. They changed from cremating the bodies and putting the burned bone remains in stone-lined boxes seaward of the *moai*-bearing classic *ahu* — to building semi-pyramidal structures and putting whole burials into slab-lined tombs within the semi-pyramidal *ahu*. Both Routledge (1919:169) and Mulloy (1970) recognized the insertion of these secondary slab-lined tombs into "*moai*-bearing *ahu". Mulloy, however, unlike Routledge, felt they were a late addition and did not belong with the original *ahu moai* (Figure 9).
This is Ahu Kihikihi Rau Mea, 100 m long, reported on first by Thomson in 1889 (Figure 10). Notice how this ahu doesn't have pointed ends; they are squared. And with their normal symmetry, that would be the end of it here, equidistant on the right from the apex at the center. But in fact there is a second semi-pyramidal ahu constructed clearly down to a single point stone on the extreme right-hand side. It even has an itty-bitty moai on the top of it. Considering all of the other semi-pyramidal ahu with which we are familiar on the island, it's difficult to explain why this is located here, except that it seems superimposed on this structure, meaning its placement is younger than the much larger semi-pyramidal structure. It also suggests the overthrow of the moai was not entirely island-wide or forgotten — but that this, along with several other newly-independent lineages, indicates there was still reverence for what the moai represented.

All 27 burial chambers in Ahu Kihikihi Rau Mea reported by Thomson in 1889 are still exposed. Gill & Owsley (1993) conducted some physical anthropology on the skeletons found there. But there is an important difference here: I
think this is a transitional ahu, meaning resources still existed to enable transport of big stones, but the times they were a-changing. To me, this ahu and several others like it in size and shape, suggest the transition is from a time of traditional pressure to build classic ahu to a time for recognizing the end of your resources is imminent, and so construction style and methodology changes to that of the semi-pyramidal ahu. It is far less expensive in terms of resources and human labor. Notice the person standing in place for a sense of scale. There is a squared end and a ramp of sorts.

Figure 11 is a view from around the back wall. For those who are curious, this is not Bill Mulloy; it's his son Patrick. Look at the size of the lower blocks of this wall. Though poorly assembled, there are multi-ton stones still being moved, suggesting the culture continued to have the resources and cooperation to continue to build large walls like this. And yet, at the same time, there's an entire over-building on top of much smaller stones that fill out the seaward wall of the semi-pyramidal ahu. The smaller stones are not part of an historic pirca (a stone wall for sheep pasturage). These show a rather definite constructional change from what had been planned below them. The transitional, semi-pyramidal structure has been clearly superimposed on what was earlier built as a classic moai-bearing structure.

Here is one last map — of Ahu Tetenga (Figure 12). A canoe ramp is visible. And there used to be a concrete water tank built by the Williamson & Balfour Sheep Company. In fact, Williamson & Balfour used part of the ahu (see the scattered blocks just off the right end of the ahu structure) to build that water tank. And one can also see pieces of a crematory out in this area (up and to the right of the upper fallen moai). The line across the center is a pirca at right angles that used to continue inland; it has since been removed. The seaward wall has squared ends.

![Figure 12. Field map of Ahu Tetenga at it appeared in 1982 showing a huge, square-ended transitional semi-pyramidal ahu superimposed on an equally large classic moai-bearing ahu. The area mapped is 130 m long. The region to the right was destroyed in the making of a ranch water tank. The moai are the second and third largest on the island to reach their ahu destinations. Neither have carved eye sockets.](image)

There are only six ahu on the entire island with squared ends that still retain the semi-pyramidal shape. What is important is that the over-building or conversion of construction took place rather suddenly. The two massive statues, both without eyes, apparently were in the process of being placed on the original ahu, or maybe they were already there but had yet to undergo carving of the eye sockets — and eventually the ahu was re-built into this "transitional" form.

Like the previous ahu shown (Ahu Kihikihi Rau Mea), this one has both good and bad rockwork on the seaward wall. The well-fitted, multi-ton stones are there behind the right wing and the central platform. But on the left wing the construction deteriorates rather quickly to the east, and an ill-placed jumble of stone forms the seaward wall. I am tempted to conclude that in the construction of this ahu, the builders ran out of access to resources or perhaps cooperation. They obviously had resources to move two of the three largest statues on the island, but finishing the ahu
structure apparently came to a standstill here at Ahu Tetenga. Even at the tallest and largest moai standing on an ahu ("Paro" at Ahu Te Pito Kura), the ahu structure appears somewhat unfinished. But at Ahu Tetenga, there are two pedestals ready for the moai to be set in place. There are additional stones vertically set and multi-ton stones which were probably intended to support yet another statue. This third moai, called Ngongangonga, is on a branch road directly to Ahu Tetenga and is about 200 m from reaching its destination. A huge pedestal stone lies about 100 m behind it, still on the branch road. An historic photo shows a pukao (topknot) on the east side of the plaza, apparently waiting to adorn its moai. When I made this map in 1980, some of the older folks on the island told me the pukao had been recycled, but that there was another one as well and it too was recycled. The point is that this ahu was in the final stages of construction, and something happened to prevent that and to alter its subsequent completion.

Ahu Mahatua, on the north coast (Figure 13), has a squared end and the same thing that happened at Ahu Tetenga is happening here. Once more, a semi-pyramidal outline of the over-building. Since I would call this a “transition” ahu as well, a view from the very tip-top is called for (Figure 14).

Figure 13. Vie towards Poike along the axis of Ahu Mahatua. The squared end is directly in front. Many slab-lined tomb areas exist on the landward ramp area.

Figure 14. Top of Ahu Mahatua. Small (less than 3 m) fallen moai rest on the very edge of the vertical back wall. These have not been toppled off the edge, but remain at the level of their pedestals. “Crematory” materials are not only on the very top of the ahu structure, but surround these fallen moai.

Figure 15 reveals that the islanders have moved the “crematoria”, or slab-lined bone boxes. Two classic “crematoria” for this ahu are seaward. It was a classic ahu to start with, but somehow the shell, bone, hanithani, and obsidian mix that’s normally found in these stone slab-lined boxes was moved up on top of the central platform. Nor is this is the only ahu to reveal such a pattern.

Here’s another view of Ahu Mahatua (Figure 16). It may appear a bit odd, but, on the right, one can see a partial moai body upside down, its head to the right and the “crematory” has been placed immediately seaward of the semi-pyramidal top wall, beneath the moai body itself. To me this is, again, an architectural transition, reflecting a time when maybe a group of islanders are losing faith in the moai, and thus they have been toppled, but the “crematory” is still being used for disposition of the dead. But perhaps not quite in the traditional location in separate structures nearer the sea cliff.
The second of the five lines of evidence comes from examination of the more than 60 so-called "slope moai" (the ones that have been inserted into the sloping hillside of Rano Raraku). Most of these are not constructed to support topknots. They are not strong enough in the areas adjacent to the eyes, and the tops of their heads appear too small and thin to sustain the weight of pukao such as is seen with moai on ahu bearing these topknots (Figures 17 & 18).

The slope moai dimensions are in rather stark contrast with those of the largest moai that arrived on central ahu platforms. Virtually all of the biggest and probably most recently placed moai on ahu, have, for the most part, topknots. It makes me wonder if these 60 or more slope moai don't represent 30- to 70-year, well-organized stage during the reduction of resources on Easter Island while attempts to maintain the traditional moai still dominated part of their religion. Perhaps simpler questions could be posed as the islanders watched the palm forest disappearing: Although some have speculated that deforestation may have been too gradual to be noticeable within a single generation (Brander & Taylor, 1998), it's still difficult to escape asking how the islanders could not have known about the consequences of forest reduction and what it would mean with regard to moving the moai? Are these slope statues the result of actual advanced planning for eventually having no wood to move the moai? I would suppose that the early Easter Islanders knew what was going to happen at least two generations before it became a reality. I'm speculating that they were not as stupid or as unknowing as our age-old Western archaeological paradigms sometimes suggest.

So whatever lineages may have been represented in the embedded Rano Raraku slope moai, my interpretation is the islanders knew in advance of the carving of the statues and that the resources for moving them to ahu were limited, or simply were not going to be available. With that foresight, and yet still wanting ancestors to be represented for veneration, they nevertheless carved these huge slope moai in a style not only to represent their particular district lineage, but in a manner which did not need the resources to support the movement, placement, and weight of topknots either. They are not all huge, but most of them are, and, as Mulloy thought, they evidently had no plans for moving them (Figure 19). And that's why I think there are many more than 60 statues representing several generations in time. Notice how thin and, with all due respect, fragile many of these statues are, and most of them, again, cannot support topknots. They are magnificent and well carved compared to most of the more powerfully-built moai abandoned along the roads. So I think the islanders knew very much in advance that their religious culture was headed into uncharted territory, about to experience a major change, and these slope moai allowed the lineages to cling to what was left of their traditional
ancestral respect. They could see the end of huge ahu construction, of large moai transportation, and even the need for carving ever grander moai. A position on the slopes of Rano Raraku was the only peaceful option for their own remembrance.

Also, while I think the islanders knew in advance they were going to run out of resources to move the moai or build houses and boats, etc., they had not yet reached the point of cultural conflict.

The third of these five lines of evidence comes from within Rano Raraku itself (Figure 20). Others can probably come up with better statistics than I have, but one thing that bothers me is the number of moai that were completed in the quarry, but never moved out. The carvers left them in place. I have I counted at least 13 of these moai, both inside and outside the quarry.
This *moai* on the left (Figure 21) — a mere 7 m in length — was clearly in the process of being moved over the adjacent, unfinished statue on the right. The unfinished statue is of classic design, and keeled. The one on the right apparently was stopped in the process of being keeled, the left one stopped suddenly in the process of being moved from the gallery above and to its right. And both, as well as others, suggest to me that we are seeing a final phase, in a collapse scenario, which is permanent — and this probably involves some kind of major political process or decision, including possibly violence, because no one evidently returned to pick up where they had left off in the on-going, down-slope moving process. Or for that matter, the finishing of the carving process. The quarry is replete with evidence for that, about which I have more to discuss below. Here we have statues representative of those that are completed, completed incidentally, or completely detached (Figures 22; 23; 24; & 25).

**Figure 20.** A completely finished *moai* of 6 m detached from its keel and with a finished back is resting, unmoved, in its gallery.

**Figure 21.** The finished *moai* on the upper left has been stopped in the process of being moved over the finished, keeled *moai* on the right.

**Figure 22.** A *moai* at the quarry top, on its face, completely detached, in the process of being moved out of its niche, which appears to be a few meters up and to the left.

**Figure 23.** This *moai* is detached from the stratigraphy in the above gallery, and was lowered or has fallen to its present position, but further movement was arrested.

**Figure 24.** A detached *moai* on the inside of the quarry, moved only 1 m from its original position in the gallery.

**Figure 25.** A rather thin 7.5-meter *moai* carved and finished on the inside of the quarry and moved only a few cm from its original position in the gallery.
These images illustrate a few of the other examples that suggest very strongly how carving work in the quarry either precipitously stopped, or better yet, ground slowly to a halt perhaps over weeks or months. There are a whole variety of other statues that I did not classify as simply detached and just left in place and this suggests another line of evidence.

This fourth line of evidence for sudden withdrawal from the quarry activities lies in a different kind of "slope" moai. There are a number of them that are further along in the process than just being detached; they seem to be already en route to their destination down the quarry slope but something arrested their movement. Because these statues are lying on the surface, were these being hauled down, even on their stomachs and stopped? Or were they caused to fall down from a standing position?

Below (Figure 26) are two more, the obvious one lower center and another on the right. Note that neither was set along the slope of Rano Raraku. Were they in transport, abandoned in transport, or had they fallen in their present position? These examples of moai stopped in transit both on the outer and inner quarry slopes are all smaller moai, based on what was being carved and moveable with diminished but on-going available resources at the time. Importantly, they represent a population of smaller moai (perhaps eight or nine but there may be more) that were not destined to be set into the slopes of the volcano. All of these are a separate group from the 13 completed and yet left in place in the quarry galleries.

If the slope moai were being moved down simultaneously by different crews, what made them stop, or, did they simply stop one by one as decisions on how to allocate resources changed? Do we wish to apply the same gradual, slowing down process to the 13 moai carved and finished but left in place? I doubt they were all carved and finished simultaneously. In Western terms, are we looking at a "backlog" here, where the carvers are still carving statues, but the movers are awaiting permission to move them?

There certainly seems to be something amiss at the social level. There is a backlog of 13 finished statues, and eight or nine moai in transit down the slope. The expectation with regard to the finished moai seems to be that they cannot yet be moved but are expect to be. The islanders seem to be waiting, perhaps, for some political or social logjam to be removed. What do you want the answer to be?

Do we dare talk about the statues along the road? All 48 of them? In other words, did each of them lose favor with their lineage group and were then abandoned one by one? Or did it happen all at once? Twenty five of them line the southeast coastal road, 19 line the inland interior road, and only 4 are along the north road. When I consider the distribution of these moai, the vast majority of the number of statues are within 2 or 3 km of the quarry. They are not distributed evenly along any of the roadways, but instead show some clustering, as though several moai may have been moved as a group. The four along the north road are, while strung out, all within 1.5 km of Rano Raraku.
It seems to me that, if the collective culture knew they were slowly running out of tree resources to move the moai, and had a traditional cooperative organization still strong enough to allocate enough resources to continue moving the moai, they might have chosen to continue moving the ones that were already closer to their destinations rather than the ones that were closer to the quarry. This might explain the distribution of the moai road statues. But at some tipping point, even the structured allocation of resources began to fail. The finished smaller moai, both in the galleries and on the slopes, may by virtue of their disposition represent a symptom of restricted resource allocation. To keep the culture, religion, and traditions intact, smaller moai became the alternative, at least up to a point.

The realization of the pending limitation on resources, and its possible consequences must have became clear to some far-sighted district and lineage chiefs who, early on, chose to leave their tall, representative moai embedded at Rano Raraku. That allows Polynesian-style social contract obligations, already established, to remain intact, but at a less expensive level than moving them along the moai roads. But in the face of clearly dwindling resources, how did they reconcile that with the rights, privileges, and procedures of other districts? Could it be that the Tangata Manu (Birdman) ceremony and rituals emerged from that dilemma? As a cultural response, the solution had to be decided by the supernatural, the deity Makemake, and grew out of the psychologic need for a solution too difficult to make by negotiation.

This takes us to the fifth line of evidence that the final collapse or free fall occurred within days or weeks and derives from an examination of certain ahu. The three ahu most important for this are Ahu Tetenga and two unnamed inland ahu, one of which is adjacent to Taharoa Bay, and the other is next to the arroyo Te Ava Ranga Uka north of Vaitea. The three ahu all have toppled moai upon them, but none of the moai have eye sockets carved in them (Figures 27a,b; 28, & 29a,b).

![Figure 27a,b](image1.png) An unnamed ahu inland from Hanga Taharoa on the north coast with two fallen "medium-sized" moai, neither of which has traditional eye sockets carved into the face. The two moai are sturdy enough to support pukao (or topknots) but apparently neither had.

![Figure 28](image2.png) Ahu Tetenga, with the second and third largest moai moved to an ahu. Neither have eye sockets carved into the faces. Historically two pukao were in the plaza but had not yet been raised onto the moai.
If we believe Routledge (1919) and Englert (1948), *moai* had to be standing on their *ahu* before having their eye sockets carved. These three *ahu* suggest they had to have been standing for a certain amount of time before the ritualized carving of the eye sockets. The question is — for how long? It is tempting to think the passage of time between the time the *moai* were standing on the *ahu* to the point at which they had their eye sockets carved would have been short. There may be other *ahu* similar to these.

That modification of the *moai* on the *ahu*, most likely while standing, was seen in a six cm wedge of *moai* powder on the seaward side of Ahu Tautira directly behind the pedestal for one of the original *moai* (Seelenfreund 1980). Whether the origination of the powder came from polishing or repairing the surface of the *moai* or from carving the eye sockets is not known. Equally unknown is how long the *moai* stood on their platforms, eyeless, before they were deliberately toppled. In the Ahu Tetenga situation, the *moai* may have fallen during the raising of the *moai*, vertically, to the pedestal area. This would have been a catastrophe that could not easily be corrected or reconciled.

The important point here is that these are *moai* directly associated with an *ahu* and its immediate (though prehistoric) construction. The *moai* seem to have been caught in some kind of transition in Easter Island society when the carving of the *moai* eye sockets apparently no longer mattered. Since we do not know how long the *moai* stood before receiving carved eye sockets, this evidence suggests a rather sudden transition. It also suggests Rapa Nui culture had lost faith in the *moai* complex as it was traditionally expressed.

Though five lines of evidence for Easter Island collapse have been outlined here, some snippets of other evidence as well suggest the *moai* complex of beliefs was being lost before the resources to build *ahu* and move *moai* had reached the tipping point. Several *ahu* exhibit rather unusual structures that were built after the toppling of the *moai*.
There is a moai on an ahu inland from Mahatua (Figures 30 & 31). Its name is controversial among historical and islander sources, and it has a huge garden wall, with multi-ton stones and 4 statues built into it. Some pieces may weigh as much as 5 tons. At this post-toppling stage (which also means post-moai stage), the islanders still apparently had the resources to move the moai anywhere they wanted to, and put them in a non-religious context, again suggesting they had lost faith in the traditional moai complex. In this case, they built them into a huge, rather oddly deep, 3-m manavai (rock garden) wall. Ahu Heki'i also has some similar huge stone "out-gardens".

**Conclusion**

All I am trying to present here is the idea that there seems to be several lines of evidence, archaeologic in this case, that suggests the Easter Island collapse took place in, at first, longer, then shorter stages, and the question is: How long do you want the stages to last? Remember the backlog of completely carved statues? How long does it take to create a backlog of 13? Would that be one per month? Would that be 1 per week? What do you want the answer to be?

And so, being unable to date any of this precisely, although I have my ideas, all I am looking at is a kind of archaeologic process that brings a classic culture to its knees eventually, and as archaeologists, we also have a responsibility to bring our inconclusive results to the public. If we accede, and rightfully so, to the idea that the moai were somewhat central to the Rapanui, then let's take a socio-geographic look at them. What we do know is that there are about eight contexts for the geographic position of moai:

1. Those in the quarry, more than 350 of which are still fixed to the bedrock and are in various states of completion that range from just an initial outline and carving to completion.

2. The great group of more than 63 moai standing belly-deep in the outer and inner slopes of the Rano Raraku quarry, most in finished condition but deliberately planted in that fashion. I emphasize deliberately.

3. Another group, combining both inner quarry and outer quarry numbers of which there are at least 16, that were finished and carved in a complete fashion including their backs (unlike other reported ideas; e.g., Heyerdahl & Ferdon 1961). They were completed in the gallery they were carved in, or moved out of their gallery by a few meters or less, and then abandoned.

4. Another group of moai, all on the basically modern weathered talus slope surface of the quarry, and the movement of these was apparently arrested while being transported down the slope or entirely out of their galleries. These number at least 13 on the outer slope quarries of Rano Raraku and include at least 3 more on the inner slope quarries.

5. Another group of moai, again all on the surface around the base of the quarry area, that seem to have already been in the process of moving towards their respective roads.

6. A large group of moai, at least 47 or 48 in number, were left standing on or beside the moai roads built to move them to their respective ahu.

7. Then there are those remaining moai which made it to the 133 moai-bearing ahu (Van Tilburg 1994), virtually all over the island, and while at one time were standing, all of which were toppled over by about 1835. They all had eye sockets carved in them (see below).

8. Lastly, there are three ahu which have fallen moai on them that do not have eye sockets carved into them. It appears in the historical literature (Routlege 1919) that eyes were carved in them only after they were standing on the ahu and ceremonially accepted. These three ahu are Ahu Tetenga on the southeast coast; an unnamed ahu about 2 km inland from the coast along the east edge of the arroyo just northeast from Vaiteka; and finally, another unnamed inland ahu about 2 km inland from the eastern part of the north coast.

The significance of this classification of the contexts of the carved moai leads to a somewhat backward series of conclusions:

First and rather extensively, there seems to have been a “free-fall” in the island's prehistoric collapse, at least archeologically. This might include the last stage of collapse, where transportation of all moai stopped abruptly — potentially those remaining on the road, those in process of being lowered from the quarry, and those fallen on the surface...
slopes of Rano Raraku, either outside the crater or within.

Secondly, modern observations strongly suggest that the collapse was sudden given the three *ahu* whose *moai* do not have carved eye sockets. In Ahu Tetenga, for example, those fallen *moai* might represent a catastrophe during construction of the *ahu* and erection of the *moai*. I wonder sometimes if the failure to erect the second or third largest *moai* on the entire island had a social impact on the islanders attempting to move and erect other *moai*. On the other two *ahu* where *moai* lack carved eye sockets, abandonment clearly occurred after the statues were erected and after they had fallen. Again the fact that there are only two of these suggests they were caught within the sudden social and/or religious transition.

I wonder, and this is pure speculation, if the embedded slope *moai* of both the inner and outer slopes of Rano Raraku, were *moai* that had been commissioned by people who did not have, or were not permitted to have, the cultural or other resources to ever move the *moai* to an *ahu*. At the very least, these are *moai* intended to be where they are. And I am not alone in this interpretation. Such a situation would represent a time when people on the island knew resources (in this case, trees) were limited but the people were powerless to utilize them in whatever limited form they existed. They could feed carvers, of course. And, at the same time, they wished their lineage to be represented in a Polynesian variation on a standing ancestral museum, the anthropologic premier classic ancestral cult, and that is why they differ significantly from both the abandoned *road* *moai* and those which finally arrived on the *ahu*. They differ particularly in that the "*road* *moai*" (which is to say, most of them) were carved with sufficient strength in their necks to support the topknots. Very few are so thin as the Rano Raraku slope *moai*. And, of course, there are the *pukao* waiting at the Puna Pau topknot quarry for transport to be placed separately on stronger *moai* at unknown *ahu* destinations. I suspect these all belong to *moai* already on the road. Would you like to match them?

Virtually all of the Rano Raraku surface "down-slope *moai*", as I call them, are much smaller than those embedded in the slope. This suggests their resources, or the lineage's right to use them, might have been gradually limited through time, and so moving smaller *moai* was more economically feasible. Ahu Nau Nau, whose *moai* fell in windblown sand that surrounded the central platform at the time of its destruction, at least preserved the eyes of the fallen statue, and may be one of the most recently built *ahu* prior to the "collapse". We need dates and excavation reports on that *ahu*. Note that the Ahu Nau Nau *moai* are the smallest of all the reconstructed *ahu* to date and they have *pukao*.

I also want to mention something about the circumstance of the superposition of semi-pyramidal *ahu* over classic *ahu*. We have all kinds of similar analogies (or "homologies", if you will) to what I’m about to suggest. And all of this is only just an idea. In Mesopotamia, when the inhabitants of the cities of Sumer conquered their neighboring territories, they placed their new ziggurats and their new gods upon them. And we can see this process continuing over a 2,000-year period from the cities of Sumer up through the culture of Babylon. The religion of conquest reigned supreme. If you look at Cortez marching in on top of the Aztec, within two years you had Catholic churches going in next to or over the top of the Aztec temple bases. Archaeologically, a revolution at the temple level. If you look at Pizzaro literally going through the Inca, within about five years, you have Catholic churches built either over the top of the temple bases or next door to them. Archaeologically, a revolution at the temple level.

I sometimes wonder if there weren't two prehistoric invasions on Easter Island as postulated in their legends, and this is because there is such an abrupt transition of semi-pyramidal *ahu* over the older classic *ahu*, with slow prehistoric and historic toppling of the *moai*. And yet, because of the semi-pyramidal architecture and it's brand-new funerary pattern of whole burials (a new structure unknown anywhere else in the Pacific), I’m only — only — tossing out an idea ... that the revolution might have been home-grown, possibly as a forced result of "no more resources", or alternatively, the result of a new migration of Marquesans, whose notions of burial patterns had changed. Are we looking at an archaeologic syncretism of religious structures? And subsequent mythological re-adjustment to both social conditions and geography? I haven't reached a conclusion yet.

So I leave it up to you: "What do you want the answer to be?"

**Notes**

1Sadly, in tour-guide jargon. Ahu Akivi has become, in just the last ten years, the location of the "seven brothers" who are looking to the west, from where the original islanders supposedly came. In some literature these seven statues have even been referred to as "seven kings" who are "looking out to sea in the direction whence they came". In reality, the *moai* on Ahu Akivi are overlooking the ceremonial plaza, which is somewhat larger than the size of a football field (European or American). No one seems to have bothered reading the report on the entire excavation of Ahu Akivi, by Mulloy and Figueroa (1978). All the *moai* on an *ahu* anywhere on the island share one among many common traits: They all face the plaza, regardless of whether or not they are on the coast or are inland. One big inland *ahu* at the end of our surveyed north
road, had nine *moai*, all under 12 tons, looking *inland over* its plaza, even though it is 3 km from the shore.

2 Or what might be called "priestly blackbirding"?

3 I am not counting, incidentally, the keeled *moai* amongst the 13.

4 Routledge's observation of the number and placement of statues on the interior and exterior of Rano Raraku inspired her impression that at least some were "intended to remain *in situ*" (p. 189). Similarly, Van Tilburg (1994) asserted more forcefully that "It is ... beyond doubt that the numbers and sizes of most of [the statues in Rano Raraku] could not have been accommodated on the existing *ahu*. None of which are prepared to receive them. While there are many unanswered questions with regard to Rano Raraku, in my opinion some or all of the standing statues, especially those with perfunctory pavements, artefacts or burials associated, were never meant to be moved further" (p. 146).

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**References**


GIS Applications in Easter Island: Geodetic Adjustments and Survey Maps Accuracy

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Abstract - This paper discusses the variables and methodology involved in the geodetic transformations required for the adjustment of the Easter Island Archaeological Survey's cartography — until recently supposed to be Datum Easter Island 1967 — into the current world geodetic system, WGS84, base of the NAVSTARGPS system, and explores the limitations for archaeological fieldwork of the absolute method used by the "satellite navigators" in relation with the cartographic scales considered.

Recent research on Easter Island involving local surveys done with GPS technology, led some scholars to speculate that the maps of the island-wide archaeological surveys done in 1968 are inaccurate when data are compared with GPS-generated georeferenced locations of geographical features and archaeological features and sites.

This paper discusses the true nature of the problem, warns about indiscriminate use and current limitations of GPS surveying on the island without the control and corrections we analyse and — by validating the accuracy of the published survey cartography — proposes the procedures required to make such adjustments to be able to use the archaeological survey’s site locations maps.

The cartographic base on which the Easter Island Archaeological Survey\(^1\) is sustained comes from an analogical aerophotogrammetric restitution executed at 1:10,000 scale, carried out by SAP\(^2\) in July 1965, based on aerial photographs taken in January 1964 at an average scale of 1:17,500 (effective at sea level). Its georeference corresponds to an astronomical datum, supposedly established over the “1924 International Ellipsoid”. Such restitution, with a 5 m contour interval, constitutes a detailed registry of the morphological features and historical planimetric elements found on the island surface and, together with derived maps of scales 1:25,000 and 1:30,000 it was officially used until 2005. In order to work with sheets on a suitable scale for cartographic registry in areas with a high density of archaeological sites, the original charts 1:10,000 were enlarged by William Mulloy\(^3\) to a scale of 1:5,000, and the island was arbitrarily divided into 35 quadrangles covering 2.5 km east-west by 3 km north-south. Since 1977 the authors refined this cartography and, as the survey systematically covered the island, generated field-adjusted topographic maps and georeferenced the 35 quadrangles originally designed by Mulloy (Figure 1).

In its early stages, the archaeological survey used plane table surveying methods for the topographic registry of sites directly over the quadrangle sheets. Due to the low precision of the graphic determination of directions along with the negative effects of island weather conditions on the exposed paper dimensional stability, however plane table usage was replaced in 1978 by a faster and more accurate tachymetric method and frequent control measures were made to the planimetric and orographic elements depicted in the maps. Local "Connecting Traverses", used as the basis for the topographical surveys, always started and ended in points with known cartographic position. Control measures were made in the field to ensure that the archaeological sites would show in their true positions with respect to landscape features and elements depicted (natural and man-made features) in each of the quadrangle maps, as well as with true orientations and dimensions in the case of large structures (ahu), long stone alignments and intra-site features. In this way, any mapped site would be easily identified in the field by correctly reading the landscape features represented in its vicinity and its spatial relation to other sites. Several site relocation activities carried out in this traditional way in different parts of the island, at different times and for different purposes, have shown that, for trained people, this method always works. The only key is to know how to read a topographic map and use it for orientation in the field.

The development of new technologies, especially from the 1980s, totally changed not only the way maps are produced, but also how they are used and handled. Digital maps, in addition to computer aided design (CAD), geographic information system (GIS) developments, remote sensing / satellite imagery, global positioning systems, (GPS) and electronic developments for field measurements, dramatically improved accuracy and efficiency, extending mapping beyond its traditional boundaries.
In 1982 the SAP carried out a second aerophotogrammetric flight, with an average scale of 1:25,000 covering the whole island, 1:5,000 for Hanga Roa, the west coast and Rano Raraku, and 1:2,000 for the airport runway. The 1:25,000 scale aerial photographs were the basis for a new 1:5,000 map covering Hanga Roa and the modern agricultural areas surrounding the town, made at the Easter Island Studies Centre. The field network of control points for the aerophotogrammetric restitution was based on three permanent landmarks still in the area, all of them of known geodetic positions exactly the same reference system used by the 1965 restitution. Regardless of minor differences shown in the shape of some contour lines (mainly due to the action of different operators undertaking different restitution processes at different times), the resulting cartography matched accurately with the SAP charts.

Our first apprehensions about the georeference system of Easter Island cartography arose in 1992 while testing a Sony GPS receiver, to be used in the initial mapping of areas related to the research project and reconstruction of Ahu Tongariki. The positioning results, as given by the receiver for Easter Island datum, differed strongly from those obtained by direct cartographic reading — vector errors were larger than 150 m. However, aware of the limitations of an elementary GPS passive receiver, clock synchronization errors, pseudo-ranging method restrictions and the random error (Selective Availability) introduced intentionally by the United States Department of Defence, the fieldwork continued in the usual form and no further inquiries were made about these problems at that time. In 1993, the authors incorporated GIS technology to the Easter Island Archaeological Survey Program, with the sponsorship of ESRI Chile (at that time INCOM), through the ESRI software Arc/INFO PC and ArcView (Vargas et al. 1996; & 1998:147-152). Quadrangles were digitized, creating significant thematic layers (coverage), and all the information as georeferenced according to the geodetic information shown in the original charts. In 1998, in the course of a field season of the project "GIS Mapping Techniques on Easter Island" 5, georeferenced data for digital mapping of the prehistoric settlement in the environs of Ahu Tongariki and Ahu Tepeu were collected. Sponsored by ESRI, Trimble Navigation Ltd. and Topcon Corporation, we used DGPS post process methods with Trimble Pathfinder Receivers and took direct measures in the field with a Topcon Electronic Total Station. As NAVSTAR GPS depicts Earth locations on the "World Geodetic System 1984" (WGS 84), which differs in size and position from any other geodetic datum defined locally for mapping, a coordinates transformation process had to be done for each position in order to fit with the local cartography (Figure 2).
This was solved internally by the GPS software, selecting UTM coordinates on the predefined "Datum Easter Island 1967" as the desired output format. However, this resulted in great displacement, of about 160 m, for all points at Ahu Tongariki and Tepeu, evidencing an error in the identification of the target datum, and consequently in the parameters used for the transformation process (see Figure 3).

Transformed (target) positions laid almost 150 m east and about 70 m south of its true locations on the archaeological map, defining a rhumb line near N64°W (transformed-towards-mapped positions) and a separation vector of about 160 m. The apparent displacement for a point without performing any kind of transformation between both datums is about 295 m, in a rhumb line near S81°W (WGS 84-towards-mapped positions) (Figures 4 and 5).
Figure 4. One island, to geodetic, and cartographic positions.

Figure 5. Enlargement of an area of Figure 4 showing magnitude and relative orientation of mean displacement on the north coast.
The international geodetic registry only briefs for the zone the datum known as "Easter Island 1967", with an astronomical origin associated with the "1924 International Ellipsoid", and almost all geodetic applications and GPS equipment have built-in values that take into account the existing displacement between the center of this local datum and WGS 84. The mentioned registry only briefs three translation parameters (dX=211, dY=147, dZ=11), so the coordinate transformation process is accomplished by means of the simplified method of Molodensky, with an uncertainty of 25 m for each of the resulting Earth-centered Cartesian coordinates. The other values (rotation angles for the three Cartesian axes and a scale factor) needed to perform a more precise Helmert (Bursa-Wolf) seven parameters transformation (Figure 6), are not available for the "Easter Island 1967" datum. In any case this would not solve the problem because we are dealing with a completely different local datum.

The correct way to derive at least seven parameters needed to perform an analytical datum shift that will place the maps coinciding with the WGS 84 frame, starts by collecting precise DGPS-WGS 84 positions for a number of landmarks well distributed over the island, and with known precise coordinates for the local datum on which the mapping was georeferenced. Unfortunately, as we realized during the ground control fieldwork for the aerophotogrammetric restitution in 1982, most of these old landmarks have been destroyed, and there are no vestiges of their precise locations. Finding some landmarks could solve the problem in an analytical way, for we know the local geodetic coordinates of a few of them and more fieldwork is needed to solve this problem.

On the other hand, a preliminary cartographic derivation of seven parameters, carried out by the authors based on ten carefully selected horizontal control points (nine along the coastal perimeter and one at the center of the island) gave, through a Helmert transformation, an average deviation of less than 10 m at the control points, except for the eastern headland of the island (Poike) that showed a 40 m deviation. The coordinates for each selected control point were obtained by digital means in UTM format; identifying them in both the original cartography of 1965 and the new digital restitution georeferenced on WGS 84, made by the IGM in 2005, with the same aerial photographs taken by SAP in 1982 (see the island silhouettes in Figures 4 and 5).

With these results in mind, and supported by the fact that the archaeological information surveyed in each quadrangle is geometrically consistent and linked by "Connecting Traverses" to permanent geographic and manmade features, present in the field and in the original maps, it was advisable to perform a differential transformation based in the digital correlation between homologous elements in both cartographies (1965 and 2005). In this way, blocks of archaeological features (sometimes approaching the size of a survey quadrangle or 6 to 7.5 square kilometers) are being moved to the new map locations, tied to homologous planimetric and geographic elements, thus assuring the preservation of its spatial geometry and correct geo-reference in datum WGS 84. The next step is to get DGPS positions over a number of well-distributed points in each quadrangle / block, in order to evaluate the results.
Conclusions

Independently of the low precision inherent to a cartographic reading of coordinates, the result of our research and analysis confirms that the datum "Easter Island 1967", considered for datum shift in the GPS equipments and related software is not the one employed in the construction of the maps used for the Easter Island Archaeological Survey. Therefore, researchers unaware of this crucial fact are using their GPS adjusted to the wrong Easter Island 1967 datum that is not the base of the SAP cartography used by the survey and are thus obtaining results with large unacceptable errors (incorrect positions of up to 160 m).

The situation we detected at Poike needs further study. The 40 m deviation, shown at the selected control point in that area, may mean that some amount of rotation or displacement could be affecting the whole peninsula (or part of it), in relation to the rest of the island, where much better results were obtained. The cartographic transformations needed there (or alternatively transformations needed in the area), will need a single block adjustment of all the archaeological sites locations in the four quadrangles that cover Poike. All these sites are topographically tied to a main traverse, with extensions covering the entire peninsula.

Thus, considering:

a) that the original goals of the Easter Island Archaeological Survey were to identify, record and map the archaeological landscape of the island and other relevant aspects of the environment;

b) that for this purpose the original restitution of the island was enlarged twice its size;

c) that the size of a single point needed to symbolize an archaeological site covers approximately an area of 15 m²;

d) the ± 0.02 in. (± 0.5 mm = ± 2.5 m at 1:5000 scale) accepted as cartographic tolerance for 90% of horizontal positions by the USA National Map Accuracy Standards (NMAS);

e) the dimensional instability of paper maps due to changing conditions of humidity and temperature; and

f) the fact that the absolute method for calculating positions by pseudo-ranging, used in nearly all the GPS "general purpose handheld" receivers, cannot model or eliminate the negative effects of the ionosphere, troposphere, etc., and therefore precision of the calculated positions cannot be better than ± 10 or ± 15 m.

It is clear that the differential cartographic transformation that we are carrying out to place the Easter Island Archaeological Survey maps into the WGS 84 Reference System, ensures that mapped positions will match the coordinates given by general handheld receivers, within a range covered by the resolution of this kind of equipment and by the limitations inherent to map reading procedures.

The seven Helmert parameters determined by our cartographic approach may also yield precision within this sort of practical tolerance in the transformation of mapped sites coordinates to datum WGS 84. As mentioned above, another approach is needed for the Poike region which could even yield a different set of parameters for that area.

Notes


2 Servicio Aerofotogrametrico de la Fuerza Aerea de Chile (SAP).


4 This was made possible thanks to the financial support of Joan Seaver, PhD, California.

5 Carried out by the authors and A. Huntley from Saddleback College, California.
6 A datum transformation method that only considers the 3D shifts between the centres of the involved ellipsoids.

7 At SAP no one seems to know about this datum except for its astronomical origin and its association with the International Ellipsoid 1924 but, certainly, it is not the "Easter Island 1967".

8 Institute Geografico Militar (Chile).

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References


Chapter 2

Easter Island Paleo-Botany and Landscape Archaeology
The Vanished Palm Trees of Easter Island: New Radiocarbon and Phytolith Data

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Abstract - Easter Island was formerly covered with palm trees that constituted one of the most distinctive attributes of the landscape. Twelve $^{14}$C dates were obtained from fragments of wood and of nuts discovered in archaeological sites and in cracks in cliffs. These dates, which cover a period between AD 1210 and AD 1440, are mainly centred around the 14th century which suggests that the population of palm trees was still important at this time. The lack of dates after AD 1450 suggests that the palm forest greatly decreased during the 15th century, without disappearing completely, as proved by European accounts. The existence of palm trees on Rapa Nui is confirmed by the presence of numerous palm phytoliths in archaeological sediments. Phytoliths are biogenic opal particles produced by plants. Because of their chemical composition, they are usually well preserved even in sediments unfavourable to the preservation of organic remains. Palm (Arecaceae) produce great quantities of phytoliths, including a very characteristic “spherical echinate” morphotype. The morphometric analysis of that kind of phytolith made it possible to improve our knowledge of Paschalococos disperta, the extinct Rapanui palm. The statistical comparison of fossil Easter Island palm phytoliths with phytoliths extracted from various palm species (Jubaea chilensis, Juania australis, Cocos nucifera, various species of Pritchardia) showed that phytolith assemblages produced by Jubaea chilensis are close to those from Easter Island sediments. Nevertheless, because of the differences between the two pools of data, we have put forward the hypothesis that more than one species grew on the Island. Moreover, phytolith morphotypes sometimes vary from one part of the plant to another. We investigated the differences between trunk and leaf phytolith spectra, in order to determine which parts of plants are found in archaeological deposits. In addition to paleoethnobotanical implications, the characterisation of leaves versus stem (which is currently impossible by wood anatomy criteria) will improve the interpretation of radiocarbon data. Indeed, if the trunk is a long-lasting organ that can sometimes be several centuries old, leaves represent a shorter period, and thus are more accurate for radiocarbon dating.

Introduction

Formerly, palm trees constituted a major element of the landscape of Easter Island and their disappearance certainly had a considerable impact on the local ecosystem and the daily life of the Rapanui. Although it is obvious that the remains of pollen, nuts and charcoal found on the island are those of palm trees, further identification is difficult. Pollen and nut morphologies suggest that these palm trees were a close relative of Jubaea chilensis, from the Arecaceae family (Coccoceae, Butiineae) (Grau 2000:161), a large sugar palm from Chile. Nevertheless, some morphometrical differences between fossil nuts and Jubaea nuts have led botanists to create a special taxon, called Paschalococos disperta (Dransfield et al. 1984:750; Zizka 1991:65). Probably endemic to Rapa Nui, this Pascauan sugar palm could reach a height of 20 m with a diameter of about 1.50 m; It could produce approximately 400 litres of sweet sap and 800 to 1000 small coco nuts which presented, doubtlessly, an economic interest (Orliac 1993:407). Its characteristic silhouette, with its trunk swollen into the shape of a bottle, is carved on the Kohau Rongo Rongo tablet Atua Mata Riri which is associated to a song about the origin of Rapanui vegetation (Orliac 1993:406).

Surprisingly, the date of the disappearance and the identification of the components of this palm population remain undetermined. Radiocarbon and phytolith analyses contribute some new data on this subject.
Radiocarbon data

Available palm macro-remains are fossils nuts, discovered in caves or in clefts of cliffs, and nuts or stipe fragments, identified in archaeological charcoal assemblages (Figure 1).

![Figure 1. Locations of sites where vestiges of palm trees were discovered.](image)

Dating of Nuts

Analyses of charcoal from domestic ovens (*umu*) have revealed the presence of several hundred fragments of palm nuts that could be dated. Our first dating was obtained in 1988, from two fragments of nut discovered by M. Orliac, at Hanga te Pahu, at the bottom of an oven without stones, under 60 cm of sediments (Orliac, Arnold, Valladas 1990:217). The calibrated dates were AD 1212-1430 and AD 1300-1640 (2 sigma).

Numerous nut fragments were also collected during our excavations at Maunga Puhi Puhi and Te Aheru in 2000 (Orliac C. & Orliac M., 2001). At Maunga Puhi Puhi, fragments of nuts from a pit containing combustion residues located near a large house delimited by two rows of huge stones (some of them carved with representations of sea animals) (Orliac 2001:9-11) were dated (2 sigma) from Cal. AD 1320-1350 and 1390-1440 at a depth of 45-47 cm deep, and from Cal. AD 1270-1320 and 1340-1390 at a depth of 50-58 cm deep (Orliac 2001:9-11). At Te Aheru 187 nut fragments discovered in the fill and close to a small stone platform were dated (2 sigma) from Cal. AD 1280-1400 and Cal. AD 1290-1420 (Orliac 2001:8).

In 2000, we also discovered 3 fossil nuts, off-archaeological context, one in a cave on the Poike peninsula and two others in clefts in the Te Pora cliff, on the west coast. The former were dated from Cal. AD 1160-1270, and the latter from Cal. AD 1020-1200 and 1230-1300 (2 sigma). These radiocarbon dates were completed by the dating of a nut fragment found in 1934-35 by Henri Lavachery, which was entrusted to us by the Brussels Museum of Art and History. That remain was dated from Cal. AD 1240-1300 (2 sigma).

Few other published dates can be added to those carried out on our own findings or on museum material. The fossil nuts discovered in a cave near Ana O Keke (Poike peninsula) during a speleological survey in 1983 by J. M. Grould et A. Gauthier and investigated by J. Dransfield dated from Cal. AD 1040 to 1280 (2 sigma) (Dransfield et al. 1984: 750). A. Mieth, H.-R. Bork and I. Feesser (2002:92) published a date of Cal. AD 1256-
1299 (2 sigma) for nuts discovered also at Poike; in the same area, D. Mann et alii. dates 2 fragments of nuts from Cal. AD 1290 to 1400 and from Cal. AD 1320 to 1440 (Mann et al. table 1, in press). More recently, during the VII international conference on Easter Island and the Pacific, P. Wallin presented 3 datings of fossils nuts from Anakena; two of them came « from a dark brown clayey soil at the bottom of a trench…where they might have been mixed…during the construction of Ahu Nau Nau I »; they were dated, at 2 sigma, to Cal. AD 1326-1448. « The third nut shell indicates the early use phase of Ahu Nau Nau I, since it was found on top of the plaza floor and was dated at 2 sigma to Cal. AD 1400-1452 » (Wallin, Martisson-Wallin and Possnert 2010 this volume).

**Stipe Dating**

Palm “wood” is scarcely identified in charcoal assemblages. A fragment was found (Orliac 2002) in a cremation area, delimited by a stony row and the back wall of the *ahu* O’Rongo, in a place containing a large quantity of burned human bones. This structure was dated with 95 % of reliability, between Cal. AD 1270 and 1400 (Huyge & Cauwe 2002:15). Rare sub-fossil trunks are known on the island. M. Orliac discovered a burnt one in 2004, in a natural section, south-east of Poike that dates from Cal. AD 1450 to 1640 (2 sigma) (Orliac C & Orliac M, 2004:31), not far from an other stump dated by A. Mieth and H.-R. Bork from Cal. AD 1309 to 1416 (2 sigma) (Mieth & Bork 2003:353-36).

**Discussion**

These dates of Rapa Nui palm remains are currently available (Figure 2).

---

**Figure 2.** Dates from nuts and trunks of palm trees (2 sigma). 1. Palm wood fragments, 2. Nut shell fragments from archaeological contexts, 3. Nut shell fragments discovered off-archaeological sites.
It appears that:

- the majority of nuts or nut fragments from archaeological contexts date from c. Cal. AD 1250 to 1450.
- the nuts discovered off-archaeological sites are dated mainly from c. Cal. AD 1040 to 1300.
- palm « wood » charcoals date from Cal. AD 1270 to 1640.

The majority of these dates are centred on the 14th century. Taking into account the geographical diversity of the samples, this could indicate that the population of palm trees was still large at this time, when human settlement was already well-established, which is also proved by numerous other dates from archaeological sites.

The lack of dates before the 11th century is surprising. The dated remains come from habitation sites and caves where a rat, Rattus exulans, introduced on the island by the first immigrants, had accumulated them. Thus, all these vestiges are evidence for the human presence on this isolated island; they could indicate that the colonization of Rapa Nui occurred later than predicted, maybe during the 10th or the 11th century.

That synthesis of radiocarbon data also emphasizes the quasi-absence of dates after AD 1450. This suggests that the population of palm trees greatly decreased during the 15th century, but without disappearing completely, as described by the accounts of Roggeveen (Roggeveen 1970:97, Bouman (Bouman 1994:96), Captain Arup and Palmer (Palmer 1870:168).

**Remarks**

Nuts are the most accurate material for radiocarbon analysis. If the vanished palm from Easter Island was comparable to Jubaea chilensis, it could have been a long-living tree. Thus, if the dates obtained on nuts or nut fragments are accurate, those from stipe can concern several-century-old trees which prevents further discussion about the decline of the forest. Rather than trunk “wood”, leaves rachis could have been used for fuel by the Rapanui; the use of that kind of lignified axes in ovens is well-known in various Polynesian islands. These are short-lived deciduous organs, whose charcoal is accurate for dating. Unfortunately, wood anatomy does not allow for distinguishing trunk wood from leaves rachis. The achievement of such a distinction could improve the interpretation of radiocarbon data.

**Phytolith Data**

Phytoliths are biogenic silica opal particles that are usually well-preserved in sediments. The plant from the palm family (*Arecaceae*) produces a characteristic morphotype called « globular echinate » (cf. ICPN’s recommendations, Madella *et al.* 2005). That morphotype is present in large amount in sediments from Easter Island (Orliac & Delhon 2002, 2003; Horrocks & Wozniak 2008) because of the scarcity of macroremains such as nuts or charcoal, phytoliths are the most abundant and the best preserved witnesses of the Rapa Nui palm palaeopopulation.

« Spherical echinate » morphotype is characteristic of the whole palm family. Nevertheless, it is abundant enough on Easter Island to allow a morphometric analysis in order to try to improve the determination (Figure 3).

Our first phytolith analyses were carried out in 2002-2003, following the discovery of several palm phytoliths on slides prepared in order to study nanofossils (Janin in Orliac & Orliac 2001). It was the opportunity to build a first reference system of palm phytoliths involving several Jubaea chilensis, among which included 5 several-hundred-years old trees and a sample of Juania australis. Only the trunks were investigated for this first study. Fossil phytoliths were observed on the slides prepared for nanofossil analysis, without any specific preparation, of sediments from Te Peu, Hanga Hoonu and Aheru. In spite of a relatively small reference collection and of the absence of specific phytolith extraction from sediment, morphometric data showed that most of the phytoliths from archaeological samples fit with the variation range of Jubaea phytolith. Nevertheless, an appreciable amount of Easter Island phytolith is over that variation range. This fact suggests that another palm species could have grown on the island at the same time as *Paschalococos*. The input of data from Juania australis failed to confirm that hypothesis (Orliac & Delhon 2002, 2003).
From these preliminary data, and because many questions still remained after macroremains studies, we undertook new analyses in the framework of the CNRS program GDR-2834.

They aimed at:
- Refining the taxonomic attribution of the phytoliths that were over the variation range of Jubaea trunk phytoliths, hoping that it could help us to know if other palms than Paschalococos were present on the Easter Island; for that purpose, several other species were investigated.
- Going further in fossil phytoliths analyses; to that purpose, phytoliths were extracted from archaeological and off-site sediment.
- Testing the capacity of phytolith analysis to distinguish trunks from leaves.

**Material**

The analyses concern, on the one hand, a reference corpus, made of phytoliths extracted from fresh palm trees, and on the other hand phytolith assemblages extracted from archaeological and off-site sediment from Easter Island. Data from nanofossil slides have also been taken into account.

**Reference Corpus**

The collection consisting of several samples of Jubaea chilensis and one Juania australis was supplemented by samples of Cocos nucifera, Pritchardia pacifica et Pritchardia pericularum. In order to check if the different parts of the tree could be distinguished by phytolith analysis, we separated them before phytolith extraction. Trunks, leaves rachis, and in some cases leaflets, nuts and spathe were processed (table 1). We observed that neither nuts nor spathe contained phytolith.
Archaeological and Off-site Sediment

Phytolith extraction following the proper protocol of phytolith analysis was done on sediments from archaeological sites previously named and on off-archaeological site sediment from Poike and Orito. Both provided palm macroremains, a burnt stem at Poike and root prints at Orito. The archaeological site of Aheru also provided macro-remains: fragments of nuts were identified in the oven, and root prints are visible close to the site. The data previously obtained from nanofossil slides were also included in the study (Table 2).

### Table 1. Composition of the Reference System.

<table>
<thead>
<tr>
<th>reference</th>
<th>species</th>
<th>sample</th>
<th>plant part</th>
<th>origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>A-5007</td>
<td>stipe</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>A-5007</td>
<td>leaves</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>A-5007</td>
<td>nut</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>G29-030</td>
<td>stipe</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>G29-030</td>
<td>leaves</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>G29-030</td>
<td>nut</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>not communicated</td>
<td>spathe</td>
<td>Antilles (France)</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>Orlic Collection</td>
<td>stipe</td>
<td>Chile</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2002</td>
<td><em>Jubaea chilensis</em></td>
<td>Orlic Collection</td>
<td>leaves</td>
<td>Chile</td>
</tr>
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<td>Orlic Collection</td>
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<td>Algarrobo</td>
<td>stipe</td>
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</tr>
<tr>
<td>Orlic &amp; Dellion 2003</td>
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<td>La Serrena</td>
<td>stipe</td>
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<tr>
<td>Orlic &amp; Dellion 2003</td>
<td><em>Jubaea chilensis</em></td>
<td>Limahuida</td>
<td>stipe</td>
<td>Chile</td>
</tr>
<tr>
<td>Orlic &amp; Dellion 2003</td>
<td><em>Jubaea chilensis</em></td>
<td>Cocalan*</td>
<td>stipe</td>
<td>Chile</td>
</tr>
<tr>
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<td>Candelaria*</td>
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<tr>
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<td>leaf rachis</td>
<td>Menton (France)</td>
</tr>
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<td>leaflet</td>
<td>Menton (France)</td>
</tr>
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<td>Refuca</td>
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<td>Chile</td>
</tr>
<tr>
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<td>stipe</td>
<td>Tahiti</td>
</tr>
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<td>not communicated</td>
<td>leaf rachis</td>
<td>Tahiti</td>
</tr>
<tr>
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<td><em>Cocos nucifera</em></td>
<td>not communicated</td>
<td>leaflet</td>
<td>Tahiti</td>
</tr>
<tr>
<td>this study</td>
<td><em>Pritchardia pacifica</em></td>
<td>not communicated</td>
<td>stipe</td>
<td>Tahiti</td>
</tr>
<tr>
<td>this study</td>
<td><em>Pritchardia periculorum</em></td>
<td>not communicated</td>
<td>leaflet</td>
<td>Tahiti</td>
</tr>
<tr>
<td>this study</td>
<td><em>Pritchardia periculorum</em></td>
<td>not communicate</td>
<td>leaf rachis</td>
<td>Tahiti</td>
</tr>
</tbody>
</table>

1. sample provided by C. Ducastillon and C. Bischof, Jardin Botanique d’Antilles (France)
2. sample provided by J. Grau, Ecology Institute of Santiago (Chile)
3. sample provided by the gardens of Menton council (France)
4. sample provided by C. Orlic
5. sample provided by J. Pirovano
6. sample provided by J-F Butaud

* Samples from trees of more than 400 years old (J. Grau, personal communication), including "La capitana" from Cocalan, supposed to be the oldest palm of Chile (~700 years)

### Table 2. Sediment Samples.

<table>
<thead>
<tr>
<th>reference</th>
<th>archaeologica/off-site</th>
<th>site</th>
<th>sample</th>
<th>context</th>
<th>palm evidence</th>
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</thead>
<tbody>
<tr>
<td>this study</td>
<td>archaeological</td>
<td>Aheru</td>
<td>5a</td>
<td>archaeological section</td>
<td>root prints</td>
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<td>archaeological</td>
<td>Te Pea</td>
<td>55-30/40 cm</td>
<td>oven bottom</td>
<td>0</td>
</tr>
<tr>
<td>this study</td>
<td>archaeological</td>
<td>Te Pea</td>
<td>55-40/45 cm</td>
<td>oven bottom</td>
<td>0</td>
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<td>Te Pea</td>
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<td>oven bottom</td>
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<td>this study</td>
<td>off-site</td>
<td>Polio south</td>
<td>Polio south</td>
<td>natural section</td>
<td>burnt trunk</td>
</tr>
<tr>
<td>this study</td>
<td>off-site</td>
<td>Orito</td>
<td>Orito</td>
<td>quarry</td>
<td>prints</td>
</tr>
</tbody>
</table>

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Methods

Phytolith Extraction

Phytolith extraction is done by dry-ashing (carbonisation) of fresh vegetal tissues and from wet-ashing (physico-chemical reactions) of sediments. Fresh palm samples are heated in a muffle furnace at 400°C for 2 to 4 hours, until burnt to a cinder. Ashes are rinsed with hydrochloric acid (HCl, 10%) and with water, and then mounted on microscope slides.

A few grams (1 to 5) of sediment are mixed with hydrochloric acid (HCl, 30%) in order to destroy carbonates. Sand and other coarse particles are eliminated through sifting (mesh: 300µm), and organic matter is solved into hot oxygen peroxide (H2O2, 30% vol., 90-100°C). Clays are eliminated by decantation cycles, and phytoliths are finally concentrated on a heavy liquor (ZnBr2/HCl, d=2.35). The residue is rinsed, dried and mounted on a microscope slide.

Morphometric Analysis

The observation of the slides under a light microscope at magnification 600 to 1000 times enables the identification of many different phytolith morphotypes. Among these, we focused on « globular echinate » to carry out a morphometrical analysis (Figure 4).

Morphometric data were measured or calculated for 50 to 100 phytoliths of each reference slide and at least 20 phytoliths from each sedimentary sample (according to the slides richness), for a total of more than 900 pools of “reference” measures and more than 200 pools of “fossil” measures.

<table>
<thead>
<tr>
<th>species</th>
<th>sample</th>
<th>plant part</th>
<th>genus</th>
<th>globular echinate</th>
<th>other morphotypes</th>
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</thead>
<tbody>
<tr>
<td><em>Jubaea chilensis</em></td>
<td>A-997</td>
<td>stipe</td>
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<td></td>
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<td></td>
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<td>A-997</td>
<td>nuts</td>
<td>Amnes</td>
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<td><em>Jubaea chilensis</em></td>
<td>QF-035</td>
<td>stipe</td>
<td>Amnes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Jubaea chilensis</em></td>
<td>QF-035</td>
<td>leaves</td>
<td>Amnes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cocos nucifera</em></td>
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<td>nuts</td>
<td>Amnes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cocos nucifera</em></td>
<td>QF-035</td>
<td>leaves</td>
<td>Amnes</td>
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<tr>
<td><em>Jubaea chilensis</em></td>
<td>QF-035</td>
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<td><em>Jubaea chilensis</em></td>
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<td>QF-035</td>
<td>leaves</td>
<td>Amnes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results

Reference System

All the samples from stipe (trunk) and from leaves provided phytoliths. On the contrary, nuts (Jubaea chilensis and Cocos nucifera) and spathe (Jubaea chilensis) were sterile in biogenic opal. It appears that phytolith production varies from one part of the plant to another (Figure 4): The “globular echinate” morphotype is most...
of all characteristic of the ligneous parts of the tree: bark, trunk and, to a lesser extent, leaves rachis. It is rare or missing in the leaflets and its shape is often altered towards less circular and less ornamented and/or smaller particles. Sometimes, nearly polyhedral forms dominate leaf assemblages. Moreover, the presence of a second type of particle, very frequent in the analysed samples, although it has never been described to our knowledge, must be noticed. These are round, spherical to flat (“token shaped”), with a smooth surface and an internal cavity, often bilobate (Figure 4). That morphotype, which should be named “globular to tabular orbicular with bilobate cavity” according to the ICPN (Madella et al. 2005), is much more frequent in leaves than in trunks and its preservation in sediment is still unknown. Spherical rugose (or “globular granulate”) morphotypes, often thought to be characteristic of dicotyledones, have also been observed.

The morphometrical analysis of palm phytoliths shows important variations of size and shape parameters from one species to another and from one organ to another (Table 3). Our reference system shows that the morphometric spectra of *Jubaea chilensis* trunks are obviously different from those of other species, except *Pritchardia pacifica* whose phytoliths are on average as big as those from *Jubaea*.

Concerning *Jubaea chilensis* “wood”, in spite of their relative homogeneity, the values cluster in two pools. The first one corresponds to the oldest Chilean trees, which seem to produce bigger phytoliths. The second one is made of the trees from the botanical garden of Antibes and the younger Chilean one which globally produces smaller opal particles.

The different organs have shown varying phytolith spectra; when present, spherical echinate phytolith is smaller in the leaves than in the trunk of the same species.

Morphometrical data (class-coded) were the subject of a correspondence analysis (Figure 5-A). Axis 1 sets trunk assemblages apart from leaves. *Jubaea* trunks are grouped together and the oldest specimens make a very homogenous cluster. It is notable that the trunk from coconut (and to a lesser extent from *Juanita*) shows phytolith spectra resembling those from *Jubaea* and *Pritchardia*’s leaves. Axes 2 and 3 isolate “old” Chilean *Jubaea* from younger ones and from other species, which suggests that phytolith production evolves during the tree’s life-time.

### Table 3. Descriptive Statistics of Selected Morphometrical Parameters in Reference Samples.

<table>
<thead>
<tr>
<th>species</th>
<th>sample name</th>
<th>Dmax (um)</th>
<th>size index</th>
<th>spine density index</th>
<th>N</th>
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</thead>
<tbody>
<tr>
<td><em>Jubaea chilensis</em></td>
<td>Antibes-A</td>
<td>12±4</td>
<td>121±50</td>
<td>11±4</td>
<td>100</td>
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<tr>
<td><em>Jubaea chilensis</em></td>
<td>Antibes-G</td>
<td>12±3</td>
<td>116±48</td>
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<td>100</td>
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<tr>
<td><em>Jubaea chilensis</em></td>
<td>Chile 2002</td>
<td>11±2</td>
<td>109±40</td>
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<td>100</td>
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<tr>
<td><em>Jubaea chilensis</em></td>
<td>Algarrobo</td>
<td>16±3</td>
<td>231±118</td>
<td>7±2</td>
<td>50</td>
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<td><em>Jubaea chilensis</em></td>
<td>La Serena</td>
<td>17±3</td>
<td>242±73</td>
<td>6±2</td>
<td>50</td>
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<tr>
<td><em>Jubaea chilensis</em></td>
<td>Limahuida</td>
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<td>258±108</td>
<td>5±2</td>
<td>50</td>
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<td><em>Jubaea chilensis</em></td>
<td>Cocalan</td>
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<td>13±2</td>
<td>132±38</td>
<td>10±2</td>
<td>50</td>
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<td>10±2</td>
<td>89±29</td>
<td>13±5</td>
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<td>Coco trunk</td>
<td>9±1</td>
<td>70±17</td>
<td>14±4</td>
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</tr>
<tr>
<td><em>Jubaea chilensis</em></td>
<td><em>Jubaea rachis</em></td>
<td>9±1</td>
<td>69±18</td>
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<td>145±54</td>
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<td>Pperi. leaflets</td>
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<td>102±31</td>
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<td>Pperi. rachis</td>
<td>7±1</td>
<td>50±14</td>
<td>14±3</td>
<td>50</td>
</tr>
</tbody>
</table>
Fossil Assemblages

All the processed samples showed palm phytoliths, except the one from Orito (Figure 6). The presence of palm at Orito is recorded in the form of root prints. Nevertheless, the sediment didn’t provide enough phytolith to carry out an analysis. The weakness of phytolith signal can be explained either by a bad preservation of these particles in that specific context (maybe due to leaching), or by the sampling of levels deeper than the phytoliths deposition layers. Phytolith input in soils mainly results from the decomposition of aerial organs on the surface. The sampling of layers located under the palaeo-surface can be detrimental to phytolith analysis. The scarcity of palm phytoliths in Orito sample fits the results obtained from soils of the Antibes botanical garden (Orliac & Delhon 2002, 2003). Because of frequent soil cleanings, the accumulation of phytolith under the palm was nearly nil. For different reasons, the phytolith accumulation in the deep sediment of Orito and in the anthropic one from the botanical garden of Antibes was not sufficient to allow a phytolith analysis.
Table

<table>
<thead>
<tr>
<th>site</th>
<th>sample name</th>
<th>Dmax (µm)</th>
<th>Dmax - Dmin</th>
<th>spine density</th>
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<tbody>
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<td>Aheru</td>
<td>5a</td>
<td>14±3</td>
<td>180±70</td>
<td>6±2</td>
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<tr>
<td>Te Peu</td>
<td>S5-35/40 cm</td>
<td>14±4</td>
<td>180±74</td>
<td>5±2</td>
<td>25</td>
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<tr>
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<td>184±74</td>
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<td>25</td>
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<tr>
<td>Te Peu</td>
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<td>173±64</td>
<td>6±3</td>
<td>25</td>
</tr>
<tr>
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<td>107±46</td>
<td>12±4</td>
<td>38</td>
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<tr>
<td>Hanga Hoona</td>
<td>HH 45-47</td>
<td>12±3</td>
<td>126±58</td>
<td>11±5</td>
<td>23</td>
</tr>
<tr>
<td>Poike south</td>
<td>Poike south</td>
<td>15±3</td>
<td>199±88</td>
<td>6±3</td>
<td>20</td>
</tr>
<tr>
<td>Orito</td>
<td>Orito</td>
<td>15±3</td>
<td>199±88</td>
<td>6±3</td>
<td>20</td>
</tr>
</tbody>
</table>

Figure 6. Descriptive statistics and histograms of selected morphometrical parameters in the fossil samples, compared to the modern *Jubaea chilensis* sample.
The distribution of morphometrical data from sediment samples is close to that of Jubaea chilensis, except for the samples of the structure S1 from Te Peu and of Hanga Hoonu (Figure 6).

The input of fossil phytolith spectra as supplementary individuals in the correspondance analysis illustrates these similarities (Figure 5-B).

Samples from Poike and Aheru, as well as 3 samples out of 4 from Te Peu show same phytolith spectra as Jubaea trunks. On the contrary, those from Hanga Hoonu and from the structure S1 of Te Peu are markedly different. The first is akin to Jubaea trunks, especially the young trees from the botanical garden of Antibes and from the Orliac collection, but it also shows certain similarity with Pritchardia trunks (P. pericularum as well as P. pacifica). The second looks like Cocos and Juania trunks as well as the leaves assemblages, especially that of Jubaea chilensis leaf rachis.

**Discussion**

The results of the morphometrical analysis show that, in most cases, fossil phytolith assemblages from Easter Island are close to those produced in the trunks of *Jubaea chilensis*. Thus, it seems that *Paschalococos disperta*’s trunks are responsible for most of the phytoliths preserved in the rapanui sediments studied here. That interpretation based on morphometrical phytolith analysis is corroborated by the presence among these samples of that of Poike, which corresponds to the sediment surrounding a charred *Paschalococos* stem.

![Figure 7. Cluster analysis dendrogram (Pearson’s similarity index) of the studied “globular echinate” phytolith assemblages (morphometrical data, class-coded).](image)
Assemblages from the oldest trees of the reference system appear to be the closest to the fossil assemblages; in both cases, phytoliths are large-sized. More than the age of the trees, this fact is probably linked to the differential preservation of palm phytoliths in sediment, to the detriment of smallest particles (Albert et al. 2009).

Nevertheless, certain fossil assemblages obviously fall outside that general pattern: the attribution of samples from Hango Hoonu and from the structure 1 from Te Peu to *Paschalococos* trunks is problematic. The cluster analysis of the morphometrical data (Figure 7) confirms the close relation between most of the fossil assemblages and the oldest *Jubaea*. The sediment from Hanga Hoonu is clustered not only with several *Jubaea* (those from the Antibes and Orliac collections), but also with “wood” from other species: *Juania australis* and *Pritchardia pericularum*; the sample from the structure S1 of Te Peu is clustered with the leaves rachis of *Jubaea chilensis* and of *Pritchardia pericularum* and with coconut “wood”. Thus, these new analyses do not allow us to remove our doubts about the presence of another palm than *Paschalococos disperta* on the Island.

At Te Peu, the sediments were sampled in several ovens of various ages. S1, S2 and S3 date after AD 1650, but they are older than S5, which probably dates back to the 19th century. All of them provided numerous palm phytoliths. The possibility of the presence of palm on the Island when that oven was in use should be considered. But the sediment may have contained huge amounts of palm phytoliths, inherited from past vegetations. To favour one of these interpretations, it is necessary to know whether the phytoliths mainly come from the fuel used in the oven or from the sediment that filled it. Only coupled analyses of the infill and of the embanking sediment could help to solve that question.

The oven S1 has a peculiar phytolith spectrum that reminds one of coconut tree “wood” or, most probably, leaves rachis. That result evokes the use of palm as lighting fuel in Polynesian ovens (Orliac 2003).

**Conclusion and Perspectives**

The synthesis of available dates confirms that a palm, *Paschalococos disperta*, was common on the island at least until the 14th century. Morphometric analyses of phytoliths show that its closest modern relative is *Jubaea chilensis*. The question asked on the basis of the first phytolith analyses about the presence of another palm species (Orliac & Delhon 2002, 2003) remains unanswered.

Phytolith analysis allows us to identify trunk “wood” and rachis “wood”. Nevertheless, this cannot be done systematically with archaeological samples. The sediment phytoliths are a mixture of various plants and plant organs and, above all, differential preservation favours large particles to the detriment of small leaf phytoliths. Nevertheless, this is not the case for phytoliths embedded in fossil macroremains. Fragments of palm “wood” recovered from archaeological sites probably bear exactly the same phytolith assemblages as their fresh homologues. Thus, phytolith analysis of these macroremains prior to radiocarbon dating could tell if the dating is done with a fragment of trunk, (which is a perennial organ that can be several centuries older than the archaeological site it comes from), or with a fragment of rachis, which is a deciduous organ. This could be a way to improve dating, and thus to trace more precisely the history of the vegetation and of the human settlement on Rapanui.

Finally, the occurrence of many palm phytoliths in a recent structure, probably dating back to the 19th century, suggests either that palm populations were dense enough to put a huge quantity of phytoliths into the soils (in which case the phytoliths are older than the oven), or that palms were still present and used (at least in that oven) during the 19th century.

**Acknowledgments**

Many contributors enthusiastically took part to the gathering of reference palm samples: C. Ducatillon and C. Bresch (Botanical Garden of Antibes, France), Y. Monnier, professor in Museum National of Natural History (France) and the gardeners of the Exotic Botanical Garden of Menton (France), J. Florence (IRD, France), J.-F. Butaud (Tahiti), J. Grau (Ecology Institute, Santiago, Chile). That research was carried out with the assistance of the Ministry of Foreign Affairs and the GDR 2834 of National Center for Scientific Researches that respectively provided funding for $^{14}C$ dating and for a part of the phytolith analyses. We are also grateful to Paul Bahn and Claude Bec for their help in the translation of this article.
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References


The complete journal of Cornelius Boumann, Master of the ship Theinhoven, forming part of the fleet of Jacob Roggeveen, from March 31th to April 13th 1722, during their stay around Easter Island. 1994. Rapa Nui Journal, 8 (4): 95-100.


Plant Microfossil Analysis of Deposits from Te Niu, Rapa Nui, Demonstrates Forest Disruption c. AD 1300 and Subsequent Dryland Multi-Cropping

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Mark Horrocks  
Microfossil Research Ltd, and University of Auckland, New Zealand

Linda Cummings  
Paleo Research Labs, USA

Abstract - Plant microfossil analysis was recently carried out on 12 soil samples associated with a variety of landscape features at three locations (100-250 m a.s.l.) on the northwest coast of Easter Island at Te Niu. These results, along with earlier microfossil analyses of 7 soil samples from Te Niu, indicate burning of palm-dominated forest and the development of a mixed-crop, dryland production system. Charcoal and obsidian associated with the soil samples provide a radiocarbon and obsidian hydration timeframe. The original Te Niu forest was cleared probably between AD 1300 and 1450, with coastal forest cut initially and upslope forest a century or more later. Starch grain, pollen and phytolith evidence indicates cultivation of four introduced crops: common yam (Dioscorea alata), sweet potato (Ipomoea batatas), taro (Colocasia esculenta) and bottle gourd (Lagenaria siceraria). The results show the potential for this type of analysis in providing direct evidence of crop type and range elsewhere on Easter Island.

Introduction

Early European visitors to Rapa Nui, such as Roggeveen whose men briefly surveyed the island in AD 1722 (Bouman 1994) and Gonzalez, Cook and La Perouse who visited during the AD 1770s (Cook 1821; Corney 1903; La Perouse 1797), observed various food production practices of the local people. These included the cultivation of sweet potatoes, taro, yams, and bananas and the use of rocks as mulch in gardens. The visitors also noted that the island was almost completely treeless. Details about the vegetation actually growing on Rapa Nui prior to the 20th century are sketchy at best. During the early 1900s, Skottsberg (1956) recorded native flora he found on the island and in the 1980s Flentley (1993) identified pollen collected in sediment cores encompassing the past 30,000 years. More recently, additional studies of plant remains—macrofossils and microfossils (e.g. Cummings (1998), Orliac (2000, 2003), Pearthree (2003), Horrocks and Wozniak (2008) have furthered the information regarding the island environment prior to humans and how it changed after Polynesian from Mangareva (Green 1999, 2006) arrived.

In this paper we bring together the information from three plant microfossil studies carried out using soils collected at Te Niu, a prehistoric settlement on the northwest coast of Rapa Nui. A total of 19 soil samples was collected at Te Niu. In this paper, we include radiocarbon and obsidian dates associated with the soil samples tested for plant microfossils. The findings have confirmed a palm and hardwood forest was present at Te Niu prior to human colonization. After establishment of a settlement the vegetation became dominated by grasses, ferns, and herbaceous weeds. Our studies also show that many of the traditional Polynesian cultigens described ethnohistorically by early European visitors were grown at Te Niu after land clearing commenced circa AD 1300.

The Te Niu project area (see Figure 1) extends 1.5 km up the lower western slopes of Terevaka from Ahu Te Niu, a monument complex built at the top of a 100 meter high coastal cliff (Wozniak 1998, 2003). Soils and other archaeological deposits retrieved from Te Niu have been analyzed in three microfossil studies over the past decade (Cummings 1998, Wozniak 2003, Horrocks and Wozniak 2008). Using a range of plant microfossil types, namely pollen, phytoliths and starch grains, these studies have provided direct evidence of environmental change, and crop type and range. Wood charcoal and obsidian artifacts provided dates we could associate with

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the microfossils. We are therefore able to determine the timing of vegetation change at Te Niu, and what that change entailed (including which cultigens were grown on the northwest coast).

The radiocarbon dating of charcoal from the excavations at Ahu Te Niu (Table 6, Wozniak 2003) indicates that major ahu construction occurred within a century after the vegetation was cleared by fire (burning occurred between AD 1300 and AD 1400). Obsidian hydration dating (Table 7, Wozniak 2003) has demonstrated that several stages of remodeling took place between AD1600 and AD1850. Radiocarbon dated charcoal from excavations in garden and household contexts inland from the coastal ahu demonstrate that habitation and cultivation activities took place at Te Niu on land cleared of forest at approximately the same time the coastal ahu was built. The dating methods also show that the Te Niu settlement and activities at the ceremonial center continued for more than five centuries.

Background

The scientific study of environmental change on Rapa Nui began with pollen studies of sediment cores by Flenley and King (1984). Flenley (1993, 1998) and Flenley et al. (1991) refined the initial work using additional cores. The cores, taken from swamps on the island - Rano Kao, Rano Raraku and Rano Aroi (Figure 1), contained a record demonstrating that formerly a Holocene forest consisting of trees and shrubs, including Sophora toromiro and other native hardwoods, and a palm (Paschalococos disperta, Dransfield et al. 1984) covered much of the landscape. Flenley et al. (1991) identified this palm as a close relative of Jubaea chilensis based on its fossil pollen and endocarps, and also root impressions he observed in the soil. They postulated that the altitudinal forest limit (c. 425 m) was marked by a shrub zone of Asteraceae and Coprosma and that the greatest change in vegetation type took place about 1000 years ago, when grasses and ferns largely replaced forest vegetation. Their radiocarbon chronology and observations of increased sedimentation in the swamps suggested that land clearance occurred from c. 1200 to 800 yr BP, with the forest completely gone by c. 500 yr BP. He interpreted these changes as evidence that humans had arrived on the island. Mann et al. (2003) substantiated Flenley et al.’s (1991) findings by also demonstrating that island-wide geomorphological changes (erosion and sedimentation) accelerated after 765 yr BP.
Orliac’s (2000) study of charcoal from *umu* ovens on Rapa Nui provided additional information describing the more recent changes in vegetation. She identified additional forest tree and shrub species (both native and Polynesian introduced taxa) and corroborated that there had been a dramatic decline of these forest species coincident with an increase in herbs and ferns. She also believed this was due to human-caused deforestation, and demonstrated that the now depleted vegetation of Rapa Nui originally comprised at least 20 species of trees and shrubs (six species as yet unidentified) in addition to the extinct palm. Both Orliac (2000, 2003) and Pearthree (2003) found that herbaceous plants and grasses and twigs increasingly replaced hardwoods as cooking fuel after AD 1300. Pearthree (Table 1, 2003) reported one of the most common non-woody tissues he found in the ovens were culms and rhizomes of Cyperaceae, *Paspalum forsterianum*, and an unknown grass in *umu* ovens on Rapa Nui. However, Pearthree also found macrofossils of cultivated plants, namely sweet potatoes, *Cordyline*, sugar cane, and putative taro and yam remains. The timing of forest depletion as outlined by Flenley et al. (1991), Orliac (2000, 2003), and Pearthree (2003) also coincides with the findings of Stevenson (1999) and Stevenson et al. (1999) which show that residence structures and house gardens were installed over much of the island during the 12th to 13th centuries. These recent studies strongly suggest that while the forest provided materials for *ahu* and house construction, cooking fuel, and *mouai* transport (Flenley and King 1984; Flenley et al. 1991; Gurley and Liller 1997; Grau 1998), for the most part, forests were cleared for the cultivation of crops.

The study of environmental change along the northwest coastal cliffs of Rapa Nui began at Te Niu with an archaeological survey and excavation protocol in 1996 (Wozniak 1998). During the survey, Wozniak found three adjacent image *ahu* that had been converted into a single semi-pyramidal *ahu*, now called Ahu Te Niu, situated at the top of a steep cliff at 100 m a.s.l. She also found archaeological remains of households surrounded by gardens inland from the coastal *ahu* up to 300 m a.s.l. Most of the gardens at Te Niu were covered by lithic mulch—a surface layer of small rocks such as that noted by La Perouse along the northwest coast at Te Peu in 1786 (La Perouse 1797, Wozniak 1999). La Perouse surmised the rocks had been used to protect soils from erosion and retain moisture in gardens.

**Methods**

Wozniak carried out a systematic excavation protocol during 1996 that included placement of excavation units from the coastal *ahu* (Ahu Te Niu) and proceeding inland (east of the *ahu*). Soil samples (pre-human and cultural deposits) were collected from each of the excavated units for microfossil studies along with charcoal and obsidian artifacts and debitage, some of which were used for dating. Wozniak excavated six trenches perpendicular to the length of Ahu Te Niu - three each in front and behind the *ahu* (Wozniak 2003). Also, excavation units were placed every 50 m along a central axis from the *ahu* inland for 1000 m. In addition, units were placed 50 m apart along transects perpendicular to this central east-west axis, originating at the east-west axis and running to the north and south boundaries (that is, to 250 m north and south) of the project area. The perpendicular transects were at 200 m and at 600 m east of the *ahu*. Additional units were placed in a rock shelter, several household sites, and suspected garden areas (under layers of lithic mulch) as described below.

Soil samples collected during the excavations were stored in plastic bags. In 1996 and 1998 a total of seven samples were analyzed for plant microfossils by Linda Scott Cummings, Paleo Research Laboratories (Golden, Colorado). Cummings (1998) reported her findings on two of these samples and Wozniak (2003) discussed the results of the other five samples. In 2006, an additional 12 soil samples were analyzed by Mark Horrocks, Microfossil Research (Auckland, New Zealand) and have been discussed by Horrocks and Wozniak (2008).

For the 1996 and 1998 studies, Cummings (1998) used hydrochloric acid (10%) to remove calcium carbonates followed by sodium hexametaphosphate and water rinses to remove clay prior to heavy liquid separation. Zinc bromide (density 2.1) was used for the flotation process, followed by centrifugation, to separate organic from inorganic remains. The supernatant containing pollen and organic remains was decanted and diluted. The samples were treated in hot hydrofluoric acid to remove any remaining inorganic particles, and then were acetylated to remove any extraneous organic matter. Cummings recorded spores, pollen grains and aggregates, and indeterminate pollen, which include pollen grains that are folded, mutilated, and otherwise distorted beyond recognition. Phytoliths were extracted separately from the same sample using heavy liquid floatation (sodium hexametaphosphate). In the 2006 analysis (Horrocks and Wozniak 2008), sub-samples (4.5-5.0 cm<sup>3</sup>) were prepared for pollen (and spore) analysis by the standard acetylation and hydrofluoric acid method and then bleached (Moore et al. 1991). Sub-samples (4.5-5.0 cm<sup>3</sup>) were also prepared for analysis of starch residues and phytoliths by combined density separation (Horrocks 2005).
The wood charcoal samples retrieved from the 1996 excavations were radiocarbon dated by Beta Analytic Inc., Miami, Florida (standard or AMS depending on the sample weight) or by the University of Arizona AMS laboratory (AMS only). The $^{13}$C/$^{12}$C ratio was calculated for most of the samples. Calib IV software supplied by the University of Washington was used to calibrate radiocarbon ages and AD/BC ranges to 2 sigma.

Volcanic glass artifacts (usually debitage or broken tools of obsidian) were obsidian hydration dated by Christopher Stevenson (then at Virginia Department of Historic Resources, Petersburg, Virginia). Hydration depths were microscopically measured under oil immersion objectives (Stevenson 2000; Stevenson et al. 1987). An estimate of the hydration rate was calculated after retrieval of several pairs of Ambrose cells that had been in place for a period of one year (Ambrose 1976). Ambrose cells were placed in the balks of several excavation units prior to refilling them with soil. The locations chosen for cell placement represented various geomorphic settings at Te Niu. This procedure aided in determining the rate of hydration under varying soil conditions (Stevenson et al. 1993) and these rates were used to calibrate the hydration rate for the obsidian artifacts found in various contexts. Stevenson then calibrated the errors of convergence for each date.

### Provenience of Soil Samples Used for Microfossil Studies

Of the total 19 soil samples from Te Niu used for plant microfossil studies, seven were examined in 1996 and 1998 by Cummings. These samples were cultural deposits from excavations at Ahu Te Niu (Site 26-1), at a rock shelter (Site 26-50) at ~150 m a.s.l., and in three garden and household contexts - Sites 26-M200N (600 m inland from the ahu at ~170 m a.s.l.), and Sites 26-22B and 26-22C (200 m inland from the ahu at ~140 m a.s.l.). Profile diagrams and photos of the excavation units are shown in Wozniak (2003).

The 12 soil samples examined in 2006 by Horrocks came from three locations between the coastal ahu and 950 m inland (between 100 and 250 m a.s.l.), and represented a variety of landscape features. Profiles of the excavations from which these 12 samples were taken are illustrated in Horrocks and Wozniak (2008). The ahu excavations yielded one sample from the ahu ramp unit representing the pre-human, B soil horizon, one sample from a charcoal lens (preserved under the present ahu) formed when the coast was cleared of forest (by fire) prior to ahu construction, and one sample from the rear wall (these sediments were laid down immediately before or during the construction period of one of the original ahu platforms c. AD 1450). There were also samples of deposits from the reconstruction-remodeling phase when the three image ahu platforms at Te Niu were transformed into the single semi-pyramidal complex now in evidence. Four additional soil samples came from Site 26-6, a household complex 200 m inland from Ahu Te Niu. A total of eight excavation units had been placed at Site 26. (These were identified as Units 26-6c-1, 26-6c-2, each 1 m x 1 m and 26-6-1 to 26-6-6, each 0.5 m x 0.5m.) One sample each was collected from a planting pit feature and from the matrix surrounding the pit within the garden soil of the lowest cultural layer (Unit 26-6-1). One sample came from cooking area deposits of Unit 26-6-6, and one came from the balk profile exposed in front of the former residence at Site 26-6 (Units 26-6c-1 and -2). The sample from 26-6c-1 was collected near the base of the cultural layer. Soil was also taken from a planting pit feature exposed in Unit 26-T0 during the systematic excavation sequence. This unit was located in a concave geomorphic landform, 950 m inland from the ahu, of the type often used as garden areas probably because of better moisture retention. This particular site had been subsequently buried under colluvium.

#### Table 1. Soil Samples and Dates from Te Niu, Rapa Nui, examined in the 1996 and 1998 Microfossil Analysis.

<table>
<thead>
<tr>
<th>Soil Sample</th>
<th>Site No</th>
<th>Unit</th>
<th>Depth (cm b.s.)</th>
<th>Context</th>
<th>Date (AD)</th>
</tr>
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<tr>
<td>AHU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS 87</td>
<td>26-1</td>
<td>3</td>
<td>100</td>
<td>Ahu rear wall sediments</td>
<td>1450**</td>
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<tr>
<td>ROCK SHELTER/HABITATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>K-20</td>
<td>26-50</td>
<td>1</td>
<td>20</td>
<td>Rock shelter sediments</td>
<td>1500-1650**</td>
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<tr>
<td>Soil Sample</td>
<td>Site No</td>
<td>Unit</td>
<td>Depth (cm b.s.)</td>
<td>Context</td>
<td>Date (AD)</td>
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<td></td>
</tr>
<tr>
<td><strong>GARDENS</strong></td>
<td></td>
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<td></td>
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<tr>
<td>SS 141</td>
<td>26-22B</td>
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<td>52</td>
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<td>26-22B</td>
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<td>44</td>
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<td>pre-human</td>
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<tr>
<td>SS 306</td>
<td>26-22C</td>
<td>1</td>
<td>33-65</td>
<td>Garden/base of pit feature</td>
<td>1440-1530*</td>
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<tr>
<td>SS 290</td>
<td>26 M 200 N</td>
<td>1</td>
<td>40</td>
<td>LMG/pit feature</td>
<td>1600-1700 ***</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* radiocarbon date (calibrated, 2 sigma)  ** obsidian hydration date  ***estimated from dates of higher and lower layers</td>
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<td></td>
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**Table 2. Soil Samples and Dates from Te Niu, Rapa Nui, examined in the 2006 Microfossil Analysis.**

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<th>Unit</th>
<th>Depth (cm b.s.)</th>
<th>Context</th>
<th>Date (AD/BC)</th>
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</tr>
<tr>
<td>SS 145</td>
<td>26-1</td>
<td>1</td>
<td>60</td>
<td>under rock</td>
<td>1750-1850***</td>
</tr>
<tr>
<td>SS 146</td>
<td>26-1</td>
<td>1E</td>
<td>65-70</td>
<td>under rock</td>
<td>1459-1831**</td>
</tr>
<tr>
<td>SS 180</td>
<td>26-1</td>
<td>1E</td>
<td>105</td>
<td>deforestation fire</td>
<td>1500-1750 ***</td>
</tr>
<tr>
<td>SS 194</td>
<td>26-1</td>
<td>1</td>
<td>150</td>
<td>B horizon (pre-human)</td>
<td>6612-5844 BC*</td>
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<tr>
<td>SS 156</td>
<td>26-1</td>
<td>1</td>
<td>100-115</td>
<td>A horizon (pre-human)</td>
<td>~1300*</td>
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<tr>
<td>SS 189</td>
<td>26-1</td>
<td>3W</td>
<td>85-90</td>
<td>pit with charcoal, bones</td>
<td>1393-1459*</td>
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<tr>
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<td>26-1</td>
<td>3W</td>
<td>80</td>
<td>pit with charcoal, bones</td>
<td>1597-1718</td>
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**HOUSEHOLD/GARDEN SITES**

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<th>Sample</th>
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<th>Depth (cm b.s.)</th>
<th>Context</th>
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* radiocarbon date (calibrated, 2 sigma)  ** obsidian hydration date  ***estimated from dates of higher and lower layers
Results

The plant microfossil results demonstrate that the northwest coast of Rapa Nui originally was covered by palm forest as has been reported for the island in general (discussed above). Palm pollen and phytoliths dominated the remains in the three microfossil studies. The radiocarbon and obsidian hydration dating strongly suggests that forest clearing began at the Te Niu settlement about AD 1300 and subsequent cultivation continued through the mid-19th century. In this section we will first discuss the general dating sequence, followed by the microfossil evidence for Te Niu. We then describe sample by sample provenience with a description of microfossils and their associated dates.

A charcoal layer about 1 cm thick (exposed during three of the six ahu excavations) was found on top of a pre-human soil horizon and at the base of the cultural sediments under the ahu. Pre-human soils 1.5 m thick lay below the charcoal lens. Tube-like casts produced by former palm roots were evident in the pre-human soil. Carbon found in one of the casts was dated to 7430 radiocarbon years BP, while the lateral extension of this unit (Unit 26-1-5) into the plaza in front of the ahu (having no charcoal lens) returned 9155 radiocarbon years BP.

The charcoal lens was made up of carbonized palm endocarps, small pieces of hardwoods, and grass-like material. On the surface of this lens lay localized groups of burnt rat and fish bones, presumably from surface cooking hearths used after the initial burning episode that formed the lens. The cultural sediments laid down on top of the charcoal lens comprised of several layers, 93 cm thick in total, dating to between AD 1300 and the late 20th century. Radiocarbon dating of the charcoal lens itself (from under the ahu) indicates that between AD1300 and 1350 -- AD 1281-1401, 1296-1407 and 1214-1436 (cal. 2 sigma) - the coastal cliff at Te Niu was cleared of forest by burning. Charcoal from a pit (Unit 26-1-3) under the rear wall of the ahu—at 85 cm depth—returned a radiocarbon date of AD 1393-1459 (cal. 2 sigma).

Obsidian hydration dates and soil samples were obtained for Units 26-1-1 and 26-1-3. The obsidian dates ranged from AD 1459 to AD 1831 +/- 45-71. Likely the obsidian was deposited during construction and use of the ahu. Both radiocarbon and the obsidian hydration dates for Te Niu show this settlement (ahu and the household sites) remained inhabited until approximately AD 1850.

Burning occurred at various locations at Te Niu about AD 1300. For example, charcoal from deposits in front of the former residence location at Site 26-6 returned a radiocarbon date range of AD 1265-1396 (cal. 2 sigma). (How long a residence was in this exact location was not determined but multiple incidences of hearths directly seaside of this excavation unit indicates a household was situated in this relative position for many centuries). Thus, the radiocarbon dating demonstrates that at least part of the former forest environment at the Te Niu project area was transformed into a mixed-crop, dryland production system about AD 1300, at the same time as the coastal cliff location (where the ahu was constructed) was cleared by burning. At least two other radiocarbon dates for this household site (Site 26-6) indicate use of cooking ovens until the middle to end of the 19th century.

The plant microfossil analyses indicate that the converted landscape at Te Niu (that is, the cultural sediments) was heavily vegetated by ferns, grasses, and other disturbance related taxa. The data also suggest that the land previously dominated by palm forest was used for cultivating a variety of crops. The Te Niu people grew Colocasia esculenta-- taro, Dioscorea alata-- the common yam, Ipomoea batatas-- sweet potato, Lagenaria siceraria-- bottle gourd or calabash (putative), Curcuma longa--turmeric (putative), and Broussonetia papyrifera-- paper bark mulberry (putative), used to make mahute—bark cloth. The Curcuma longa and Broussonetia papyrifera pollen identifications are tentative because pollen of these species are difficult to differentiate from other species in their respective families. Evidence of other crops, such as Musa, the banana, and Saccharum officinarum, sugarcane, were not identified at Te Niu, although Cummings (1998) found a possible Musa phytolith in north coast sediments from the La Perouse area (Figure 1), and Pearthree (2003) found macrofossils of sugarcane in umu ovens from several locations on Rapa Nui. Saccharum officinarum pollen is difficult to differentiate from that of many other types of grasses. Specific examples of our microfossil findings are discussed below.

The soil sample SS87, collected at a depth of 100 cm below the surface from under the rear wall of Ahu Te Niu in Unit 26-1-3 was examined by Cummings (1998). An obsidian hydration date from this level indicates the piece of obsidian was buried about A.D. 1459. Charcoal from the same excavation, with a radiocarbon date of AD 1393-1459 (cal. 2 sigma) corroborates the obsidian date. This date most likely represents the construction period of the middle image ahu structure (of the three image ahu ultimately built here). Grasses and palms are the dominant vegetation represented in the pollen record of the SS87 sample, although pollen concentration in this sample was relatively low -- approximately 400 pollen grains per cc of sediment. Pollen of the cultivated Broussonetia
papyrifera (putative) and possibly Sophora toromiro (endemic to Rapa Nui) were present. Small quantities of Cheno-am, High-spine Asteraceae, and grass pollen were identified, as was a deteriorated Ipomoea batatas pollen grain. In addition, a large number of fern spores were observed in this sample. The phytolith record was dominated by palms and grasses (Festucoid—cool season grasses-- and non-specific types).

Another soil sample (K20) examined by Cummings (1998) was collected at 20 cm depth (32-35 cm total sediment thickness) in a rock shelter. Site 26-50, located approximately 250 m inland from the ahu. There were no sediments deposited in the shelter prior to humans clearing the land at Te Niu, as evidenced by the presence of a campfire radiocarbon dated to 550 BP (AD 1268-1627, calibrated, 2 sigma) on the bedrock. The K20 sample was taken from the top of the 12-15 cm thick Layer 2; sediments of Layer 2 were darker brown and appeared more organic than the surface Layer 1 sediments. Obsidian embedded into the surface of the base cooking hearth, and retrieved from below the K20 sample, returned dates approximating AD 1250 (AD 1203±90 1275±83 1272±85 1216±88). The pollen assemblage of K20 (estimated to be about AD 1500 as per obsidian hydration dates of debitage in Layer 2) was dominated by grasses. Other pollens included Moraceae (possibly Broussonetia papyrifera), Cheno-am, Euphorbia, high-spine Asteraceae, Liguliflorae, and Cyperaceae. Moraceae pollen concentration was high, over 16,000 per cc of sediment. Pollen of Sophora toromiro (probable), Araliaceae of the type similar to Reynoldsia, and Artemisia was also noted. Palm pollen was absent from the rock shelter sample although the palm phytolith concentration was high, suggesting that palm fronds were used in the shelter by people. The phytolith assemblage of the K-20 sample was dominated by palm phytoliths plus a wide variety of phytoliths from tall and short, and warm and cool season grasses.

Of the five samples Cummings examined in 1998, two represented pit features found under a surface layer of small rocks (lithic mulch garden contexts) and their associated controls (earlier deposits or possibly pedologically formed soil beneath and between the pit features). A third garden pit was tested without a control. The analysis of samples from all three suspected garden contexts again showed assemblages dominated by palms.

Pollen and phytolith diagrams for the soil samples (141, 141b, 305, 306, and 290) examined by Cummings in 1998 are shown in Figures 2a and 2b. Sample 141b was composed of sediment collected from the bottom of the pit feature at the base of the Unit 26-22B excavation. This unit was a lithic mulch garden containing charcoal radiocarbon dated to AD 1298-1407 (cal. 2 sigma). The pit feature from which the soil sample 141b originated also contained obsidian, dated to approximately AD 1625-1759 ±47. The control, Sample 141, represents the soil matrix below this planting pit feature (deposits presumably dating between AD 1300 and the late 17th century). The pollen concentration in the pit feature, Sample 141b, was slightly more than double and contained a greater diversity of pollen than that in the control sample. Palm pollen dominated both samples but the control sample yielded a greater frequency of palm pollen resembling Jubaea chilensis (Flenley1998). Various pollens of weedy plants, such as the Asteraceae and grasses, were present, as were pollens of Cyperaceae, Araliaceae, and Rhamnaceae. In addition, a single poorly preserved pollen grain of Colocasia esculenta (taro) was tentatively identified. Small quantities of Pinus (pine) pollen appeared in both samples. Pinus did not grow on Rapa Nui or in South America prior to the protohistoric period (AD 1700s). However, this pollen type is produced in abundance and may be wind-transported over long distances. Pines were not pollinating in Golden, Colorado at the time the samples were processed, so Cummings thought that contamination during lab processing was not likely. If the pine pollen in the Rapa Nui deposits is modern, it may have been moved down in the profiles by percolation, mechanical disturbance or bioturbation. However, long distance, upper atmosphere transport at the time these sediments were deposited is the most likely explanation for the presence of this pine pollen. Fern spores were more abundant than pollen grains in these two samples. Fern spores are more resistant to decay, so ferns tend to be over-represented in free-draining, well-aerated deposits. Unidentified starch granules were recovered from both the 141b pit and the 141 control samples. Cummings suggested that these granules might be from deteriorated grass seeds. The phytolith assemblages of Samples 141 and 141b were dominated by palms (90%). The next two most abundant types were elongate smooth and unidentified dicot phytoliths. Elongate phytoliths were more abundant in the control sample, while unidentified dicot phytoliths dominated the pit sample.
Soil samples 305 and 306 represent another pair of control and pit feature sediments that were collected from Unit 1 of a rock covered garden at Site 26-22C, situated about 20 m west of Site 26-22B. Sample 306 was collected from the bottom of a pit feature extending from 33 cm to 65 cm below the soil surface (rather than the rock mulch...
Charcoal from the 306 pit feature was dated to approximately AD 1439-1529 (cal. 2 sigma). The pit feature contained little pollen while the control sample (Sample 305) yielded a pollen record of palm, grasses and other weedy herbaceous plants, and sedges similar to control sample 141. Other pollen taxa included Araliaceae, Pinus, Cheno-am, high-spine Asteraceae, and Lythraceae. Fern spores were more abundant than pollen grains. The phytolith assemblages of Samples 305 and 306 were similar to each other, with palm and elongate smooth phytoliths dominating. The grass short cell types Festucoid and Bilobate (tall grasses) phytoliths were present, indicating that cool season and tall grasses grew in the area.

Sample 290 was collected from a pit feature in a lithic mulch garden 600 m inland from the ahu at Location 26 M 200 N along the systematic excavation transect. The garden was close to remains of a household. Pollen preservation was very poor in this sample - only half of the total pollen grains counted were identified. The dominant pollen types were grasses and Cheno-am, both typical of disturbed areas. Palms dominated the phytolith assemblage. Grass short cell phytoliths included Festucoid and Bilobate types. There was no suitable material in this unit to date but it is estimated that the pit feature was covered during the 17th century because its context and layer provenance were similar to nearby excavation units from which obsidian and radiocarbon dates were obtained.

The 2006 analysis like the two earlier microfossil analyses demonstrated that Te Niu was a palm forest prior to conversion to gardens. Palm pollen and phytoliths again dominated the samples. In the most recent study Horrocks extracted additional plant microfossil types (especially starches) of Polynesian crops reported protohistorically on the island, such as Dioscorea alata and Ipomoea batatas, which apparently grew and/or were processed at Te Niu. Starch grains of Dioscorea alata (Figure 3a) and of Ipomoea batatas were identified in all samples of cultural sediments of the 2006 study. In addition, starch of Colocasia esculenta was identified in several samples. Identifying Ipomoea starch is complicated by the presence of an indigenous Rapa Nui species, I. pes-caprae (Skottsberg 1956), reported as a famine food by Metraux (1940). However, I. pes-caprae does not have tuberous roots like I. batatas, so the starch grains found in the cultural deposits with remains of other cultivated crops at Te Niu are most likely I. batatas.

Putative bottle gourd (Lagenaria siceraria) pollen (Figure 3b), found in two garden soil samples from Te Niu (Samples 281 and 199a), suggests that gourds were grown and used at Te Niu (and likely elsewhere on the island in the past). The identification was tentative because of poor pollen preservation.

In addition to evidence of introduced crops, Horrocks’ 2006 analysis showed that fern spores were present in all cultural layers tested. Monolete psilate spores may be from a large number of undifferentiated fern species; monolete verrucate spores from Davallia solida, Dryopteris espinosa, Dryopteris parastica, Elaphoglossum skottsbergii and Polypodium scolopendria; trilete psilate spores from Microlepia strigosa; and trilete echinate and verrucate spores from Cyathea spp. Small amounts of spores of Pteris (ground ferns) were found in most of the samples. Not withstanding their superior preservation, the presence of so many fern spores indicates that the Te Niu landscape had been considerably deforested by Polynesian settlers.
The soil sample SS156, from the pre-human A horizon (below the centimeter thick charcoal lens under the ahu) contained high palm pollen (70% of total) and low fern spore values. Those soil samples post-dating the lens, however, indicate that the former forest cover present at Te Niu was removed during forest clearance along the coastal cliff. In contrast to the pre-human soil, samples from the cultural layers contained large numbers of spores from several undifferentiated fern species; palm pollen was often quite low (below 40% of total count). The high values for fern spores and scarcity of fern phytoliths in cultural deposits at Te Niu indicate that ferns are extremely under-represented in the Rapa Nui phytolith flora and point to the fact that fern spores are generally produced in abundance and readily transported on the wind, resulting in over representation in pollen records.

The dates associated with the microfossil evidence determined in 2006 are given in Table 2. The pre-human B horizon below the ahu structure was radiocarbon dated to 9155-7430 BP. The pre-human A horizon on top of the B horizon was not dated but is certainly older than the charcoal lens that represents the initial burning (about AD 1300) of vegetation growing in that A horizon. All the cultural layers at Te Niu (above the charcoal lens), therefore, are younger than 700 years old and all contain evidence of starch crops. The lower cultural layer of the Site 26-6 household unit 200 m inland from the ahu (radiocarbon dated to AD 1286-1399 (cal. 2 sigma)) also indicates that forest land immediately inland was cleared about the same time as the coastal area where the ahu was eventually built.

Charcoal radiocarbon dates from three of the excavated units in the umu oven area of Site 26-6 indicate that this location had been used from AD 1300. Both radiocarbon and obsidian hydration dates indicate that this site continued to be used as a residence through the mid-1800s.

Charcoal from the pit feature at Location 26-T0 (the site where putative pollen of Lagenaria siceraria was identified), the garden almost 1 km inland from the ahu, returned a date of AD 1428-1645 (cal. 2 sigma). This was the only unit that yielded dateable material that far inland so it is not possible to determine if gardening began this distance from the coastal settlement prior to AD 1400.

**Summary and Conclusions**

The pollen and phytolith records from all three plant microfossil analyses are dominated by palms, indicating the prevalence of this taxon in the local vegetation at Te Niu prior to land conversion to a cultural landscape. Other native trees and shrubs were likely also eliminated at the same time but little microfossil evidence of these was found in the samples. *Sophora toromiro* pollen grains were identified by Cummings along with other pollens that might represent native shrubs. Ferns, grasses and other herbaceous weeds, and crops replaced palm forest. The radiocarbon dating of the charcoal lens under the ahu and the charcoal fragments from garden areas very strongly suggests that large-scale forest destruction occurred c. AD 1300. Microscopic charcoal, likely from anthropogenic sources, was also present in high concentrations in most of the cultural layer samples.

The three microfossil studies have also shown that after forest clearing, Te Niu was used for food production. Cummings has identified isolated pollen of the sweet potato and taro at Te Niu along with putative pollen grains of turmeric and paper bark poplar. The starch and pollen results of the 2006 analysis provide the most direct evidence of cultivation on the former forest land. Starch of three introduced field crops was identified at Te Niu: the common yam, sweet potato, and taro. The high percentages of yam starch suggest intensive cultivation in a variety of horticultural settings. Sweet potato also appears to have been extensively cultivated. Starch of both yam and sweet potato were present in all cultural levels, indicating that these crops were grown at Te Niu probably from the time that Te Niu became a settlement about AD 1300. Microfossils of bottle gourd and taro appear much less common than yam and sweet potato in the Te Niu samples. Taro may be under-represented in these studies because its starch grains are difficult to identify due to their relatively tiny size. Putative pollen of an additional crop, bottle gourd, was identified in two samples. We cannot securely date the earliest occurrence of the bottle gourd growing at Te Niu, only that it was grown during the protohistoric period.

Findings of these plant microfossil studies aid in understanding more fully the extent of cultivation practiced by the former inhabitants of Te Niu, but also may lead to confusion or misinterpretation regarding the timing of cultivation of specific crops. For example, the two garden locations at which the putative *Lagenaria siceraria* pollen were identified contained charcoal fragments that indicated these garden areas had been cleared by burning prior to AD 1450. However, both of these garden areas were repeatedly cultivated, possibly until as late as AD 1860s when the island’s population was decimated by disease (McCall 1981) and the settlement at Te Niu was deserted. Soil (and charcoal fragments contained within the soil) tends to remain in situ during later planting
activities. This is an important distinction to make. Green (2000, 2005, 2006) points out, although both crops (i.e., the sweet potato, Ipomoea batatas, and the bottle gourd, Lagenaria siceraria) were introduced into Polynesia from South America, they may have found their way to the Eastern Polynesia core region separately. Alternatively, they may not have been introduced from the Polynesian core region to Mangareva and hence to Rapa Nui at the same time. Because no one has reported evidence of macrofossils of gourd rinds on Rapa Nui despite extensive excavations in cooking ovens (e.g., Orliac 2000; Pearthree 2003), we cannot securely determine if and when Lagenaria siceraria was first planted there. Another gourd-like plant, the wax gourd, Benincasa hispida, is also found in Polynesia. Both Lagenaria siceraria and Benincasa hispida were present in Polynesia prehistorically according to Golson (2002) and Green (2000), but not necessarily on Rapa Nui. Both of these may have been introduced historically (that is, by Europeans during the 18th and 19th centuries). According to the Rapa Nui linguist Stephen Fischer, the term used for bottle gourd (specifically Lagenaria siceraria) in Polynesia is hue. This word was not documented in dictionaries as a term in use for the plant on Rapa Nui until the 19th century (Green 2006, and personal communications to Roger Green on the topic).

To reiterate, our plant microfossil and dating studies have shown the conversion of native forest land to cultivation at Te Niu began c. AD 1300. Our results also illustrate that most of the major Polynesian crops grown on Rapa Nui according to ethnohistoric sources of the 18th to 20th centuries, can be identified at Te Niu.

**Dedication**

This article is dedicated to Roger C. Green, who generously reviewed and made suggestions to better this publication.

**Notes**

1 Yen (1974) notes that old varieties of the sweet potato seldom seem to have flowered in Eastern Polynesia. This and the fact that there were two known species of Ipomoea on Rapa Nui – Ipomoea batatas and I. pes-caprae (Skottsberg 1956) is potentially problematic when identifying Ipomoea pollen. However, Cummings (1998) who identified one pollen grain found at Te Niu as I. batatas, described morphological features by which pollen of these two Ipomoea species may be differentiated. I. batatas pollen is distinguished from I. pes-caprae by the presence of densely packed rods that form the shape of a coarse reticulum around each pore. Ipomoea pes-caprae pollen does not exhibit these rods. The only possibility for confusion lies with the remote possibility that other species of weedy Ipomoea grew on the island during this period of occupation.

2 Clarke et al. (2006) have shown that Lagenaria siceraria gourds from Polynesia (No samples from Rapa Nui were included in this study) have exhibited both South American (with African origin) and Asian genetic components. The concurrence may, therefore, demonstrate that the presence of L. siceraria in East Polynesia is via South America.

3 The Polynesian word generally used to refer to the bottle gourd is hue. Various writings, putatively of Don Francisco Antonio de Aguera who accompanied Gonzalez on the Spanish visit to the island in AD 1770, could be used to infer the use of hue on Rapa Nui at this time. From his Spanish transcriptions of Rapa Nui terms and phrases the 18th century presence of the word hue was in concert with a toponym for a cave, Ana Hue Neru. The tale mentioning this cave suggests that a vessel (possibly a gourd vessel) was used to transport food or water to a person living in the cave. Thus, the term hue, if not the bottle gourd itself, was likely present on Rapa Nui somewhat earlier than AD 1770.

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References


Corney, B. G. (ed.) 1903. *The Voyage of Captain Don Felipe Gonzalez to Easter Island in 1770-1; Preceded by an Extract from Mynheer Jacob Roggeveen’s Official Log of His Discovery of and Visit to Easter Island in 1722*. Cambridge: The Hakluyt Society.


Green, R.C. 2006. Further observations on the kuumala: based on some sceptics’ perceptions as feedback. *Archaeology in New Zealand* 49(3): 188-204.


Botanical Identification of 200 Easter Island Wood Carvings

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Abstract - The botanical identification of 200 wood carvings from Easter Island was carried out. These objects, mainly collected during the 19th century, are preserved in private French collections and in the following museums: France (Natural History Museum of La Rochelle, Musée de l’Hôpital Maritime in Rochefort, Musée Calvet of Avignon, the Louvre and Quay Branly museums of Paris), England (British Museum), Belgium (Museum of Art and History in Brussels), Germany (Museum of Ethnography in Cologne), Switzerland (Museum of Ethnography of Neuchâtel and Barber-Mueller Museum of Geneva), Italy (Congregation of Sacred Hearts of Jesus and Mary in Rome), Norway (Museum of Ethnography of the University of Oslo) and Russia (Peter the Great Museum in St Petersburg). These analyses show on the one hand that formerly Sophora toromiro and Thespesia populnea were mostly used by the island’s sculptors, and on the other hand that certain types of carvings (kau rongorongo, tahonga, rapa…) are exclusively carved from one of these two woods. The choice of these raw materials is not accidental; these two trees occupied a very important place in the symbolic universe of Easter Island.

Introduction

The choice of a raw material constitutes the very first operating element of a complex and active process which, on Easter Island as everywhere else in eastern Polynesia, will lead to the shaping of an adze, an offering platform, or the effigy of an ancestor or a god for example. This choice is not due to chance; more than their physical, mechanical or sensorial properties, ethnohistorical documents clearly show the symbolic value of the wood used for carving (Orliac 1990:35-42). The reasons for such a choice partially lean on the fact that the ligneous material was, in this part of the Pacific, closely connected to the force of the next world, which also was the case for the sculptor and his tools (Orliac 2005a).

The objects collected on Rapa Nui during the 19th century for the cabinets of curiosities or for the museums almost essentially concern prestigious objects with insignia of power (ua, reimiro…), representations of ancestors or spirits (moai tangata, moai kakavakava…) and the other artefacts necessary for the numerous daily rites (Orliac & Orliac 1995). The goal of the botanical identification of 200 wooden artefacts was to put in evidence these woods that are qualified as sacred because of their strong symbolic value, and finally try to approach, with humility, the spiritual universe of the ancient Rapanui.

Selection of the Rapanui Wooden Artefacts and Method of Investigation.

The majority of the Rapanui wooden carvings in this study have identical functional characteristics: moai kavakava, moai moko, tahonga, ua, rapa, reimiro, moai papa and moai vie, kohau rongorongo, moai tanga manu and moai tangata. Only well-documented objects and those collected between the end of the 18th century and 1886 are presented here. These wooden artefacts are preserved in the following museums and private collections:


Great Britain: British Museum and private collection, London.

Italy: Collection of the Sacred Heart of Jesus and Mary, SSCC, Roma.

Belgium: Museum of Art and History, Brussels.

Germany: Museum of Ethnography, Cologne.

Norway: Museum of Ethnography of the University of Oslo.

Russia: Museum of Ethnology and Ethnography, Kunstkamera, St Petersburg.

Samples have been removed from all these artefacts except for those preserved in the British Museum collections, for which the author did not obtain official authorization and for the two kohau rongorongo of Santiago. However, macroscopic observations with a stereo microscope make it possible to put forward serious hypotheses concerning the woods used for carving these artefacts. Samples a few millimetres in length and in width, and a few tenths of a millimetre thick, were removed with a razor blade from the other artefacts. These samples were orientated perpendicular to the axis of the tree (cross section), perpendicular to the wood’s rays (tangential section), and parallel to the rays (radial section). Macroscopic examinations were also conducted. Botanical identification was carried out through comparison with reference samples in the collections of the National Museum of Natural History in Paris.

Botanical Identification of 200 Rapanui Wooden Carvings

Moai Kavakava

According to the legend of the origins of kavakava, the term applies without ambiguity to the ribs (named kavakava) of supernatural beings. These male statues have a characteristic face: Arches of the eyebrow with chevron overhanging circular eyes popping outside their orbit, aquiline nose with widely opened nostrils, prominent cheekbones, chin with a small hooked goatee, wide and contorted mouth and long ears with distended lobes. The body of kavakava is marked by the overdevelopment of the rib cage with ribs and breastbone visible (Figure 1). These male sculptures were shown during the communal festivities at the time of the harvests or the main seasons of fishing, when the Rapanui offered the first fruit or the first fish to the gods. They could be held in the hand or worn suspended around the neck, sometimes among about twenty of them.

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Table 1. Botanical identification of 42 Moai Kavakava.
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The wood of 42 kavakava was determined (Table 1) and it appears that more than 69% of these objects are carved in Sophora toromiro and only 10% in Thespesia populnea; 2 are in Robinia sp. and 2 are in a Conifer wood. 5 kavakava remain undetermined.

**Moai Moko**

Moai moko are hybrid beings, half man and half lizard (Figure 1). These sculptures, often male, have an ogival and flat head separated by a well marked neck sometimes decorated with a zigzag pattern. The arches of the eyebrow overhang circular eyes popping outside their orbit. The summit of the skull sometimes carries motifs of birds or roosters. Like moai kakavaka, the ribs are represented and the arms sometimes end with hands having long and curved fingers placed under the chin. The middle of the back presents a backbone ending with the tail of a fan-shaped bird. When it exists, a hole of suspension, situated in the middle of the backbone, allowed for wearing these objects in horizontal position. According to Métraux (1940:265) they were placed on each side of the entrance of houses as protection from ghosts. According to Geiseler, they were suspended from the neck of dancers during communal festivities. The wood of 19 moai moko was analyzed (Table 2); with the exception of one atypical moko carved in Robinia sp, all of them were carved from Sophora toromiro.
Figure 1: Rapanui wooden carvings. 1: Ua staff (SSCC P025), 2: Ao (British museum 5649), 3: Rapa (SSCC P030), 4: Moai moko (Museum of Art and History, Brussels ET 45.51), 5: Kohau rongorongo (Aruku kurenga SSCC P002), 6: Tahonga (SSCC P012), 7: Moai tangata manu (British museum 1928.5.17), 8: Moai tangata (Kunstkamera, St Petersburg P 402.2), 9: Reimiro (British museum 6847), 10: Moai papa (Kunstkamera, St Petersburg P 402.1), 11: moai kavakava (Museum of Art and History, Brussels ET 48.63). (drawings M. Orliac. Scale bars: 1, 2, 3, 9 above n°1; others near n°10).
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**Tahonga**

These round or often oval ornaments evoke the tern’s egg. They are generally divided in four parts by weak relief. A hole of suspension is drilled in their superior extremity, slightly swollen. This extremity is sometimes inlaid by two eyes reminiscent of the opening of the coconut (which possesses three of them), sometimes decorated with sculptures showing opposite human heads or heads of birds (Figure 1), or sometimes engraved with figures, some of which are carved in an identical way on the skull of moai kava kava. These neck ornaments were worn during annual festivities by the king (ariki), young men recently introduced, and by certain women.

The wood of 19 tahonga was studied (Table 3). Because of the difficulty of removing samples from round objects, it was not possible to identify the wood of four tahonga; only one tahonga was carved from Sophora toromiro, one from a Conifer and the 13 others (68,42%) from Thespesia populnea.

**Ua**

Ua staff have a slightly flattened section which becomes more marked on their base. Their superior extremity ends by a head (Figure 1) with two opposite faces, with eyes often inlaid with a fragment of obsidian inclosed in a bone of fish or bird. Ears are stuck on the head and the distended lobe often wears a cylindrical ornament; these characteristics, as well as prominent cheekbones, are present on anthropomorphic statues, in particular on moai kava kava. The nostrils sometimes contain a red colouring agent and the wide mouth sketches a light pout similar to that of the stone moai. This prestigious object was preserved, as the wooden sculptures, in a reed sheath. They were doubtlessly aristocratic sceptres.

18 ua staff were studied (Table 4); nine of them (50 %) were carved from Sophora toromiro, three from Thespesia populnea, and one from Robinia sp. The wood of five ua, of foreign origin, was not identified.
Table 3. Botanical identification of 19 *tahonga*

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Table 4. Botanical identification of 18 *ua* staff.

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Rapa

The *Rapa* are dance accessories. They are constituted of two blades gathered by a handle (Figure 1): the upper blade presents a very stylized human face reduced to a continuous curved line, representing ears and eyebrows and ending up by the rectilinear line of the nose. The lower blade which is divided in two parts by a discreet longitudinal nervure ends with a small exgrowth widened in the middle, sometimes interpreted as a phallic representation. *Rapa* were mainly used by military leaders when they performed dances in front of the high chief.

Wood from 17 *rapa* was analyzed (Table 5); all were carved from *Sophora toromiro*.

**Table 5.** Botanical identification of 17 *rapa*.

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Reimiro

The *Reimiro* are pectoral ornaments, crescent-shaped, which were worn by aristocrats, both men and women and by the *ariki mau*, the king of the island. The extremities of some *reimiro* are decorated with narrow human heads, with an aquiline profile, a sharp-pointed headgear like the one of the *moai kavakava* (Figure 1). The extremities of other reimiro are decorated with stylized shells (or maybe sperm-whale tails?) and more rarely with heads of birds. Exceptionally, they can take the shape of the body of an animal like fish or rooster. Some rare *reimiro* are engraved with signs similar to those of *kohau rongorongo* tablets.

Wood from 13 *reimiro* was studied (Table 6). The majority of them, eight (more than 61 %), were carved from *Thespesia populnea*; three were carved from *Sophora toromiro*, and two were unidentified because of the difficulties in taking samples.
Moai Papa and Moai Vie.

The female representations can be classified in two categories: *moai papa* and *moai vie*. *Moai papa*, rather rare, are bigger than *moai kavakava* and *moai tangata*. Compared to the body, the head is often too small. The arches of the eyebrow, sometimes with chevrons, overhang circular eyes popping outside their orbit like *moai kavakava*. The mouth is closed by fine and pinched lips like those of the *ua*. Some *moai papa* wear a small sharp goatee similar to that of the *moai tangata*. *Moai papa* are characterized by an extremely flat chest about 2 or 3 cm and an unusual bodily gesture (Figure 1). One hand is close to the vulva and the other one on the stomach or under a breast. The hands, with long fingers, often bent back, evoke the stone *moai*. Oral tradition reports that the first *moai papa* were carved by Tu’u Ko Ihu after he created the *moai kavakava* (Métraux 1940:261).

Other female sculptures called *moai vie* have the same bodily posture but with a more classic morphology. They distinguish themselves from *moai papa* by a much thicker chest.

The wood of about a dozen of female sculptures was studied (Table 7). More than half were carved from *Sophora toromiro*, one from *Thespesia populnea*, one from *Robinia sp* and three (one *moai vie* and two *moai pa’a pa’a*) could not be identified and are carved in foreign woods.

Kohau Rongorongo

*Kohau rongorongo* are wooden tablets covered on both faces with signs set out in regular lines, each line being upside down in relation to the previous one, so it is necessary to turn the tablet upside down "to read" the text (Figure 1). The reading, from left to right, begins at the bottom and ends at the top of the tablet. The signs, often complex, are similar on all the tablets. Strongly stylized, they notably represent, in a schematic form, the shape of tortoises, birds, fishes, mollusks, plants, human beings, *reimiro*, geometrical figures, moon crescents etc. Each sign presents variants and can be associated with other signs (Fischer 1997); the quality of their drawing is exceptional. They were engraved by means of an obsidian flake, a volcanic glass as cutting as a razor. These highly sacred objects were surrounded by strict taboos.

The wood of eight *kohau rongorongo* tablets have been investigated by the author (Orliac 1999a, 2005, 2007) and three by other institutions in 1933 (Lavachery 1934) (Table 8). Six are carved in *Thespesia populnea* and four in *Podocarpus sp.* (cf *Latifolia*); *Podocarpus* never grew on Rapa Nui, and I suspect that these four *kohau rongorongo* were carved from the same piece of foreign wood. The *rongorongo* in *Fraxinus sp.*, known as the oar because of its shape, probably comes from the paddle of a foreign vessel which stopped at the island.

<table>
<thead>
<tr>
<th>Museum</th>
<th>Inventory N°</th>
<th>Botanical family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2437</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>Musée du Quai Branly</td>
<td>87.31.75</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Picpus fathers SSAC, Roma</td>
<td>P023</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum of Ethnography, Cologne</td>
<td>n°32601</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>6330</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
<tr>
<td>British museum, London</td>
<td>7834</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
<tr>
<td>Calvet museum, Avignon</td>
<td>16800</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
<tr>
<td>Calvet museum, Avignon</td>
<td>16801</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
<tr>
<td>Picpus fathers SSAC, Roma</td>
<td>P024</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
<tr>
<td>Calvet museum, Avignon</td>
<td>16802</td>
<td>Malvaceae ?</td>
<td>Thespisia populnea ?</td>
</tr>
<tr>
<td>British museum, London</td>
<td>2601</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>British museum, London</td>
<td>9295</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
<tr>
<td>British museum, London</td>
<td>6847</td>
<td>Malvaceae</td>
<td>Thespisia populnea</td>
</tr>
</tbody>
</table>

Table 6. Botanical identification of 13 *reimiro*.  

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Moai Tangata Manu

Moai tangata manu or bird man representations are not standardized and vary in their forms and proportions. Often only the position of the wings (or arm-like wings) joining near lumbar vertebra, are the only common feature on a protuberance situated at the birth of a short fan-shaped tail. The variety of these moai, sometimes more bird than man, sometimes more man than bird (Figure 1), could depict the various stages of the transformation of an entity which could be, according to Thomson: "The big spirit Meke Meke (Make Make)" (Thomson 1891:470).

These artefacts are not numerous, and only eight of them were studied (Table 9). Six (more than 75 %) were carved from Sophora toromiro, and only two from Thespesia populnea.

<table>
<thead>
<tr>
<th>Museum</th>
<th>Inventory N°</th>
<th>Botanical family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Museum, London</td>
<td>2597 (pa’a pa’a)</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>Musée du Quai Branly</td>
<td>94.26.1 (vi’e)</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>Musée Kunstkamera, St Petersburg</td>
<td>402-1 (pa’a pa’a)</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>Museum of Ethnography, Cologne</td>
<td>46890 (vi’e)</td>
<td>Légumineuse</td>
<td>Robinia sp.</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>17927/200056(vi’e)</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>17615/200033(vi’e)</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Musée du Quai Branly</td>
<td>49.41.13 (vi’e)</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum National History, La Rochelle</td>
<td>H.858 (vi’e)</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Picpus fathers SSCC, Roma</td>
<td>P009 (vi’e)</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum of Ethnography, Cologne</td>
<td>48526 (vi’e)</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum of maritime hospital, Rochefort</td>
<td>39EX29 (pa’a pa’a)</td>
<td>Malvaceae</td>
<td>Thespesia populnea</td>
</tr>
</tbody>
</table>

Table 7. Botanical identification of 11 female moai.

<table>
<thead>
<tr>
<th>Museum</th>
<th>Inventory n°</th>
<th>Artefact</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musée Kunstkamera, St Petersburg</td>
<td>402/13-1</td>
<td>rongorongo/the small</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Picpus fathers SSCC, Roma</td>
<td>P002</td>
<td>rongorongo/Aruku Kurenga</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Picpus fathers SSCC, Roma</td>
<td>P003</td>
<td>rongorongo/Mamari</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Museum National Natural History, Santiago</td>
<td>315</td>
<td>rongorongo/the large</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Museum National Natural History, Santiago</td>
<td>314</td>
<td>rongorongo/the small</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Picpus fathers SSCC, Roma</td>
<td>P001</td>
<td>rongorongo/the oar</td>
<td>Fraxinus sp.</td>
</tr>
<tr>
<td>Musée Kunstkamera, St Petersburg</td>
<td>403/13-2</td>
<td>rongorongo/the large</td>
<td>Podocarpus sp. cf Latifolia</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1903.150</td>
<td>rongorongo</td>
<td>Thespesia populnea ?</td>
</tr>
<tr>
<td>Museum of Tahiti</td>
<td>ss n°</td>
<td>rongorongo/L’échancrée</td>
<td>Podocarpus sp. cf Latifolia</td>
</tr>
<tr>
<td>Museum of ethnography, Vienna</td>
<td>2270</td>
<td>rongorongo/the small</td>
<td>Podocarpus sp. cf Latifolia</td>
</tr>
<tr>
<td>Museum Natural History, Washington</td>
<td>129774</td>
<td>rongorongo/the large</td>
<td>Podocarpus sp. cf Latifolia</td>
</tr>
</tbody>
</table>

Table 8. Botanical identification of 11 kohau rongorongo.
Moai Tangata

These representations of human beings called moai tangata are not mentioned in oral traditions but one believes that they represent family ancestors. The most classic of these moai, which measure generally from 33 cm to 45 cm, are extremely rare. Contrary to the moai kavakava, their body are very naturalic (Figure 1). Their plasticity is underlined by a light bending of their members. The sensuality of their body is opposite of the rigidity of the expression of the face and the fixedness of the eyes. The moai tangata wears a small pointed beard identical to the moai kavakava’s. The skull is often decorated with an octopus or with three heads with long wavy hair.

As bird man representations, the moai tangata are very rare and the wood of only seven tangata could be investigated (Table 10). Five were carved from Sophora toromiro (more than 70%) one from Cypressus sp, and one was not identified.

<table>
<thead>
<tr>
<th>Museum</th>
<th>Inventory N°</th>
<th>Botanical family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musée du Quai Branly</td>
<td>ss n°</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>EP.27</td>
<td>Malvaceae</td>
<td>Thespiesia populnea</td>
</tr>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2438</td>
<td>Malvaceae</td>
<td>Thespiesia populnea</td>
</tr>
<tr>
<td>British museum, London</td>
<td>EP.26</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum of Ethnography, Cologne</td>
<td>40486</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1928.5-17</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Musée Kunstkamera, St Petersburg</td>
<td>MAE-735-203</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1979</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
</tbody>
</table>

Table 9. Botanical identification of 8 moai tangata manu.

Table 10. Botanical identification of 7 moai tangata.

<table>
<thead>
<tr>
<th>Museum</th>
<th>Inventory N°</th>
<th>Botanical family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musée du Quai Branly</td>
<td>87.31.66</td>
<td>Cupressaceae</td>
<td>Cupressus sp.</td>
</tr>
<tr>
<td>Calvet museum, Avignon</td>
<td>16.744</td>
<td>undetermined</td>
<td>undetermined</td>
</tr>
<tr>
<td>Kunstkamera Museum, St Petersburg</td>
<td>402-2</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British Museum, London</td>
<td>EP.24</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British Museum, London</td>
<td>EP.25</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum of maritime hospital, Rochefort</td>
<td>39EX28D</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>ss n°</td>
<td>Leguminous, Fabaceae</td>
<td>Sophora toromiro</td>
</tr>
</tbody>
</table>

Other Non-standardized Artefacts

The wood of 34 other atypical artefacts, whose functions are not easy to identify, was also taken into account in this study because of their antiquity: It consist of about 19 male, female or asexual anthropomorphe sculptures, seven zoomorphes representations, three ao (Figure 1), four haft of mata, and a hand.

The majority (44 %) of these 35 atypical wooden carvings were carved from Sophora toromiro, eight of them (23.5 %) are from Thespiesia populnea and six remain undetermined (17.6%). Five sculptures were cut in the rachis of a palm, the wood of Triumfetta semitriloba, Robinia sp and Pseudostuga sp (Table 11).
<table>
<thead>
<tr>
<th>Museum</th>
<th>Inventory N°</th>
<th>Artefact</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>British museum, London</td>
<td>EP.31</td>
<td>male anth.</td>
<td>undetermined</td>
</tr>
<tr>
<td>British museum, London</td>
<td>5849</td>
<td>ao</td>
<td>undetermined</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1953.14.2</td>
<td>zoom. bird</td>
<td>undetermined</td>
</tr>
<tr>
<td>British museum, London</td>
<td>EP 16</td>
<td>zoom. seal</td>
<td>undetermined</td>
</tr>
<tr>
<td>British museum, London</td>
<td>EP.30</td>
<td>zoom. fish</td>
<td>undetermined</td>
</tr>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2436</td>
<td>ao</td>
<td>undetermined</td>
</tr>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2434</td>
<td>haft of mata</td>
<td>Leaves rachis (palm)</td>
</tr>
<tr>
<td>Pierre Loti museum, Rochefort</td>
<td>ss n°</td>
<td>haft of mata</td>
<td>Leaves rachis (palm)</td>
</tr>
<tr>
<td>Musée du Quai Branly</td>
<td>80.59.22.2</td>
<td>haft of mata</td>
<td>Pseudostuga sp.</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>n°4-5</td>
<td>papa double head</td>
<td>Robinia sp.</td>
</tr>
<tr>
<td>British museum, London</td>
<td>EP.22</td>
<td>male anth. with hat</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1898.1010.13</td>
<td>male anth. double head</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Barbier Müller museum, Geneva</td>
<td>BMG 5701</td>
<td>male anth.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Kunstkamera museum, St Petersburg</td>
<td>N-736-205</td>
<td>anth.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>17431/200027</td>
<td>male anth./female anth.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>17616/200034</td>
<td>anth..asex.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>87L166</td>
<td>anth. asex.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>ss n°</td>
<td>anth.masc</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>17846/200054</td>
<td>anth.masc</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, Paris</td>
<td>17845/200053</td>
<td>anth.masc</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>5990</td>
<td>atypical tangata</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>EP.32</td>
<td>hand</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1950.04.12</td>
<td>zoom. Bird</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Calvet museum, Avignon</td>
<td>16 746</td>
<td>male anth.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Private collection, London</td>
<td>ss n°</td>
<td>male anth.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Museum of Ethnography, Cologne</td>
<td>32772</td>
<td>anth.</td>
<td>Sophora toromiro</td>
</tr>
<tr>
<td>Picpus fathers SSCC, Roma</td>
<td>P026</td>
<td>ao</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2445</td>
<td>chiton</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Calvet museum, Avignon</td>
<td>16745</td>
<td>Female anth.</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Picpus fathers SSCC, Roma</td>
<td>P010</td>
<td>head of moai</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Museum of Ethnography, Cologne</td>
<td>n°32600</td>
<td>head of tortoise</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2444</td>
<td>head of tortoise</td>
<td>Thespesia populnea</td>
</tr>
<tr>
<td>British museum, London</td>
<td>1953.14.1</td>
<td>human figure</td>
<td>Thespesia populnea ?</td>
</tr>
<tr>
<td>Museum of Ethnography, Oslo</td>
<td>2432</td>
<td>haft of mata</td>
<td>Triumfetta semitriloba</td>
</tr>
<tr>
<td>British museum, London</td>
<td>8700</td>
<td>male anth.</td>
<td>Thespesia populnea</td>
</tr>
</tbody>
</table>
Synthesis : The Main Woods for Rapanui Sculptures.

These series of 200 wooden carvings are very heterogeneous from the numerical point of view, (Table 12) and no definitive conclusions can be made.

Table 12. Botanical identification according to some wooden carvings with the same functional characteristics.

<table>
<thead>
<tr>
<th>Wooden carving</th>
<th>No studied</th>
<th>Main wood</th>
<th>%</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapa</td>
<td>17</td>
<td>Sophora toromiro</td>
<td>100%</td>
<td>17</td>
</tr>
<tr>
<td>Moai moko</td>
<td>19</td>
<td>Sophora toromiro</td>
<td>94,74%</td>
<td>18</td>
</tr>
<tr>
<td>Moai kavakava</td>
<td>42</td>
<td>Sophora toromiro</td>
<td>69,00%</td>
<td>29</td>
</tr>
<tr>
<td>Moai tanga manu</td>
<td>8</td>
<td>Sophora toromiro</td>
<td>75%</td>
<td>6</td>
</tr>
<tr>
<td>Moai tangata</td>
<td>7</td>
<td>Sophora toromiro</td>
<td>71,43%</td>
<td>5</td>
</tr>
<tr>
<td>Moai papa, moai Vi’e</td>
<td>11</td>
<td>Sophora toromiro</td>
<td>54,55%</td>
<td>6</td>
</tr>
<tr>
<td>Ua</td>
<td>18</td>
<td>Sophora toromiro</td>
<td>50%</td>
<td>9</td>
</tr>
<tr>
<td>Tahonga</td>
<td>19</td>
<td>Thespesia populnea</td>
<td>68,42%</td>
<td>13</td>
</tr>
<tr>
<td>Reimiro</td>
<td>13</td>
<td>Thespesia populnea</td>
<td>61,54%</td>
<td>8</td>
</tr>
<tr>
<td>Kohau rongorongo</td>
<td>11</td>
<td>Thespesia populnea</td>
<td>54,55%</td>
<td>6</td>
</tr>
</tbody>
</table>

However these analyses outline four tendencies (Figure 2):

1 - As one might expect, Sophora toromiro appears to be the main wood used for carving on Rapa Nui. It was used to carve the majority of these artefacts (56%), especially representations of spirits or ancestors, insignias of power, and the other objects necessary for the numerous rituals which punctuated the life on the island.

Sophora toromiro is a small tree about six metres high, which belongs to the family of Leguminous-Fabaceae. Endemic to Rapa Nui, where it formerly grew in abundance, the toromiro has today disappeared from its natural environment. According to oral tradition, this tree was introduced by Hotu Matu’a, the mythical first king of Rapa Nui; however, fossil pollen has proved that it had grown on the island for at least 38,000 years (Flenley, & King 1984).

The wood of Sophora toromiro, almost rot-proof, of a dark red colour when it is old, possesses exceptional mechanical qualities: it is very hard and heavy, and its grain is very fine. This small tree, which produces yellow flowers, was sacred and planted in sanctuaries near ahu, as attested by Duché de Vancy’s drawings from La Pérouse’s voyage (Dunmore, Brossard 1985, T2:68)

2 - Unexpectedly, Thespesia populnea, rarely mentioned in oral tradition, was also very valued because it was used as a support for the very sacred kohau rongorongo as well as for reimiro (which sometimes have rongorongo glyphs) and for tahonga. 23% of rapanui artefacts were carved in this wood.

Thespesia populnea, known on Rapa Nui by the name of makoi, is a tree about fifteen metres high; it belongs to the Malvaceae family and grows in eastern Polynesia on the shores of atolls and high islands. According to the botanist G. Zizka (Zizka 1991:51), the makoi may have been brought to Rapa Nui by the first settlers.

The wood of Thespesia populnea is slightly pink and sometimes dark red; it is called the “rose wood of Oceania” because, when an artist carves it when green, it gives off a characteristic pungent odour; this fine-grained and medium-density material is easy to work and polish. Formerly, Thespesia populnea had a strong symbolic value in eastern Polynesia. In Tahiti for example it was planted in the sanctuary (marae) near the ahu, the most sacred part of the monument; in this context it was called amae and noho ahu but also toromiro, which is surprising. This tree was indispensable as an emanation of the god Roro'o who inspired the priests in their devotions; among the trees of marae, it “was the most sacred...the one that sanctifies” (Henry 1988:168). Its wood, as well as its leaves and branches, were used during numerous ceremonies. For example, twigs of Thespesia, called moa, were necessary during the ceremony of the pai’ atua that is, the renewal of the wrapping which covered the image of the tutelary god (Henry 1988:181).
A significant quantity of artefacts remain undetermined (14%) because of the difficulties of taking samples on some of them but also because they are carved from foreign wood, difficult to identify; this is the case of some kohau rongorongo tablets. These pieces of wood probably came from driftwood or from materials recovered from vessels which have a high symbolic value; we can also imagine that the three crosses set up by the Spanish in 1770 on Poike gave a very precious raw material (Mellén Blanco 1986).

Finally, some artefacts are carved in Robinia sp., a tree introduced by the missionaries according to the archives of the Picpus fathers; indeed, Mrg Jaussen mentions that "In June, 1871, the missionaries left on Rapanui one half-hectare of vineyards, seven sorts of fig trees, peach trees, orange trees, Robinia, pines, badamiers etc. in a country where there are no trees" (arch-Roma 75-10 ms ssscc PAC 53b, p 165). Seventeen years later, in 1888 during his stay on Rapa Nui, father Albert Montiton indicates that "on the ground of the mission were two or three copses of acacias (Robinia sp.), posthumous pupils of destroyed plantations planted by the first missionaries. I had them all extracted and planted around the church and along the roads of the cemetery" (Archives SS.CC, PAC No 31:208). This tree, with a hard wood, valued by the presence of the missionaries who brought the « new gods », has all the qualities required for the production of wooden artefacts that the foreign sailors liked to buy.

Conclusion: Men, Trees and Gods

The choice of these woods used to carve artefacts of a sacred character is not due to chance and cannot be explained by simple plastic or mechanical criteria (Orliac 1993, 2000). Let us remember that other trees were formerly growing in the island (Orliac 1999 b) like Alphytonia sp. and Elaeocarpus sp; Sapindus saponia is always present on the island; these woods could have been used for carving. In fact, Sophora toromiro and Thespesia populnea have a special status in Rapa Nui; they were planted in the sanctuaries, near ahu moai, the monuments devoted to the divinities and in oral tradition they are associated with gods and the mythical ancestor Hotu Matu’a. Furthermore, these trees have yellow flowers and produce red wood which in eastern Polynesia are invariably the colours of gods.

Driftwood deposited on the shores also acquired a sacred character. When wood was lacking, any arrival of this "precious" material appeared to the Easter Islanders as a divine gift full of mana (supernatural power). This is
clearly exposed in the legend of Rano, whose body is metamorphosed into a great tree that the sea deposits on the shore; its branches will be transform into moai kavakava, rapa and moko (Métraux 1940:120).

When the missionaries arrived on Easter Island they planted different trees like Robinia sp. the leaves of which look like those of Sophora toromiro (whose number had largely declined on the island at this time). These trees were planted near the church and the cemetery and, in one way, they may also have acquired a symbolic value.

Although I think it is impossible to understand the reasons for the choice of specific wood for carving artefacts of the same functional characteristics, it nevertheless seems clear that on Rapa Nui, like everywhere in eastern Polynesia, raw materials played an important symbolic role. The knowledge of the woods used by carvers may give us a better insight to the mental universe of the Rapanui people and, consequently, a better understanding of the relations they maintained with nature, entirely inhabited by gods.

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References


Geiseler, W., 1883. Die Osterinseln, Berlin.


Jaussen, Msg. Archives de la Congrégation des SS.CC , Roma 75-10 ms sssc PAC 53b.


Empirical Assessment of a Pre-European Societal Collapse on Rapa Nui (Easter Island)

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Abstract - Leading archaeologists and popular writers have constructed narratives about pre-European societal collapse on Rapa Nui. The island is thought to have undergone a radical prehistoric shift towards anarchy as the island ecosystem was destroyed by overpopulation and environmental catastrophe. Elements of this story were first told by early 20th century ethnographers. In 1955, Thor Heyerdahl’s Norwegian Expedition added to the narrative by recovering archaeological data which they attributed to warfare and destruction. More recent authors have retold the account of prehistoric societal failure, and today Rapa Nui is often depicted as a model for world ecosystem disaster. Despite the popularity of this narrative, there is very little solid evidence that drastic societal change occurred prior to European contact. We review the evidence for pre-European societal collapse, and consider GIS-based methodologies for establishing the dynamic social and environmental landscape to enable the empirical evaluation of whether or not the narrative of Rapa Nui’s prehistoric demise is supported.

Introduction

“The fascination of Easter Island lies, not in the purported ‘mystery’ of its stone statues or rongorongo tablets, but rather in its evolutionary record of cultural achievements … which were inevitably to crumple under pressures of over-population and environmental degradation. Easter Island is the story of a society which – temporarily but brilliantly surpassing its limits – crashed devastatingly” (Kirch 1984:264)

Few places in the world have captured as much attention for their archaeological significance as Rapa Nui (Easter Island). The existing culture-historical model for Rapa Nui’s pre-European contact (before AD 1722) cultural trajectory is one in which the island is portrayed as a classic example of “overshoot and collapse” that occurred due to overpopulation and resource depletion (see Anderies 2000; Bahn and Flenley 1992; Brander 2004; Brander and Taylor 1998; Diamond 1994, 2005; Flenley and Bahn 2002; Kirch 1984; Mahon 1998; Rolett and Diamond 2004). These scholars suggest that Rapa Nui society disintegrated and crashed after the islanders degraded their environment and allowed their population to reach an unsustainable level. Authors have gone so far as to use the island as an analogy for the planet (Bahn and Flenley 1992; Diamond 2005; Flenley and Bahn 2002; Ponting 1991; Wright 2005) in their interpretations, suggesting that the Rapanui people brought an ecological catastrophe upon themselves in the late pre-contact sequence.

The notion of ecological collapse due to human-induced environmental change on Rapa Nui has recently been called into question by numerous scholars. Hunter-Anderson (1998) notes that evidence for physical erosion on the island is lacking and that climatic factors may have been more significant than human-induced change (see also McCall 1993), while Rainbird (2002), Peiser (2005) and Hunt (2006) discount the notion of a prehistoric collapse and instead attribute the societal collapse to introduced European diseases. Hunt (2007) suggests that
Polynesian rats were responsible for palm deforestation (said to have been a primary component of the ecological collapse) because they consumed the nuts, prohibiting the forest from regenerating. Tainter (2006) questions the classification of Rapa Nui as a classic example of “overshoot and collapse”, bringing forth evidence that is contradictory to a human-induced ecological collapse, including agricultural intensification, social factors, and the role of rats in the loss of the palm forest. As Hunt and Lipo (2007) point out, no studies have provided sufficient evidence for a cultural and ecological collapse on Rapa Nui prior to European contact. This paper builds on that work by empirically assessing the wide range of archaeological, palaeoecological, and ethnohistoric data that has been used by researchers to construct the collapse narrative.

The Society that Self-destructed?

The majority of archaeological syntheses (Bahn and Flenley 1992; Flenley and Bahn 2002; Heyerdahl and Ferdon Jr. 1961; Kirch 1984, 2000; McCoy 1979; Van Tilburg 1994) and popular accounts (Diamond 2005; Wright 2005) of Rapa Nui prehistory portray the island as the locale of societal collapse brought on by a self-induced ecological catastrophe, namely through deforestation and over-exploitation of natural resources. Although some scholars have proposed different causal mechanisms for the supposed downfall of Rapa Nui society, such as prolonged isolation (Van Tilburg 1994), detrimental effects of climatic change associated with the Little Ice Age or ENSO events (McCall 1993; Orliac and Orliac 1998), or European contact before 1722 (Langdon 1975), most scholars conclude that major environmental changes triggered a detrimental societal change involving the replacement of a hierarchical socio-political system with a new competitive order. The late pre-contact period is generally characterized as a time of fragmentation, warfare and famine.

Thor Heyerdahl’s famous 1955 Norwegian Expedition was the first to present the story of prehistoric collapse in developing a culture history for the island (Heyerdahl and Ferdon 1961). Their culture historical model was based on archaeological investigations and information from ethnographic accounts. Recorded oral traditions were combined with limited archaeological data to divide the cultural sequence into three periods. The date of ca. AD 1680 was established as the chronological marker of the fall of Rapa Nui society based on the correlation of ethnographically recorded genealogical estimates combined with a single radiocarbon determination from the so-called ‘Poike Ditch’ (Smith 1961). This date marked the beginning of a period characterized as “unsettled”, where warfare, cannibalism, and famine were rampant (Heyerdahl and Ferdon 1961). In subsequent archaeological studies, this culture-historical scheme provided researchers with a framework within which to interpret various lines of archaeological and palaeoecological data. The adequacy of the archaeological data on which the Norwegian Expedition culture history was based was questioned by Golson (1965), but this critique went largely unnoticed (but see McCoy 1979; Mulrooney et al. under review; Vargas et al. 2006). In his extensive review of their work, Golson emphasized the unsatisfactory nature of establishing a chronology based on very limited and ambiguous data. He suggested that the dates established by the excavators seemed to be too early based on their limited chronometric data, and he recommended that a date as late as AD 1750 might be more appropriate to use as a chronological marker of the beginning of the Late Period. Significantly, the validity of the Norwegian Expedition’s scheme was generally not questioned by subsequent researchers and has been used to develop a general culture historical model that depicts the rise and fall of a civilization that self-destructed in the pre-contact period.

According to the existing model, three general phases comprise the Rapa Nui cultural sequence. Some researchers (Ayres 1975; Stevenson 1984, 1997; Stevenson and Haoa 2008), following the Norwegian Expedition’s model, place the transition to the third phase at c. AD 1680, while others (Kirch 1984, 2000; Lee 1986; McCoy 1976; Mulloy 1978; Van Tilburg 1986; Vargas et al. 2006) argue for societal collapse in the 16th century (Figure 1). In the accepted culture historical model, the first two phases were marked by settlement and expansion into optimal locations, the establishment of territories, rapid population growth, and the development of an ideologically and politically centralized social hierarchy (Stevenson 1997, 2002). The ideological basis of society was expressed through ceremonial architecture and eventually resulted in the alteration of initial settlement locations into centralized sacred locations adjacent to large coastal religious structures (ahu) (Stevenson 1986). The population was divided into a number of distinct territories (mata) made up of corporate descent groups, with large ahu platforms with large statues (moai) within each community level division (Stevenson 2002). The movement of key resources, such as volcanic tuff from Rano Raraku used in the carving of moai, red scoria from Puna Pau used to fashion pukao (topknots, or headdresses for statues), and obsidian from Maunga Orito, Motu Iti and Rano Kau used to make stone tools, shows that there was widespread cooperation amongst territorial groups (Stevenson 2002). During the second phase, major deforestation and widespread physical erosion are thought to have occurred, due to the use of timber to aid in the transport of statues and the clearing of land for intensified agriculture (Mieth and Bork 2004). Toward the end of the second
general phase, the greatest socio-political complexity and the most intensive level of agricultural production are thought to have been developed on the island. Inland regions contained managed field systems (Stevenson 2002; Stevenson et al. 1999; Stevenson and Haoa 2008) and status differentiation was manifest in the form and distribution of different types of residential, agricultural, and religious features (Martinsson-Wallin 1994). This phase is thought to have ended abruptly at the beginning of the third general phase some time between AD 1500 and AD 1680 with the onset of warfare and the replacement of the centrally organized chiefdom with a competitive political system (Diamond 2005; Stevenson 1997, 2002).

The “political upheaval” that is said to have occurred during the third general phase is thought to have been brought on by massive environmental degradation and subsistence stress, coupled with population overgrowth. According to most researchers, this resulted in changes to the settlement pattern and shared ideological beliefs that continued into the protohistoric phase. As Rapanui people adapted to an impoverished environment, the statue-building industry is thought to have ceased (Diamond 2007; Martinsson-Wallin 1998), inland agricultural fields were abandoned (Stevenson 1997), and the period is characterized as one of fortified settlement in refuge caves and internecine warfare between two loosely defined factions on the western and eastern sides of the island (Flenley and Bahn 2002; Van Tilburg 1994). Scholars agree that these proposed changes were abrupt and radical, and that a drastic shift in the overall socio-political system occurred. The chiefly elite of the hierarchically organized society were displaced from power and replaced by a new warrior class (matato’a) and warring groups intentionally toppled the statues of other groups. According to most researchers, long periods of warfare ensued, the society disintegrated into a state of anarchy, and there was a drastic demographic collapse.

### Palaeo-ecological Data

In the existing model for societal collapse on the island, detrimental human induced environmental change is conceived as the causal mechanism for the collapse of the society. Human-induced deforestation of the palm forest is said to have been complete by no later than AD 1640, leading to physical erosion (Flenley and Bahn 2002). Mieth and Bork’s study on the Poike Peninsula led them to conclude that “an unstoppable process of degradation set in after deforestation, in the course of which the fertile soils were eroded, re-sedimented and thus withdrawn from horticultural use for a long time” (Mieth and Bork 2004:82). Mann et al. (2004:148) also argue, based on their work on Poike, that primeval soils were “severely eroded” beginning abruptly at AD 1200. However, conclusive evidence for the processes of deforestation and resulting physical erosion is limited. The extrapolation of physical erosion on a very restricted area on the Poike Peninsula to the rest of the island is unjustifiable as there is little evidence for the massive island-wide “almost ubiquitous soil erosion” that Mieth
and Bork present (2004:90). A detailed land evaluation study by Louwagie (2004; Louwagie et al. 2006) shows that the marginal to moderate soil characteristics on the island had more to do with nutrient availability than they did with water availability or erosion resulting from deforestation. In fact, Louwagie et al. (2006:312) note that the marginal status of Rapa Nui soils “did not develop after erosion of a fertile forest soil that may have been present before deforestation.” They go on to conclude that sheet erosion that resulted in the exposure of less fertile strata was limited to small areas and that these events actually pre-date human arrival on the island.

The palynological work of Flenley and his colleagues indicates that deforestation occurred, but these studies have been inconclusive in establishing the exact timing of this process (Flenley et al. 2007). Their work at the Rano Kau crater lake is the most extensive palynological study to date on the island, and they conclude, based on two pollen cores at this location, that the process of deforestation occurred from ca. AD 676 to AD 1550 (Flenley 1993, 1996, 1998; Flenley and King 1984; Flenley et al. 1991). They assume that the deforestation represents anthropogenic change as people intentionally cut down the entire forest for statue transport and agricultural intensification. However, this assumption may be erroneous, as it is conceivable that rats, not humans, played a major role in preventing forest regeneration through the consumption of palm seeds (Bahn and Flenley 1992; Flenley and Bahn 2002, 2007; Hunt 2006, 2007; Hunt and Lipo 2007; Tainter 2006). Alternatively, the analysis of wood charcoal by Orliac and Orliac (1998; Orliac 2000) suggests that the rapid shift from the use of ligneous fuels to herbaceous fuels during the late 17th century documents a much more rapid environmental change than that suggested by long-term forest clearance. The causal link between palaeoecological and archaeological data is not sufficiently evidenced, and the story of a societal collapse triggered by environmental degradation is based on a priori assumptions that are currently not supported by the palaeoecological data.

**Archaeological Data**

The existing culture historical model described above has shaped interpretations of various lines of archaeological data, and the types of data collected have been shaped by the assumption that this model is accurate and meaningful in Rapa Nui studies. Settlement pattern analyses (McCoy 1976; Stevenson 1984; Vargas 1998; Vargas et al. 2006), studies of burial practices (Seelenfreund 2000; Shaw 1996, 2000a, 2000b), stylistic analyses of artifacts and ahu structures (Ayres 1975), and rock art studies (Esen-Baur 1998; Lee 1986, 1992, 1993) have all been interpreted within the culture historical framework for societal collapse. The summation of this model in more recent syntheses of Rapa Nui prehistory has drawn from these lines of data, along with palaeoecological data, to reify the prehistoric collapse of Rapa Nui society (Diamond 2005; Flenley and Bahn 2002; Kirch 2000).

According to Kirch’s (2000) synthesis, a societal collapse is “well-marked in the late prehistoric archaeological record” (2000:274). Kirch notes that the collapse of Rapa Nui society is evidenced by the manufacture of obsidian spear points, the destruction of elite dwellings, habitation in refuge caves, cannibalism, a change in burial practice, and a marked ideological shift away from ahu structures to the worship of the Birdman (tangata manu) cult centered at Orongo. To this, other researchers have added evidence for the abandonment of inland field systems and houses and decreased population levels (Stevenson 1984, 1986, 1997; Stevenson and Haoa 2008). However, in examining the data on which these conclusions are made, it is clear that there is ambiguity. Artificial evidence in the appearance of obsidian mata’a, which have been interpreted as spear points, in the 15th and 16th centuries, and their proliferation in the 18th and 19th centuries, has been interpreted as evidence of endemic warfare on the island in the collapse literature (Bahn 1993; Flenley and Bahn 2002). Flenley et al. (2007) suggest that there is strong evidence for the use of these artifacts as weapons based on early European accounts and ethnohistoric documents. However, as Hunt and Lipo (2007) point out, plant remains found in surface use-wear analyses point to a function as agricultural implements rather than weaponry (Ayres et al. 2000; Church 1994, 1998; Church and Ellis 1996). Thus, Flenley et al.’s (2007) assertion that these artifacts functioned as weapons ignores the archaeological evidence, instead preferring post-contact observations.

The destruction of elite dwellings has been proposed based on the distribution of individual hare paenga stones (well-dressed basalt curbstones used in the foundations of elite houses) across the landscape, and the re-use of these stones in other structures. Although it is evident that elite houses were destroyed and re-fashioned, the timing of such events is unknown. The re-use of hare paenga stones in ana kionga (fortified refuge caves) is widespread (Stevenson 1997), but the dating of such structures is ambiguous. The interpretation of these features as a new type of habitation feature during the late prehistoric sequence is unsubstantiated based on limited chronometric data obtained from a small sample of these features. To date, only two ana kionga have been securely dated on the island, and frequency distributions of 50 obsidian hydration dates from these features have
been interpreted as supporting the collapse model due to an increase in the frequency of dates from the 17th century (Rorrer 1998). However, the dating of these ana kionga suggests somewhat continuous occupation throughout the late prehistoric sequence and into the historic period (Figure 2). Possible evidence for a marked increase in occupation is only apparent at one of the two locales during the 17th century, which is insufficient for documenting a dramatic settlement shift. Additionally, the timing of the fortification of these locales has not been firmly established.

The presence of charred human remains in middens has been documented as evidence for widespread cannibalism on the island, as well as endemic warfare (Kirch 2000). However, as noted by Hunt and Lipo (2007), osteological studies have shown that “few fatalities were directly attributable to violence” (Owsley et al. 1994). Although Owsley has been cited as saying that there was evidence of “blunt force trauma” (Flenley et al. 2007; Van Tilburg 1994:107), this only occurred in approximately 2.5 percent of the collection of skeletal remains that were examined. In addition, Owsley et al.’s sample of 462 individuals is loosely dated to the Late Pre-contact and Proto-Historic Periods (dated to AD 1680-1750 and AD 1750 to 1868, respectively). Therefore, the limited “blunt force trauma” that Owsley et al. document is not securely dated to the pre-contact period. Hunt and Lipo (2007:94) also rightly point out that cannibalism “remains unproven for Rapa Nui” and that “to date, no unambiguous evidence for cannibalism has emerged.” Given the prehistoric practice of making fishhooks and needles from human bone, the presence of small pieces of human bone in middens is not surprising, and does not conclusively suggest cannibalism. Furthermore, the occurrence of burnt human bone would be expected, based on the fact that cremation was utilized prehistorically.

Late changes in burial practices from cremation to bundle or extended burials in rebuilt ahu structures, below toppled statues, in caves, and in above ground tombs (avanga), have been contextualized within ideological changes that occurred as the society collapsed (see Martinsson-Wallin 1994; Shaw 1996, 2000a, 2000b). None of these changes have been securely dated to the prehistoric era, however. Sixty-six dates have been obtained from burial contexts using obsidian hydration dating (Figure 3). However, these dates may be indicative of activities other than interment, such as the construction and refashioning of architectural features. In each of the burial types examined, there is a significant increase in obsidian samples dating to the period from AD 1750 to 1850, which may indicate that the use of the tombs and caves for burials may have only occurred following European contact. Nonetheless, the inherent difficulty in establishing temporal relationships between artifacts and burial events makes this line of data especially difficult to assess.
The ideological shift from coastal *ahu* structures around the island to the singular ceremonial centre at Orongo and the emergence of the Birdman cult have been presented as an innovative ideological framework that developed with a new competitive political order as the society collapsed (see Lee 1986, 1993). However, the limited sample of radiocarbon dates from Orongo indicates use from the 15th century until the 18th century (Lee 1986). The characterization of the Birdman cult as “militaristic” has recently been called into question as well (Esen-Baur 1993) and there is no conclusive evidence to show that this ideological framework was separate from the prehistoric statue-building ideological system, nor that it was developed following a prehistoric collapse (see Van Tilburg 2006).

A significant shift in the settlement pattern of the late cultural sequence has also been proposed (McCoy 1976; Stevenson 1984, 1986, 1997; Vargas 1998; Vargas *et al.* 2006), with a shift in habitation areas from inland regions back to the coast as the population decreased following cultural and ecological collapse. The abandonment of inland agricultural fields and residential features has been proposed based on the dating of five residential features in Maunga Tari (Stevenson 1997). Of 105 dates obtained using obsidian hydration dating and radiocarbon analysis, 101 fall before A.D. 1600, leading Stevenson to extrapolate a model for the entire island based on this limited sample, which is insufficient for documenting an island-wide trend. Based on the cumulative probability distribution of over 1000 obsidian hydration dates from residential features on the south coast, Stevenson (1997) also concludes that demographic collapse is evidenced by a drastic decline in settlement from AD 1650 to 1699, which is manifest in decreased obsidian consumption (Figure 4). However, this interpretation is far from conclusive. This decrease in obsidian consumption from AD 1650 to 1699 may not necessarily reflect demographic change. The subsequent increase in obsidian consumption during the 18th century does not support the notion that a dramatic demographic collapse occurred previously. Flenley and Bahn (2002; Bahn and Flenley 1992) attribute this increase to the increased manufacture of obsidian *mata’a*. However, the fact that these artifacts do not appear to have been used as weapons does not support the notion that they proliferated as a by-product of a disintegrated, competitive political system that was apparently in place at this time. A dramatic decrease in obsidian consumption does not appear to have occurred until well after European contact (also see Vargas *et al.* 2006).
It is clear, based on the archaeological data, that a dramatic shift is not “well-marked” in the archaeological record from the late pre-contact period. The collapse narrative is based on assumptions about human remains representing cannibalism, the ambiguous dates from two refuge caves and 18 burial contexts, an ideological shift with limited temporal precision, and an island-wide settlement model that is based on limited settlement shifts (the ambiguous dating of residential features and five sites associated with an inland field system) projected onto island-wide changes. The supposed artifactual evidence for warfare, a shift in habitation to refuge caves, and a major ideological change are scarcely substantiated by the present data. Limited dating of burials, residential features, and ceremonial features lends little support to the notion that the use of these features drastically changed during the late pre-contact period. In addition, the supposed demographic collapse that is said to have occurred is speculative, given that it is based on a decrease in obsidian consumption that was followed by an increase in obsidian consumption. Likewise, the proposed abandonment of inland agricultural field systems is in need of validation. It is clear that the orthodox model for prehistoric collapse has been established and reified based on very limited archaeological data.

Ethnohistorical Data

The logs of early explorers (Roggeveen in 1722, González de Haedo in 1770, Cook in 1774, and La Pérouse in 1785) lend insights into the social and environmental conditions on Rapa Nui during early encounters, and these logs do not support the orthodox model for prehistoric collapse on Rapa Nui. The earliest reports do not depict an anarchic society characterized by famine and warfare. Conversely, Jacob Roggeveen’s crew, the first European visitors to the island, described the people as tall, muscular, and well-proportioned (Behrens 1903), and noted that they had a variety of agricultural foodstuffs, which they traded with the explorers. He noted that the women “…sat before us and disrobed, laughed, and were very friendly…and beckoned us to come with them…” (Behrens 1903:136). He did not observe any evidence of warfare amongst the people, and did not note that any of the moai were toppled. In fact, his logs describe a ritual in which people knelt before the statues and bowed their heads, which suggests that the ahu and moai still had an important ideological role. Similarly, the Spaniards who briefly visited part of the island in 1770 noted that the islanders had a “docile disposition” and did not mention any indication of warfare or that statues had been toppled (Fischer 2005:62). In contrast, during Cook’s visit in 1774, he noted that many of the statues had been pushed over, cultivations had been destroyed or abandoned, there was little fresh food to be had, and the people were “small and miserable” (Brander 2004; Fischer 2005).

Based on the observations of these early explorers, it appears that the “Huri Moai” (statue toppling) or Decadent Phase did not occur until well after European contact. Therefore, these reports would indicate that any cultural collapse, as evidenced by warfare and an ideological shift, occurred during the late 18th century. In his ethnography, Métraux (1957:169) notes that during the late 18th century or the early 19th century, a series of
inter-tribal wars were waged, resulting in the intentional destruction of statues on ceremonial *ahu* platforms. These conflicts were known as “the wars of the throwing down of the statues”, and it is clear that the society underwent significant changes during this post-contact time period.

Limited information also comes from later explorers, traders, and missionaries who visited the island during the 19th century. During this century, the island experienced a “fatal impact” with westerners, resulting in a high mortality rate due to introduced diseases and the removal of islanders by the blackbirding trade in the early 1860s. The population reached a mere 110 individuals in 1877 (Fischer 2005:121), which resulted in the loss of a wealth of information in the form of oral traditions and traditional knowledge of the past.

The period from the 1880s to the 1940s saw the arrival of ethnographers and the first scientific expeditions to the island. The ‘salvage ethnographies’ of Thomson (1891), Routledge (1919), Englert (n.d., 1948, 1970) and Métraux (1940, 1957) have become indispensable accounts of traditional Rapanui society as it was described by local informants. These ethnographies contain extensive information on Rapa Nui social structure, customs, and beliefs. However, these documents must be examined with caution due to the context in which they were recorded. The severe decline in population experienced during the 1870s would have resulted in the loss of knowledge from oral traditions, and those stories that were subsequently collected may have been shaped more by the contemporary social context than the historical period that they were supposedly describing. It has been hypothesized that these ethnographies “relate principally to the final century of Rapa Nui political history as an independent island, and reveal little about the organization of the chiefdom prior to the impacts of western culture” (Stevenson 2002:213-214).

**Conclusion**

The inadequacies of archaeological, palaeoecological, and ethnohistorical data are clear, but have been largely ignored in the popular and academic literature. To date, there is no conclusive evidence for the proposed pre-contact collapse of Rapa Nui society. Although researchers have begun to question the existing model in the archaeological literature in recent years (e.g. Hunt 2006, 2007; Hunt and Lipo 2007; Hunter-Anderson 1998; Peiser 2005; Rainbird 2002; Tainter 2006; Young 2006), these critiques have offered limited evidence to the contrary. By reviewing the evidence for pre-contact collapse, we have shown that the empirical evidence for prehistoric collapse is lacking. The ambiguous nature of many lines of data does not warrant asserting claims of “environmental suicide” (Diamond 1994:366) and a “downward spiral of cultural regression” (Kirch 1984:264) during the late pre-contact period. The question of whether or not a prehistoric ecological and societal collapse occurred on Rapa Nui is still debatable, and further archaeological data is needed to refute this widely accepted model.

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References


Behrens, C. F., 1903. Another Narrative of Jacob Rogeveen’s Visit Translated by the Editor from the German of Carl Friederich Behrens. In B. G. Corney (Ed.), *The Voyage of Captain Don Felipe Gonzalez in the Ship of the Line San Lorenzo with the Frigate Santa Rosalia in Company to Easter Island in 1770-1*. Cambridge: The Hakluyt Society, pp. 131-137.


Stevenson, C. M. and S. Haoa, 1998. Prehistoric Gardening Systems and Agricultural Intensification in the La


On the Road of the Winds:
Journeying Across the Blue Water of the Pacific, and
Along the Roads of Rapa Nui

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Abstract - In (1963) Koskinen first wrote about the strong symbolism attached to the “path” in Polynesian thinking. Clearly within Pacific societies, a disparate range of human experience is expressed and understood with regard the idea of movement through space as a dominant form of metaphoric extension. This paper continues this discursive framework and outlines an initial attempt to explore the idea of journeying as a transformative experience within Polynesian social life. Through considering the role of transformation within “road” journeys, a comparison is presented between voyages across the Pacific and journeying along the moai roads of Rapa Nui.

Introduction

In the words of Patrick Kirch “the history of the Pacific is more than anything a history of voyages, and all that word entails: curiosity, courage, skill, technique, stamina, doubt, hope and more” (2000:392-3). That such voyages should be described as traversing ‘the road of the winds’ is an interesting characterization and one that influences the scope of this contribution. In this paper I wish to think about the nature of Polynesian journeying by both sea and land. This comparison may appear disparate but represents an attempt to draw out a better understanding of the role of journeying in the negotiation of pre-contact Polynesian social identity and its transformation. In particular, I suggest that within a prehistoric Polynesian context, journeying provided not merely a metaphorical medium for articulating strategies of change, but one based upon an altered embodied experience. My ultimate argument is that different forms of journey by sea and land affected a phenomenological rendering of cosmology, thereby providing a physicality to otherwise transcendent concepts (Richards 2008).

My point of departure, however, is not the South Pacific, but the 1934 Academy award winning film, It Happened One Night. In this picture Ellie Andrews, played by Claudette Colbert, detaches herself from her wealthy background and embarks on a ‘road’ journey, from Florida to New York. Along the way she inevitably encounters an array of people, including an unexpected travelling companion Peter Waine, played by Clark Gable. For Ellie Andrews, her passage along the road constitutes a life changing experience and when she ultimately returns home and is reinserted into her social context she is quite simply a different person (Cohan & Rae Hark 1997: 5). This personal transformation is a consequence of displacement and incongruence, in this case enlightenment is produced through exposure to a variety of people and situations along the road. Here, the ‘road’ represents both a revelatory and transformative medium producing, in Ellie Andrews, an altered understanding of both herself and the world she inhabits. Essentially, she becomes a wiser and better person and It Happened One Night captures an essence of journeying as one of transformative practice that leads to social and moral awareness in the context of relatively low risk.

This image of the ‘road’ as being a medium and metaphor of transformation is also present within the 1969 film Easy Rider. In this film it is the experiential nature of the road trip that is the primary ‘vehicle’ of portraying a highly metaphorical and allegorical journey. Interestingly, themes involving difference and the juxtaposition of social values are powerfully articulated through the vehicles of transportation: the ‘chopper’ motorcycles. Indeed, within Easy Rider the motorcycles can be viewed as highly charged symbols embodying the condensation of meaning that Turner (1967) attributes to ‘dominant’ symbols. To ride a motorcycle is also ‘raw’ and exciting, and produces a very different bodily experience to walking or travelling within an enclosed vehicle. Sitting astride their vibrating, powerful, silver machines, Captain America and Billy, with the wind in their faces, travel within highly varied and spectacular landscapes with broad open vistas. Unsurprisingly, a large proportion of the film is concerned with attempting to communicate this experience to the audience through extensive footage of the travellers riding along the open road. The physical experiences of motion, as opposed to metaphors of the road, are undoubtedly intended as a powerful discourse in the exploration of issues of change, difference and alienation.
For Captain America, played by Peter Fonda, and Dennis Hopper’s Billy, the journey as a form of emancipation is at once illuminating and dangerous. As the voyage from LA to New Orleans to Florida, unfolds, the road gradually takes on a darker quality as the familiarity of the Californian desert is left behind. Strangers encountered along the route are progressively ambiguous and different, and consequently the journey becomes increasingly dangerous. As with It happened one night, the characters of Easy Rider are transformed by their experiences, but unlike the former the nature of this change is more risk-laden and complex than some form of social or moral enlightenment.

Ultimately, the very incongruity which facilitates the transformatory experience for the travellers, also provides the context of their demise as they are brutally murdered by strangers. Taken at its simplest, this is a result of social difference and the threat of the ‘other’. However, their journey is teleological and failure is realised before their violent deaths occur and is succinctly voiced in the words of Captain America - “we blew it”.

These differing views of the ‘road’ and the experiences of the journey that they portray are obviously grounded in the different historical contexts of the United States during the 1930s and 1960s. However, despite the substantial differences between these periods we see similar themes of ‘the road’ and ‘the journey’, through both practice and metaphor, being deployed in alternative ways to create extremely different but equally evocative social commentaries. Perhaps these themes also provide an interesting way to think about journeying both on land and at sea in other social contexts. In particular, an argument can be made that there are similarities between these two very different mediums of travel, in terms of categories of social identity and their transformation and manipulation.

Voyaging Across the Pacific Ocean

The colonization of the Eastern Pacific is indeed a story of great ocean voyages (Kirch 2000:392-3). The ‘Polynesian triangle’ represents the traversing of vast stretches of blue water by Polynesian voyagers (Figure 1). Unsurprisingly, voyaging is a consistent theme in Polynesian oral traditions (e.g. Finney 1996:108) and is a characteristic of Polynesian life that forms a strong component in the construction of social identities. For example, many of the rich oral traditions defining Maori social groups are predicated on the voyages from Hawaiki to Aotearoa, the named canoes that carried them, and the places where they landed. It is these accounts, including the genealogies, which invoke and imbue a sense of belonging between people and ‘place’. Material constituents of ‘place’, such as boulders, rock outcrops, etc., recognised as components of voyaging canoes or their occupants (Orbell 1985b:108-11), act as mnemonics of these fabulous journeys. Hence, origin voyages are a central feature of Polynesian life, being invoked through engagement with materialities of memory framed by genealogical discourses. A consistent theme is one of constructing social identities through specific and strategic recollections of a past that involved transformation through journeying. In this instance, such pasts are frequently traced back to eventful voyages from Hawaiiki, and specifically, the particularities of island colonization. Given the clear inter-relationship between voyaging and the construction of social identity it is surprising that Finney (1991: 398) was startled by both the political expectations and the demands of his Polynesian colleagues for ‘authenticity’ within the Hokule’a project.

As voyaging had effectively disappeared by the contact period, assessing motivation for colonization of the Pacific triangle relied on ethnological accounts and archaeological assumptions. For instance, Dening tells us that “the main motives for less spectacular journeys were economics and war” (1972:121). More substantial voyages which transported ‘micro-societies’ were attributed to ‘civil unrest’ (ibid:124), created by population pressure, political competition, etc. (e.g. Kirch 1984:81-82). A more abstract reason that continually re-occurs in both traditional accounts and archaeological interpretation is the passion or love of adventure and travelling (e.g. Haddon & Hornell 1975:45; Firth 1936: 32; Irwin 1980:328). Could it be that what is consistently interpreted as the urge to adventure (Lewis 1994:17; Finney 1996:109), belies something altogether different?

Undoubtedly, physical engagement with the sea and seawater constitutes an altered experience of the world in terms of embodied practice. To be at sea imposes physical variation in stability and motion; hence, to be in or on water requires the employment of different bodily actions and human senses. The point to be made here is that bodily engagement with water as a substance, materially and experientially represents difference and becoming different (see Handy 1927:52-53). Such difference is a physical quality of the ocean voyage, when the stability of land is substituted for the constant motion of the ocean. The Pacific Ocean is far from stable and predictable.
Dramatic changes in weather conditions can occur very quickly at sea, thereby creating uncontrollable and unpredictable circumstances that are not open to social intervention. Thus, apart from the obvious transformative qualities of (sea) water itself, storms at sea can create conditions where voyagers are removed from the world of social control to a chaotic and dangerous world of supernatural forces. For those voyaging through such conditions, if fortunate enough to survive, a return is consistent with the ritual process of re-aggregation. Interestingly, it is in this context of voyaging as rites de passage that the frequent role of storms and strange adventures within the theme of ‘drift voyages’, within traditional accounts of island colonization may be better understood (cf. Sharp 1957, 1964).

Another way in which social attitudes towards the sea become discernable is through the significance attached to the status of the voyaging canoe. Although ethnographies are slippery tools for archaeological understanding, one consistent observation of such accounts in the Pacific is the ‘sacred’ status of large ocean-going canoes. The *tapu* surrounding construction practices was not only to facilitate the successful passage from tree to canoe, but a series of categorical shifts that culminate in the creation of something ‘otherworldly’ (e.g. Best 1976:65-75; Handy 1927:282-296). Here, the completed canoe is not only an inalienable object embracing the labour and identity of the actual builders, but through temporal compression, embodies a form of transcendental practice. For instance, Handy (1923:154-155) records that tree felling for canoe hulls in the Marquesas was accompanied...
by cosmogonic chants, thereby merging the creation of the canoe with that of life. In short, the completed voyaging canoe becomes of this world and another, and again this affects both the ontological status of both voyaging and voyagers. As the vehicle of transformation, the canoe constitutes the membrane that separates humans from the ocean, a context where present touches past. Just as the motorcycles in *Easy Rider*, the canoe is complicit in this process of becoming as is effectively demonstrated by their transmutable qualities on landing on an island shore (e.g. Orbell 1985b:109).

Traditionally, the homeland, Hawaiiki, was situated beyond the western horizon. Hawaiiki is also the home to which the dead return, importantly allowing them to travel in westerly direction. Yet, Hiroa (1954:65) records the following Chant of Kahu-Koka which reveals Hawaiiki to be in the east:

```plaintext
Now do I direct the bow of my canoe
To the opening whence arises the sun god,
Tama-nui-te-ra, Great son of the sun,
Let me not deviate from the course,
But sail direct to the land, the Homeland

Blow, blow, O Tawhiri-matea, God of the winds!
Arouse thy westerly wind to waft us direct
By the sea road to the Homeland, to Hawaiiki
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What is clear about the ambiguity of the location of Hawaiiki is the degree of contingency affecting ideas of directionality and ancestral geographies (Orbell 1985a). If we follow Irwine’s (1992) suggestion of voyaging being a continuous form of practice, then as a homeland, a place of origin, Hawaiiki is conceptually fluid and always in a state of becoming. As Dening (1972:124) observes, the Polynesian voyagers always appear to have total confidence in finding an island to the east (Figure 2), hence, to travel east was necessarily to continually encounter Hawaiiki (Suggs 1960:87). As a place of origin, Hawaiiki was necessarily transcendental, providing its inhabitants with god-like qualities and for those who departed on voyages an enhanced status by virtue of the ‘journey’ (Siikala 1996:47-8).

![Figure 2. Eastwards, across the blue water of the Pacific Ocean.](image-url)
If we consider voyaging as affording both transcendent and different bodily experiences, then the easterly Polynesian journeys across the Pacific Ocean represented a transformational process realized through conjunction with the past ancestors who discovered and colonized distant islands (see Richards 2008). In undertaking journeys that had traditionally occurred time and time again, the participants were doing more than merely replicating mythical structures as a form of ‘mythopraxis’ (Sahlins 1981). Voyaging may have been interpreted and expressed as ‘adventure’, but those who journeyed across the ocean were, consequently, “no longer ordinary people” (Helms 1988: 49), they were “renewed and made different” (Orbell 1985b:137). Accordingly, voyaging across the blue water of the Pacific, as a strategic form of practice involving an altered experience of the world, maintained the potency for social transition beyond the normal rules of traditional genealogical descent (cf. Siikala 1996:47-9).

If the ocean was conceived as ‘highway’, ‘road’ or ‘bridge’, then it also effectively drew disparate places and things together, thereby combining widely separated islands and ocean pathways within a single locale (cf. Heidegger 1978:354). This is a quality of the road that is only realised in its passage. I now wish to turn away from the ocean and look at the network of roads on Rapa Nui.

Walking the Roads of Rapa Nui

Through the evidence of root moulds initially discovered in excavations by Mulloy and Figueroa (1978:22), and the botanical work of Flenley (1993; Flenley et al. 1991; Flenley and Bahn 2002:78-88), it is now known that a very different Rapa Nui was disclosed to the first Polynesian voyagers when they stepped ashore. The island appears to have been covered by swaying groves of palms with trunks up to a metre in diameter, reaching up to twenty metres in height (Van Tilburg 1994:47; Flenley and Bahn 2002:84). Indeed, when Rapa Nui was first inhabited, sometime between AD 800 and 1200 (cf. Hunt and Lipo 2006; Martinsson-Wallin 1998), it is likely that actual rainforest was still present on the island (Flenley and Bahn 2002:87).

Around the periphery of the island, there is some evidence that a coastal road or pathway was constructed, possibly at an early date (Routledge 2005:198-199). Known as the Ara Mahiva, this road may well have operated in similar manner to the Ara Metua on Rarotonga as described by Campbell (2006). The circuit of the Ara Mahiva will have created a spatial organization influencing the position of a number of coastal ahu. If mythically associated with the initial division and occupation of land by Hotu Matua, the founding ancestor, this road would at times take on ritual restrictions (cf. Campbell 2006:105-106). For instance, at times it may well have provided a route for ceremonial procession or for procuring materials required to construct local ahu. At other times it may have provided a local route for everyday routines where people meet, talk and visit one another.

In contrast to the Ara Mahiva, at some time during the florescence of Rapa Nui monumentality, cutting through the interior remnants of this vegetation, a new network of roads was constructed across the island (Figure 3). This network radiated from the great moai quarry at Rano Raraku to different coastal areas of the island (Love 2001; Lipo and Hunt 2005). With the exception of Love’s (2001) and Lipo and Hunt’s (2005) recent fieldwork, the latter are correct to point to the neglect the roads themselves have received at the hands of researchers. Indeed, virtually all the attention placed on roads has been focused upon their role in the transportation of moai from the quarry to ahu, thus, their being named ‘transport roads’ (e.g. Van Tilburg 1994:137), or ‘moai roads’ (e.g. Love 2000:118).

Today, the roads are becoming increasingly difficult to identify as island land-use patterns begin to change rapidly and sections of the roads are destroyed (Charles Love and Terry Hunt pers. com.). The road network was effectively of monumental status and its construction would have been a major undertaking involving much labour. Yet, it was virtually invisible when Routledge visited the island in 1914-15:

“From the beginning of our researches we had felt certain there must be an old road to be traced; but for many months we looked in vein, and the manager who had lived for many months on the island could throw no light on the matter. It was finally by accident that its position dawned on us. A lazy ride one Sunday afternoon took one of us to the top of a small mountain. The sun was getting low, and with the light thus just right the track was seen clearly. It could be traced shallow cuttings through the higher portions of the route and slightly raised causeways over the lower parts. At intervals along this route lay the statues. We subsequently rode over the track, and found that while in certain places it disappeared its general trend was indispensible” (1917: 331).
The variability of road visibility noted above may well be partly a product of differential land-use and natural erosion. There is, however, some evidence to indicate that divergence in the form and visibility of different road-sections across the island may be a consequence of differential construction. For instance, along the better-preserved sections, particularly the southern section to the east of Akahanga (Figure 4), the road appears in clearly defined linear stretches, concave in cross-section, and uniformly edged on either side by lines of curb stones. In contrast, when Charles Love (2001:3) excavated a road-section further west at Hanga Hahave (east), not only was the route indeterminable, there appeared absolutely no definition to the road nor its original location. Moreover, in Lipo and Hunt’s (2005) mapping of the road network, the most clearly traceable sections are those in close proximity to Rano Raraku, the moai quarry (Figure 3). As noted above, such differential preservation will partly relate to land-use variation, particularly across the southwestern area of the island where land has been under cultivation for a number of years. However, this should only account for discontinuous sections within those areas of more recent disturbance, not the variability present in the lengths of road situated elsewhere. Instead, this architectural variability is suggested to relate to differential construction regimes operating in various areas of the island.

Over the years, some effort has been expended attempting to recreate prehistoric territorial zones on Rapa Nui (e.g. Stevenson 1986; Shephardson 2005), or their occupation by corporate units (e.g. Sahlins 1958; Van Tilburg 1994:86-96). This procedure can be criticised at a number of levels, not least concerning the actual fluidity of social identity and the corresponding permeability of physical boundaries. Nonetheless, we can assume the presence of social differentiation within the island and that social groups maintained some form of spatial definition. Indeed, it is suggested that it was through attachment to land, as opposed to the occupation of clearly ‘mapped’ territories, that prehistoric Rapa Nui identity was articulated. The roads were not built within neutral space but within a highly structured and nuanced landscape. Therefore, the routes taken by each road would have affected and transgressed the homeland areas of many social groups; groups that may been in a highly volatile and competitive relationship (Vargas 1988:133; Lipo & Hunt 2005:166). Under these circumstances, the actual act of construction would have provided a potent mechanism for the negotiation of social identities. Hence, the altered appearances of the roads in different areas would have been a visible manifestation of this strategy.
Regardless of their frequency of use, the roads created a altered spatial ordering to the Rapa Nui world. There can be little doubt that the roads were utilized for the movement of moai from Rano Raraku to particular ahu, since the roads appear to radiate from the quarry and lead to monumental complexes. However, if we reverse this view, because of the ‘dendritic’ nature of the road network each road segment runs directly from a specific ‘homeland’ to Rano Raraku. As Lipo and Hunt observe, “each region (potentially related to individual social groups) had their own road...” (2005:166). As all roads lead to Rano Raraku, the quarry is effectively presenced at the centre of the Rapa Nui world: providing an axis mundi. Geographically, however, Rano Raraku is not at the centre, it is actually positioned in the eastern area of the island (see Figure 3).

There is a tendency in discussions of the quarrying at Rano Raraku to see moai production as a form of ‘industrial’ procedure involving several stages of production (e.g. Skjølsvold 1961:366-369; Flenley and Bahn 2002:116-119). In this interpretation, initial work involved shaping the moai, mostly in a supine position. Second, they were removed to the base of the volcano and erected, where, their backs were subsequently carved. Finally, the moai were transported to awaiting ahu. In commenting on the imagery of Rano Raraku, Thor Heyerdahl concludes, “we are left with nothing but a series of production stages” (1961:504). However, Heyerdahl (1958: 86), also describes Rano Raraku as a ‘birthplace’ of the moai. Certainly as a place of creation, in the form of shaping and producing moai from the rock, Rano Raraku was clearly a place of potency and sanctity, of great tapu.

Among others, both Routledge (2005:178) and Skjølsvold (1961:365) have commented on the sub-division of the Rano Raraku quarry into compartments, niches or chambers, or quarry ‘bays’ (Hamilton et al. 2008). Indeed, the discrete and exclusive nature of this architecture (see Christino et al. 1981) is remarkable for its impracticability in terms of the quarrying process and moai extraction. Suffice here to note that the actual quarry is not simply a single entity but a complex of discrete bays, each having specific routes of access and exit (Figure 5). Originally, the approach to many bays was adorned by associated standing moai (Routledge 2005:189; Van Tilburg 1994:146; Hamilton et al. 2008). To labour at Rano Raraku has been described as ‘sacred work’ by Van Tilburg (ibid). Clearly, the practices surrounding the carving and creation of moai can be likened to the tapu-laden ‘consecrated industry’ (Handy 1927:282) or ‘sacred labour’ of constructing Polynesian war and voyaging canoes (ibid:292-296). Hence, to ‘go to work’ at Rano Raraku involved engaging with a highly structured form of architectural representation which was embedded within discourses of cosmogony. Just as Handy (1923:154-155) describes labour being choreographed by cosmogonic chants within the context of Marquesan canoe...
building, so equally potent ritual chants and songs may have accompanied the work of creating *moai* at Rano Raraku where their carving was referenced back to the creation of life.

Stepping onto the road in Rapa Nui, immediately effected a fusion of homeland and quarry. Given the position of Rano Raraku in the eastern area of the island, and that much of the habitation occurs to its west, a journey to Rano Raraku necessarily involves travelling eastwards. As the road is traversed, so a number of intersections are encountered where separate roads, running from other places, conjoin with the main route. To walk eastwards along the road is therefore to physically experience a conjunction of people and places that are spatially segregated but genealogically related through lines of descent. Such an act is not simply to experience a spatially ordered convergence of different social groups. It is also metaphor and mnemonic; to walk the road in Rapa Nui is to participate in an architecture of memory. The road therefore provides a physical imperative to the linguistic conjunction of pathway and genealogy lines of descent as embodied in the Polynesian word *ara* (Siikala 1996: 47). As vistas open and close, and conjoining roads and monuments are passed in succession, so mythical time conflates. Here, the journey spatially retraces, otherwise abstract, genealogical lines of descent and so as the road is trodden, the past is revealed, as are the social relationships that comprise the social world of Rapa Nui.

As the quarry is approached so the roads converge to form at least five main routes advancing from the west. While small undulations shape the local topography, the approach to Rano Raraku is one of ascension. It is also in the main an easterly approach with all the associated auspicious connotations of moving in such a direction (e.g. Elbert 1959:148). Along these sections, the Rapa Nui roads were undoubtedly curbed by stones. This degree of definition provided an enhanced formality which essentially prohibited divergence of movement from the road or any transgression of its boundaries. It also introduced a different spatial order to the Rapa Nui world and gives rise to a ‘roadside’: a liminal space that is necessarily experienced in an ordered manner as the road is traversed (cf. Campbell 2006). Consequently, as Raitz (1999), observes, the architecture of this zone of experience “captures and mediates social and political relationships of the human world”, and provides a potent architectural reservoir for grading space.

Often, described as ‘in-transit’ (e.g. Van Tilburg 1987:33), many *moai* lie apparently abandoned along the network of roads (Shephardson 2005:171). On one road alone up to 27 statues were observed in 1915 by Routledge (2005:194). Through excavation, Routledge (ibid:195-196) eventually concluded that many of the *moai* had been set upright adjacent to the roads, facing away from the quarry. Heyerdahl’s excavations
(Heyerdahl et al. 1989:45-56), confirmed this occurrence where at least one roadside moai was found to have stood upon a stone platform. A similar ‘hard-standing’ of stones was located beneath another moai associated with the Akahanga road segment (Patricia Vargas pers. comm.). As Routledge evocatively observes “Rano Raraku was, therefore, approached by at least three magnificent avenues, on each of which the pilgrim was greeted at intervals by a stone giant guarding the way to the sacred mountain” (2005:196).

Advancing towards the quarry, single roadside moai give way to groups of moai, apparently flanking each side of the road. This architecture serves to grade space, and by default incrementally transforms the ‘spiritual’ state of a person approaching Rano Raraku (Figure 6). This monumental order also acts as an mnemonic provoking memories of known and named ancestors in a sequential and structured manner. Here I have described the journey to Rano Raraku. This is because all the attention on the roads has been from the point of view of using the routes to transport moai away from the quarry. Of course, when leaving the quarry a process of reversal is effected whereby people walk back to their daily lives and are re-aggregated back into the community – albeit in different state.

**Conclusion**

As Helms reminds us, “long-distance ‘voyages’ in the guise of ancestral journeys into time need not be limited to sea travel” (1988: 47). This is suggested to be exactly what ‘being on the road’ in Rapa Nui entails. Just as was suggested for Ellie Andrews in It happened one night, and Captain America and Billy in Easy Rider, the ocean voyagers sailing along the ‘road of the winds’, searching for Hawaiki, and those who walked the roads of Rapa Nui, were necessarily transformed by their journeys. Within the Polynesian world, journeying can be understood as a process of becoming, where past, present and future fuse within the social transformation of the actual journey. Here, the transformative properties of blue water, or the imagery of the open-road, are not simply metaphors of change and difference. Nor do social meanings totally mediate the experience of the journeyers. For instance, the materiality of the sea, from the smell of saltwater to the motion of the vessel, physically creates an altered form of bodily experience (see Richards in press).

Walking is also a very particular form of physical exercise, where posture, locomotion and purpose combine to provide a very specific experience of the world (Ingold 2004). Such an altered state of being is equally achieved through “the experience of the road as one of displacement and incongruity” (Robertson 1997:276). To approach the quarry at Rano Raraku represented an act of remembrance, a journey back in time, back through lines of ancestral descent powerfully mediated through the convergence of roads and visually punctuated by monumental architecture. Accordingly, to gain access to the quarry was to participate in a form of ordered regression to pass before the eyes of the ancestors, and to go to the very place of their creation – be it Rano Raraku or Hawaiki.

As archaeologists, we privilege material culture and reify sites and ‘place’. In Easy Rider a substantial proportion of the film is given to the experience of motorcycling along the highway and the ever-changing vistas.
of the road. Here, it is suggested that it was through the phenomenology of journeying, either along the roads of the sea or land, that people in the Pacific negotiated the crucial transformations that embodied their journeys through life and death.

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References


Firth, R. 1936. *We, the Tikopia*. London: George Allen and Unwin.


Back to the Sea: Rapa Nui’s Ahu Seascapes

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Abstract - One of the most striking characteristics of the coastal ahu of Rapa Nui is that they are situated with their backs to the sea and their moai facing landwards. Extant work has used generalized socio-economic perspectives to characterize the landward ahu territories that fall under the moai gaze. By contrast, this article reflects on the seaward orientations of the ahu and the differing scales of physical and conceptual interface between the ahu, the ahu landscapes and the sea. This is considered particularly from a sensory perspective and at a person-centred scale.

Introduction

Over recent decades work on Rapa Nui settlement, quarrying, resource acquisition and ceremonial structures has begun to incorporate a symbolic dimension (Van Tilburg & Lee 1987; Martinsson-Wallin 2002), but at the same time functionalist explanations of access to land and sea resources and socio-economic premises of territory formation have predominated (McCoy 1979; Rounds-Beardsley 1990; Shepardson 2005; Stevenson 2002). Pre-eminently, the ceremonial platforms (ahu) of Rapa Nui, particularly the "complex ahu" with anthropomorphic statues (moai), have been studied in terms of their construction elements, their chronology, and the spatial density, and distribution of specific architectural types (Martinsson-Wallin 1994). Strong lineage-based ties have been advocated between the ahu and the land on which they are situated and, on the basis of idealized Polynesian models of chieftain territories, these ties are recurrently perceived as having been rationalised in the spatial clustering of ahu and their association with hypothesized geometrical segments of territorial space — tapere, which extend from the coast towards the interior (or vice versa).
By contrast, this paper explores the spatial settings of *ahu* at locale- and person-centered scales. It is interested in place-specific social practice and how understandings of sea and land were potentially linked and interconnected. A focus on "place" as a point of social practice raises different questions concerning how Rapa Nui monumental landscapes were conceived and constructed. This study draws upon contemporary Post-Processual, British academic traditions of landscape archaeology and aspects of their wider European/application (Graves & Ladefoged, 2002:3; Hamilton and Whitehouse 2006; Skeates 2005; Tilley 2004). Such approaches to human-populated landscape spaces adopt the stance that economic and subsistence organization may be wholly subsumed by the ideological factors behind the configuration of architecture and its landscape positioning (Tilley 1994). This paper offers a different approach to previous and current work on the island in being based on fieldwork that emphasizes subject-centered understandings of landscape — but in combination with science-based survey techniques of topographic, geophysical, and surface finds mapping. The ideas that are discussed below were generated during three seasons of surface landscape survey on Rapa Nui in January / February 2006-2008 and so far more than 30 *ahu* have been studied in some detail. The method used was to systematically walk the *ahu* locales and to combine textual recording with GPS satellite mapping of the landscape and locale-specific characteristics of the *ahu* and their associated architectural components (Figure 1). This work was guided by a focus on body-centered sensory perceptions of space (phenomenology), in particular perceptions of visibility, sound, and the orientations of features and place with respect to human body positioning and the sea. The process as a whole was reflexively informed by what we already know about the archaeology and palaeo-environment of these spaces. Our textual recording of observations was standardised using recording sheets with prompt questions (see Table 1). Overarching the concept of land-tied identities, one of the most evocative characteristics of the locations of the elaborate *ahu* are that their high, dense walls face the sea — while the statues facing inland "turn" their backs to sea. Simplistically, this seems to indicate a focus of concern on the land rather than the sea and has often been interpreted as a symbolic way of controlling people and land under the gaze of the *moai*. But, equally, by facing inland the *moai* gain the sea as a backdrop, and the people on land thus have their eyes and sensory perceptions directed towards the sea. However, before focusing on sensory perception the paper will first explore the extent to which the sea as a cosmological and conceptual percept was elemental to Rapa Nui *ahu* architecture.

**Fishing and Canoes**

By the time of European contact, the inhabitants of Rapa Nui lacked seaworthy boats, yet the earliest inhabitants were descended from Polynesians who are legendary for their mastery of ocean voyaging. Bones and coprolites from middens belonging to Rapa Nui's early settlement phase indicate an initial reliance on protein from deep-sea fish such as tuna, and sea mammals, notably the porpoise and spinner dolphin (Martinsson-Wallin 1994:25). Tuna occur 1 km off shore and would have required both substantial canoes and fishhooks for their capture. Likewise, hefty sea mammals could not have been hunted by line or spear fishing from shore and must have been harpooned far offshore, from sturdy ocean-going craft. Aggrandized stone fishhooks, together with the numerous petroglyphs of canoes, deep-sea fish — particularly tuna, and fishhooks all point to the existence of strongly ceremonial aspects of fishing and canoe use (Lee 1992:112; Martinsson-Wallin 2002:74). Although we lack information on dating large and elaborate stone hooks (which imply fishing for shark and tuna), all of the earliest indications that we do have suggest deep-sea fishing and a culture based on large canoes would have been essential and symbolically-charged tenants of life to the first settlers. The canoes observed by the 16th-century European voyagers to Rapa Nui were characterized as few in number, small, and scrappily built (Best 1954:302-303). The first canoes, however, are presumed to have been built from the robust, now extinct, Jubaera-related palm that pollen and root casts indicate to have been formerly abundant on the island (Flennley 1991; Stevenson 1997:127). In purely economic terms the time of earliest settlement has a phase-specific, seaward orientation. By contrast, bones of fish and sea mammals are lacking in post-AD 1400 deposits (Martinsson-Wallin 2002) and the relentless diminution of trees would have eventually resulted in the demise of large canoes. On the one hand cultural restrictions and taboos of access to the seascape and its resources would have secured a sustainable fish catch and reinforced the efficacy of ritual behaviour (Barber 2003), while on the other hand the later shift of ritual and protein procurement to chicken and other fowl (Martinsson-Wallin 2002) would not have necessarily excluded continuing metaphorical reference to ancestral canoes.

**Ahu and Canoes**

Best (1954:35) describes Maori canoes as "vessels in the hands of gods". Indications that the conceptualization of Rapa Nui's *ahu* and the idea of canoes were likewise physically, metaphorically, and symbolically connected are dispersed through the Polynesian ethnographic literature. The tools and techniques needed for building and land-based moving of ocean-going canoes share/much in common with those required to carve and erect Rapa Nui's monumental statues (Van
Tilburg (1994). This includes the use of stone chisels, thick ropes, carving and lashing, and the mechanics of levering and pivoting. Van Tilburg posits that there is not much difference between raising the mast on a canoe and raising a statue on an ahu (transcription of Van Tilburg in NOVA 2008; Van Tilburg (1994). Van Tilburg's own experiment at moving a statue demonstrated the viability of her premise that a canoe ladder comprising parallel wooden rails fixed by cross pieces could have been effectively adapted for transporting the moai to the coastal ahu. Canoe ladders were widespread on Pacific islands for transporting heavy wooden logs, which were cut in the forest, shaped into canoes, and then transported to the coast.

### Table 1. Ahu Landscape Characterisation Prompt sheet.

<table>
<thead>
<tr>
<th>Rear/backspace of ahu</th>
<th>GPS location of ahu:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Date</td>
</tr>
<tr>
<td>1</td>
<td>Survival and size of back space</td>
</tr>
<tr>
<td>2</td>
<td>Relationship of architecture to sea</td>
</tr>
<tr>
<td>3</td>
<td>Relationship of backspace to seascape</td>
</tr>
<tr>
<td>4</td>
<td>Access to backspace</td>
</tr>
<tr>
<td>5</td>
<td>Ahu and crematoria: types of structural materials and landscapes places whence they come</td>
</tr>
<tr>
<td>6</td>
<td>Crematoria related to 1 and 5 &amp; location</td>
</tr>
<tr>
<td>7</td>
<td>Surface finds distribution — obsidian, basalt tools, coral pieces, etc.</td>
</tr>
<tr>
<td>8</td>
<td>Consideration of the past visibility and inter-visibility characteristics of the back space and its architecture</td>
</tr>
<tr>
<td>9</td>
<td>Sound and smell characteristics</td>
</tr>
<tr>
<td>10</td>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Front of ahu/plaza area</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Time:</td>
<td>Tide:</td>
</tr>
<tr>
<td>1</td>
<td>How the plaza area is defined: correspondence with landscape features, levelling, clearance, etc.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Possible approaches to the plaza and their characteristics of topography, access, sound, vision, etc.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Evidence of structures on the plaza — position, materials, visibility and other sensory characteristics</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Evidence of slipways and topographic access to the sea</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Surface finds distribution</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Structural materials and landscape locations from which they come</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Consideration of the past visibility and inter-visibility characteristics of places and features associated with and beyond the plaza area</td>
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<tr>
<td>8</td>
<td>Other</td>
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<table>
<thead>
<tr>
<th>Ahu territory inland of plaza</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Date:</td>
<td>Time:</td>
<td>Tide:</td>
</tr>
<tr>
<td>1</td>
<td>Landscape characterisation — topographic boundaries, relationship to other areas</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Present and past visual relationships of the ahu landscape area to the ahu and its moai</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sensory awareness of sea</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Prominent rocks/crags/discrete topographic features</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Structures: caves, poho pavements, boat houses, umu, manava, rock mulching, etc. — and their topographic position, visibility, sound and other sensory information, and construction materials</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Distribution of surface finds</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
Polynesian double-hulled canoes were hewn from massive hardwood trees weighing 6 to 12 tons each, while an average-sized statue weighs 12 tons and there are statues weighing as much as 40 to 70 tons, thus the land-based transportation of both are linked by being collective projects requiring the gathering and cooperation of a work force beyond the resources of single family. Accounts of Polynesian canoes indicate a general length from c. 18-24 m but in particular, the voyaging canoe, which was recorded as measuring up to a massive 37 m, can be viewed both as/a monument and as construction of monumental scale (Barthel 1978:161; Buck 1938:9; Finney 1979:329). Ahu and canoes are conceptually linked not only by their collective labor of construction but also by the unification of construction elements provided by, owned by, or dispersed amongst, multiple persons and communities. Metraux recorded in the 1940s that "the few boats on Easter Island are the joint property of all who have contributed to their building, either in work or in the furnishing of wood" (Metraux 1971:144). For, example, the 19th-century war canoes of the Marquesas island of Nuku Hiva's (Madison's Island) are described as being ... formed of many pieces and each piece, and indeed each paddle, has its separate proprietor and when a canoe is taken to pieces the whole is scattered about the valley and divided perhaps among twenty families ... and when she is to be set up everyone brings his pieces with materials for securing it. (Porter 1815:367.)

In a similar vein the construction of a Rapa Nui image ahu maximally brings together dispersed resources and architectural elements garnered and realized by various communities across the island — moai from Rano Raraku, scoria pukao and facia from Puna Pau, beach boulders (poro) and coral from rock pools (for the moai eyes), and dressed basalt blocks from various quarries.

Handy (1927:282,285) recorded that Polynesia canoe building was a "consecrated industry" and "sacred labor". In Micronesia, Gilbert Island canoe building was likewise a sacred activity with construction only taking place on ground that had been blessed (Grimble 1924:102). Thus, just as the building of an ahu was a work of religion tied in with the ancestors, the construction and voyages of large Polynesian canoes were ritually imbued enterprises. Canoes likewise encompassed concepts of social affiliation, genealogies and descent, and land claims related to the point where a voyaging "immigrant" canoe touched shore. Maori genealogies are traced back to named canoes and migratory ancestors (Buck 1950:51-59; Finney 1991:383-86; McLean 1965:302; Orbell 1985:107) and Hotu Matua's legendary landing at Rapa Nui's Anakena Bay lies in this category (Barthel 1978:160 ff). Recurrent ethnographic examples suggest that Polynesian marae (ceremonial platforms) and canoes are physically and metaphorically juxtaposed in the ceremonial/ritual context. Porter (1815: 409-410) in his descriptions of Nuku Hiva observed 4how four splendid war canoes were placed near a marae groove. The most splendid canoe — belonging to a deceased chief— was adjacent to platform and all of the canoes were filled with many human remains and effigies awaiting the metaphorical paddling of each canoe to the place of destination for the dead.

Caution is self-evidently necessary when plucking individual examples to support a premise, but collectively this melange of observations hints at a pivotal conceptual relationship between the community monuments of the land — statues and ahu, and the community monuments of the sea — canoes. There are certainly many indications that the connections highlighted above are more than just based on transferable technologies in a utilitarian sense. The Rapa Nui ahu with their colossal statues potentially drew upon the sacred role of the canoe that is central to Polynesian societies (Ellis 1871). In east Polynesian island tradition the marae is recurrently conceptualized as a canoe — thus metamorphosing the marae into a sacred vessel transporting the ancestors. In Tahitian tradition the canoes themselves were thought to sail upon the ocean as marae — floating temples of the gods (Handy 1927:167). This parallel duality of ascription is also suggested in the shared symbolism of masts on ships and statues on platforms as performing as phallic imagery and representing lineage descent (Handy 1927; Van Tilburg 1994:82; Van Tilburg & Lee 1987:134).

Ahu Routes to the Sea

In the Polynesian realm of ideas, ceremonial platforms were considered as the umbilical cord of the land and the chiefs umbilical cord was placed there (Martinsson-Wallin 1994:128). The moai, when erected on the ahu, take up a physical position between earth and sky — connecting, and mediating between people and chiefs, and between the chiefs and the spiritual world (Van Tilburg 1994). Equally importantly, they also physically intercede between land and sea. The coastal ahu are located at Rapa Nui's physical interface of land and sea. The backs of many of the ahu on the south, south west and north coasts surmount basalt flows or extensive lava sheets that run into the sea, like cords or lashings linking land and sea (e.g., the One Makihi basalt flows running
from the back of the *ahu* into the sea, and the sheets of lava at the front and back of Ahu Heki‘i over looking Hanga Ho‘onu (Martisson-Wallin & Wallin 2000, fig. 12). The back areas of other *ahu* are naturally staged down to the sea via rock-pooled terraces (e.g., Akahanga, One Makihhi, and Tarakiu) or blend with the shoreline, as for example, at Tongariki, Te Pa Haha Tea, and Te Pito Kura, all of which are only a few meters above sea level (Smith 1961:70). Many of the complex image *ahu* are located in small bays that have prime access to the sea and excellent marine resources. The historic and present-day names of the *ahu* and their associated bays suggest that several of the *ahu* are located in places where the water has special characteristics, such as at Hanga Tee o Vaihu — where “Vaihu” means "where the wind whips up the water". The placing of ceremonial structures close to the sea shore effectively made the associated sea areas *tapu* for ordinary people by obstructing a near view of, and passage to, the sea — which ethnographic data indicates as being a zone, together with its fish supply, that was the reserve of chiefs (Ayers 1981; Martisson-Wallin 2002:74). The rear walls of the *ahu* are not only seaward, but also have the most elaborate, monumental stonework of the structure and this is suggested to be a fairly early trait — AD 1100-1200 (Martinson Wallin 2002:74). This, and the fact that the dorsal designs on the backs of the *moai* present themselves to the seaward side, all affirm the importance of the *ahu* prospect viewed from the sea. Vinapu, for example, is at its most architecturally visual from the sea (Mulloy 1961: fig., 26).

In many parts of the island we have seen wide paved roads which disappeared straight down to the sea ... they were called *apapa*. A *papa* means “unload” (Heyerdahl 1965:176).

The *ahu* are more often than not strategically placed at good positions to get in and out of the sea and in some cases paved ways running down to the sea can be identified. Such “pavements to the sea” were first noted associated with the southwest coast Tahai complex (Thomson 1891:486).

…this slope paved regularly with small round boulders, having the very appearance of having been constructed as a way for hauling out boats. The coast in this vicinity is rock bound, but a narrow channel leads from the paved way out to the sea.

These ways or slides down to the sea have carefully fitted stones that create a steep, smooth slope to the water’s edge (Figures 2, 3, & 4). Given that they provide enough berth to accommodate large or double-hulled canoes, and the fact that at the base of the slipways the waters at the high tide are deep enough to cause no difficulty in hauling up, or launching, a canoe, it seems plausible to suggest that they are indeed canoe ramps (Best 1976:170 — for canoe dimensions; Macmillan Brown 1924:70). In some cases the ramps are highly monumentalized. This is at its most dramatic at the Tahai Complex where a ramp and landing area are architecturally framed by Ahu Ko Te Riku and Ahu Vai Uri and backed by Ahu Tahai (Figure 2). This ramp provides a highly visual focus point that constitutes the central architectural core of the complex (Figure 4). Here a deep and naturally protected channel passes along the north side of Hanga Moana Vero-vero to give access to a poro-paved "wharf edge that is/ebutted by shallow, calm water from which canoes could readily be lifted on to land (Mulloy 1970:12, fig.23). Previously published examples, together with our on-going fieldwork, confirm the presence of numerous, now rapidly deteriorating, paved ramps down to the sea positioned in juxtaposing proximity to individual *ahu*. Examples include Hanga Tetenga, (Figure 3) west side, Te Pito Kura —just round the coast on the west side, Vaihu — several on the west side (Figure 4); Akahanga , and Ura Uranga — single examples on the west side of each *ahu*. Vinapu, although positioned within a cliff-top valley some 27 m above sea level, had a prepared slipway down to a sheltered landing place on its east side. This is illustrated by Mulloy (1961:99, fig.26), but is now nearly destroyed. These slipways / canoe ramps would have required constant maintenance — the stones stayed in place by their own weight and were not-cemented and maintaining access to the sea would have been a key activity at these *ahu* (Mulloy71970:19). In other cases access to the sea for sea-going crafty is self-evidently naturally supplied — pre-eminently at Anakena Bay directly behind Ahu Naunau, where the beaching of large canoes on the bay's white coral sands would have been easily managed. Several *ahu* are almost at ocean-level (see above) and Te Pito Kura for example is only 3 m above sea level of Hanga Kouri at a point where the water is so shallow that it affords an ideal landing place for craft drawing little water (Mulloy 1961). At Hanga Te o Vaihu the slipway nearest the *ahu* on its west side is associated with a shallow inlet that has been cleared of boulders to create a channel wide enough to enable craft to come alongside a *poro*-paved landing stage (Figure 5). Thus, while there is no wholly consistent architectural strategy, the recurrent pattern is that of an association between *ahu* and natural and/or enhanced easy access points to the sea. The effect of this association is to ritualize and heighten the concept of going to sea and the potentially concurrent idea of voyaging. Indeed, the eyes of the *moai* would be the last land-based image encountered when setting forth on the Ocean.

**Architecture and Referencing the Sea**

There are widely recognized sea referents in Rapa Nui’s architecture. The backs of some of the *ahu* platforms,
such as Hanga Tee o Vaihu, have a canoe-like bow, which thus provides a boat-like architectural base (Van Tilburg & Lee 1987:146) and there are canoe-shaped burial cairns (*ahu poepoe*). The most commonly noted form of canoe-shaped architecture are the *hare paenga* — the boat-shaped houses of the elite that are situated proximate to *ahu*, and their *paenga* (stone foundations) were often incorporated in the walls of *ahu* platforms. But the associations go beyond these sea / land architectural crossovers and relate to the very materials of construction. *Poro*, surf-worn basalt beach cobbles, were elemental components of specific architectural and conceptual parts of the *ahu*, specifically the sloping front ramp and the

![Figure 2](image2.png)

*Figure 2.* The Tahai complex with the "canoe ramp" located between Ahu Vai Uri (left) and Ahu Tahai (middle).

![Figure 3](image3.png)

*Figure 3.* "Canoe slipway" on the west side of Ahu Tetenga.

![Figure 4](image4.png)

*Figure 4.* Arena-like "canoe slipway" of the west side of Ahu Hanga Tee o Vaihu. The location of the Figure 5 can be seen on the far side of the bay.
abutting plaza pavement. *Poro*-paved slipways link the land and sea, and associated *ahu*. "Sea pavements" of *poro* front the boat-shaped houses. Inland, *poro* pavements associated with various domestic structures are a common occurrence. *Poro* were also included within the structure of *manavai* and usually one or more *poro* were included in c. five stones that form the retaining box of an *umu* (earth oven) (Figure 6). Inland, given the local availability of columnar basalt for cobbles, it is particularly interesting that *poro* were used for components of both *ahu* and domestic structures, and this suggests that the sea boulders were meaningfully chosen, sea-derived constituents of inland architecture. A similar interweaving of land and sea materials occurs with sea coral, which is relatively prolific in the rock pool areas at the back of some *ahu* (e.g., Tarakiu and One Makihi). Coral is most famously used for the eyes of the *moai*, but inland small quantities were recurrently incorporated, alongside calcareous sea algae covered stone, in the walling of *manavai*. A Rapa Nui legend tells of the role of sea-associated materials in crop planting, specifically *karakama* (coral stones) and seaweed, to exert a symbolic magic — to bring rain and promote growth (Englert 2006:31).

*Figure 5.* A stone-cleared channel at Hanga Tee o Vaihu that provides access to a "canoe ramp"

*Figure 6.* *Ahu* Seascapes Zones. Map of the topographic location of *Ahu* Ura Unga showing the locations of major finds and types of architecture ith respect to the major zones of "sea awareness" (the *ahu* back, the plaza, and the "ahu landscape") for communities under the "moai gaze".
The Sacred Sea – Ahu and Sea Phenomenology

In Maori myth the Ocean is personified as *Marae o Hure-moana, Marae roa,* and *Tuhua roa* — which are variously translated as the plaza (*marae*) of the Ocean maid. This situates the Ocean as a sacred place (Best 1976:21-22). In Melanesian tradition the seaward prospect / side of architecture is traditionally access-restricted and sacred, as for example Feinberg notes for the Anuta atoll in the Eastern Solomon Islands:

The buildings [houses] are rectangular with doors on either end and one on the inland side. This side facing the sea has no entrance way. It is the sacred side and place of honour. Only adult males may sit here (Feinberg 1988:296; fig.1).

The binary oppositions of sea / inland and gendered activities are recurrent in Oceanic traditions. These include that of male / fishing / sea and seaward versus female / gardening / inland, which Feinberg observed in Nukumanu, Papa New Guinea, and similar formats recur in Polynesian contexts (Feinberg 1988:296,302). There is clearly potential to consider Rapa Nui's *ahu* within such sea-orientated binary structures. From a phenomenological point of view it is obvious that the majority of Rapa Nui complex *ahu* indisputably have intimate sensual connections with the sea. The results of detailed fieldwork centred on four *ahu* — Akahanga, Tarakiu, Vaihu, and Ura Uranga - allows these experiences to be characterized into particular configurations and levels of intensity associated with four distinct "seascape zones" of increasing distance from the *ahu* and the sea: i) the back area of *ahu*; ii) the plaza and pavement area immediately in front of the *ahu* ramp; iii) the topographic setting of the plaza beyond the *ahu* — often a valley; and iv) the immediate landscape beyond the topographic zone of the *ahu*, which is generally invisible from the preceding zones (Figure 6). These zones not only have particular relationships with the sensory substance of the sea but also with its location on the horizon. Polynesian literature recurrently notes how the seaward horizon is a supernatural distance that delimits the island world and is variously the place from which the ancestors came, a place that the souls of the dead travel to, and a magical destination for voyaging canoes (Helms 1988; Patton 1996:139).

**i) The area at the back of the *ahu* (direct interface with the coastline).**

Experientially, at a human scale, the backs of *ahu* are hidden spaces that wholly focus on the sea. The height of the *ahu* platform fully screens the back area and its associated activities from those in front of the *ahu*. Both ends of the *ahu* / *ahu* back space are rarely inter-visible. Visibility along the space immediately at the back of *ahu* is often inhibited by the curve of the platform wall, or by changes in the orientation of its line (e.g., very obviously at Hanga Tee o Vaihu and Akahanga). Yet, the backs of many *ahu*, especially around the south coast, are inter-visible with each other and generally very visible from the sea. This suggests that a unique relationship with the sea is the more dominant architectural and spatial concept than solely securing the secrecy of activities undertaken at these locales. Landward access to the back of *ahu* is often controlled, and restricted to one end of the *ahu* by the strategic placement of one wing right up against the bay. For example on the south coast at Tarakiu, Hanga Tee o Vaihu, and Akahanga, passage to the back is only possible on the east side of these *ahu* and body movement is then directed right towards the west end where *ahu* crematoria are recurrently, although not exclusively, situated.

Here, the line of passage creates the potential imagery of cremating the dead against a backdrop of the west and the setting sun — or the Polynesian Hawaiki, the mythical land in the west from whence the ancestors came in canoes and the place to which the human spirit returns in death (Orbell 1985). There are, however, some exceptions to the location of crematoria in the west. On the southwest coast at the Tahai Complex, access to the crematoria is again restricted to a single direction of ingress to each *ahu* back — again the crematorium is situated at the right end of each *ahu* — when the spectator is facing seaward, but the direction of approach in these particular examples is northeastwards. Thus, while the concept the west sea horizon is important, seaward / landward relationships may be the overarching structuring principle in the in the layout of an *ahu* complex rather than simple adherence to absolute cardinal directions or an anthropocentric system of left-hand / right-hand directions. This has reverberations in Campbell's (2006:113) observation that the placement of *marae* around the perimeter of the Melanesian island of Rarotonga is based on a landward / seaward orientation with respect to the positioning of the Ara Metua ritual road that encircles the island. Here the *ahu* face into the road and the more impressive *ahu* on the landward side of the road thereby face seaward and have the greater status.

In addition to the *ahu* back area having controlled visual and physical access, it is characterized by strikingly particular sensual qualities, which would have heightened the special nature of the activities that took place there. Here, interpersonal sound communication is immensely inhibited by the sound of the wind and the sea. At Akahanga, on a relatively calm February day, it was impossible for us to communicate orally between the back area of the west and east components of the *ahu*. The backs of *ahu* near the sea are frequently engulfed in a misty
spray when the waves are high (see the description of Te Pito Kura in Smith 1961:195). The same sea winds would have wind-dried and blown away the stench of rotting exposed bodies and also the acrid fumes of burning them on the crematoria — that are classically, but not exclusively, found at the back of ahu. Concurrently, the updraft of air as the wind hit the back of the ahu would have oxygenated crematoria fires and aided the combustion of bodies. Polynesian tradition, as discussed above, suggests that these areas may have been exclusively "male" spaces.

**ii) The area in front of the ahu platform and the associated plaza area (up to c. 200 m inland).**

In contrast, immediately in front of the ahu, the height and density of the ahu platform substantively baffles the noise and impact of sea winds and the temperature feels markedly warmer, creating a still microclimate. Unpredictable, high spurts of white spray from the crashing waves behind the platform provide a visually dramatic backdrop to the ahu when viewed from immediately in front and from the proximate plaza — but only the spray, not the sea, can be seen. With increased body distance from the ahu, the horizon takes on a visual and potentially cosmological significance. At distances from the front of the ahu of c. 100 m at Ura Uranga and Tarakiu the sea appears on either side of an ahu. For a human eye-view, towards the inland end of the plaza, the top of the ahu platform becomes visually coincident with the sea / sky horizon, giving the visual impression that the statues directly intercede between land and sky. The later effect continues up to distances of c. 200 / 300 m inland and can coincide with the general point at which the boat-shaped houses are often situated facing seawards (Vargas et al. 2006: 210, fig.5.23; Figure 6).

The plaza floors are consistently level, probably at least in part due to sediment infill of the dry valley bottoms with which they are often associated. They appear to have been kept stone free, since there is an un-naturally sharp division between the plaza and the juxtaposing stony areas beyond and this is most striking at Tarakiu and Ura Uranga. At Tahai, the tiered effect of each plaza with respect to the other suggests the possibility that they were actually landscaped (Figure 2). Such examples suggest that the plazas were designed and conceived as open arenas and that within them views of the ahu platform would have lacked visual obstruction by trees. In situ experiments suggest that under such conditions any construction activities and raised human voices associated with activities in front of the ahu could have been heard up to the inland perimeter of the plaza but rarely beyond (Table 2). Thus, the plaza may have effectively provided a sensorial-controlled area where the sound and vision of the sea is minimized while the sounds of activities travel (Figure 6). The activities associated with the plazas are somewhat under-elaborated in the literature, but given the ritualized nature of Polynesian canoe construction — in addition to other activities — the ahu plaza may have been locations for canoe building and maintenance prior to launching. Best's consideration of the spiritual and mental concepts of Maori canoe construction emphasizes the separation between the everyday and canoe making (1976:95). Women and children were not allowed to approach a canoe under construction and the final construction stages took place near to where it was to be launched, this being a tapu place where the tools of construction had to stay put and where the workmen had special garments to wear when working on the canoe. Pragmatically, canoe construction would have benefitted from the flat ground of the plaza and the tools, adzes and ropes used for ahu construction may have equally been used for this activity. Possibly, our find of a fragment of polished axe at Tarakiu (Figure 7) could point to fine woodworking associated with the finishing of canoes, whilst coral, which collects in the rock pools behind the ahu, was traditionally used for polishing / finishing canoe woodwork (Baybayan 2008).

![Figure 7. Fragments of polished tools (for fishing canoes?) from Tarakiu plaza (left) and Ura Uranga ahu landscape (right).](image)

**iii) The "ahu landscape" (from c. 200-300 m to 1 km inland).**

The coastal image ahu are situated in locations that are hidden for much of their inland landward approach. Sensory knowledge of them is occasionally physically blocked by hills — most extraordinarily at Ahu Naunau (Routledge 2005,
fig. 97), or more recurrently by their positioning in valleys — even when they are on sea cliff tops such as at Vinapu and Maitaki Te Moa. These topographically defined and visually constrained spaces associated with the coastal ahu penetrate up to 1km inland from the ahu platforms and are what I term the "ahu landscapes". From a sensory perspective these ahu landscapes extend inland up to the topographic lip of the valley and in today’s deforested landscape this is the maximal extent of what can physically be seen from the ahu. Equally, in a seaward direction each ahu landscape constitutes the maximal landscape from which its associated ahu can be perceived.

Table 2. Experimental sound characteristics of ahu landscapes.

<table>
<thead>
<tr>
<th>Sound</th>
<th>Meters inland that sound disseminated from in front of the ahu platform could be heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat female and male voice</td>
<td>10</td>
</tr>
<tr>
<td>Stressed sentences: female and male voice</td>
<td>50</td>
</tr>
<tr>
<td>Stone percussion (basalt on vesicular basalt)</td>
<td>110</td>
</tr>
<tr>
<td>Male shout</td>
<td>140</td>
</tr>
<tr>
<td>Female shout</td>
<td>150</td>
</tr>
<tr>
<td>Female yell</td>
<td>170</td>
</tr>
<tr>
<td>Male yell</td>
<td>180</td>
</tr>
</tbody>
</table>

*Noise source:* Hanga Tee o Vaihu: Front of ahu directed to ahu landscape, February 2007. Conditions: low cross wind east to west, dry and sunny; 4:05 pm.

Seaward-facing boat-shaped houses are classically positioned at the interface between ii) and iii). At Te Peu, for example, this coincides with the first slight topographic rise above the plaza and here the houses overlook and bound the plaza's outermost extent. At this point in the ahu landscapes the statues and plaza are visible in their entirety but the sounds of activities on the plaza would have been inaudible. Fully into the ahu landscape, the ahu and its moai takes on a more distant persona and at Ura Uranga from a distance of c. 750 m, the ahu gives a visual impression of being a vessel floating on the sea (cf. Figure 8 for a similar effect at Tongariki). The precise nature of this trompe d’oeille varies today from site to site and any original tree cover beyond the plaza would have restricted any such visibility. At these distances with or without tree clearance the plaza area is fully foreshortened and its activities are wholly hidden, often being below a human sight line. The daily activities of this zone were ultimately evidenced by the presence of stone mulching, umu, and manavai. In Polynesian tradition, ideas of "inland" and "cultivation" are often female-associated. This suggests that these landscapes may be metaphorically differently gendered to those more closely associated with the sea. There are distant reminders of the sea, the ahu and the "moai gaze" — but they are not a palpable presence. Interestingly, from a sensory perspective the dispersed rocky outcrops and the January / February cooling breezes that they afford when surmounted are the more dominant. It is on these outcrops that evidence of obsidian working was most often found— by contrast obsidian is rare in the plaza area (Figure 6).
iv) Beyond the ahu landscape (c. > 1 km inland).

These landscapes were not part of this study, and brief comment must suffice here. Approaching the coastal ahu inland from beyond the ahu landscape, the ahu and their settings are generally wholly hidden places due to their valley positions. It is only the sea itself that can be seen and increasingly heard. On entering the rim of the valley, the ahu are today dramatically revealed and this revelatory drama must have been part of the consciousness of at least the later ahu landscapes.

Thus, human sensory and perhaps gendered experiences of coastal ahu relationships with the sea would have been very different in the four zones of ahu backspace, ahu plaza, the ahu landscape, and the inland world beyond. In the backspace, the sea dominates and access to the sea is controlled. In the plaza the sea is present as muffled sound and spray emerging above the ahu. In the ahu landscape — ultimately in the expansion phase of c. AD 1100-1680 of rock gardens and manavai — the ahu with its standing moai has all the characteristics of a distant, peopled or multiple-mast canoe at sea, while further inland looking seaward, the sea alone dominates. A seaward journey to coastal ahu thus would have encountered staged sensory experiences that played on the relationship of the ahu to the sea and on the sea and ahu to the horizon. Polynesian male / female binary oppositions associated with the sea suggest that the ahu backspace and plaza area may have been male gender-associated, while the ahu landscape may have had more overtly female gendered-associations.

Conclusion

For the past forty years Rapa Nui and its ahu have been studied in a conceptual frame of Polynesian chiefdom territories. Research has less often drawn upon the Polynesian and wider Oceanic studies to explore the seaward context of the ahu and their associated landscapes. This literature can usefully inform contextual landscape studies of the ahu. When Rapa Nui's land and sea features are considered from a symbolic and sensory perspective can be suggested that the locations of ahu are as much conceptual and framed by sensory and gendered perceptions as opposed to simply being a product of socio-economic territorial organization. Isolating such ideas becomes viable when ahu are investigated as structures with specific relationships to places and particular understandings of the world, rather than more narrowly focusing on them as independent architectural edifices. While interest has often been expressed in what the eyes of the moai gazed at, a reversal in perspective is to consider what people under the moai gaze experienced — which can be characterized as a seaward perspective. The architecture of the ahu and the structures of the ahu landscapes recurrently make reference to the sea in terms of the incorporation of sea-generate materials and canoe-like structural forms. The relationship of the backs of the ahu to the sea is intimate. It both facilitated and controlled access to the sea via monumental slipways and the positioning of coastal ahu on bays was a key concern. It is important to explore social practice at an individual human scale rather than the patterning produced by the activities at the more generalized level of corporate clan groups. People working within an ahu landscape and for those individuals that had access — based on gender, age, or other forms of status — approaching the plaza, moving into the backspace, or launching a canoe would have all experienced mimetic and metaphorical prompts to particular ritual and mythical concepts of the sea, sea vessels, and sea journeys, be they of the living or the dead.

Acknowledgement

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Berg.


Chapter 3

Easter Island Anthropology and History
When Home is the Navel of the World.
Lives and Futures of Young Rapa Nui
– or, What a Not So Young Anthropology Novice
Thinks she Might Finally Think About This

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Abstract - This paper briefly presents aspects of being young in a geographically isolated, yet world famous place like Rapa Nui. More specifically, it explores how life experiences of a group young Rapa Nui can be colored by spatiotemporal circumstances, while their practices within these structures can in turn influence what Rapa Nui becomes. This exploration is tentatively analyzed and compared to personal experiences, following the guidelines of Pierre Bourdieu’s pant objectivation.

The title "When Home is the Navel" is the only part of my forthcoming thesis that I'm comfortable with. It is of course a word play upon the possible interpretations of the name Te Pito o te Henua as "center of the world", "end of the world" or even the sacred part of the "umbilical cord of the world". Yet in my use here it refers to Rapa Nui being world-known as the "island of the moai" whereas few know where it is and that there actually are people living there. Then it refers to the young people growing up there, seemingly loving it and logically seeing the world from the angle of their home place. And finally it refers to my problems of looking beyond my own navel as a young Norwegian anthropologist going to study fellow young people at the opposite end of the world.

In addition to using the anthropological method of participant observation, I was advised to try a method that Bourdieu (2003) called participant objectivation. Instead of exploring the lived experience of the researcher, this method focuses on the social conditions of possibility of that experience (Bourdieu 2003:282) — social conditions such as for example the researcher’s age, gender, beliefs and life history. Like Bourdieu showed with the book "Homo Academicus" (1988) the world of science is not as objective as it tries to be and the professional views of a researcher are heavily influenced by his or her position within the academic world. Even what seem to be the most personal choices of research topics and methods are expressions of dispositions formed by one’s social and academic background.

For the researcher in question here, her basic social conditions are among others those of growing up in a very small country, which according to the national anthem was built by ancestors who freed Norway from Danish-Swedish colonialism, German occupation and poor living conditions on the upper European rim — until finding one of the world’s richest oil reserves in the 1960s. My generation of young Norwegians now enjoys a prosperous egalitarian society while being told that we have all the possibilities in the world, if we only knew how to manage them. As Norway also is "Thor Heyerdahl country" I early learnt about Rapa Nui at the other extremity of the globe, but as Heyerdahl was much criticized by the Norwegian academia, was afraid of being met by the same attitude if I wanted to do research there. So, whereas another young Norwegian wrote an ironic novel about us who didn't "build the country", but who could try to outdo the "Kon-Tiki man" by arguing that Polynesians migrated on ice skates on a frozen Pacific (Loe 1999) — I simply wanted to see Rapa Nui with my own eyes. Yet, having grown up with feminist teachers indoctrinating us that "girls can too" I eventually ended up going to Rapa Nui for research — and thus seizing the possibility of making the childhood dream come true.

As an anthropology student of the new millennium the possibilities of topics and methods also seemed almost unlimited. So I went to Rapa Nui with open eyes and waited for my thesis topic to "reveal itself through the lives and concerns of my young informants. This eventually resulted in the situation well described by another novice fieldworker (Candea 2007:173) where initial openness becomes lasting indeterminacy concerning how to decide what topics to focus on. Being the first (before, for instance, Khan 2003) to study young Rapa Nui, I also felt a responsibility of making my study as complete as possible, but I got increasingly desperate as I felt unable of finding the threads that would make all the pieces become a picture.
There were not many preliminary studies to base my thesis on, but in a short article Grant McCall (1998) briefly described the situation of the 1990s when more and more children grew up in mixed marriages, not learning the Rapa Nui language and customs, surrounded by international tourism and increasingly being drawn away from the local into the global — as, he wrote: "knowing how to fish or to recount a Rapanui legend will not get you a job in Santiago or Sydney" (McCall 1998:89). He imagined a class of educated cosmopolitans growing away from the traditional farmers and fishermen of Rapa Nui, yet maybe at some point, he wrote, these young Rapa Nui might discover what they are losing and: "Perhaps by then, they will be signing up for heritage and language classes to recover again that lost past" (McCall 1998:90).

My first impressions in the field in 2002-03 were of proud young Rapa Nui telling me that their home island is "Paradise", that this was the place they wanted to live their lives and that they felt no urgent need to "see the world" (even though they would not say no an invitation). As my own little peripheral country is only world-famous in its own imagination I had eagerly left it as a teenager in order to "see the world" and maybe my own restlessness made this meeting with the apparent "rootedness" of these young Rapa Nui more fascinating than it should be. After all, I was of the opinion that the sheer existence of the term *globalisation* (Robertson 1994) can indicate that globalization often actually *increases* the importance of local belonging and "roots" (for instance Rapport & Dawson 1998). Yet, this "love for place", or "topophilia" as Yi-Fu Tuan (1974) would say, of the young Rapa Nui was my first impression and is still the only thing I feel I can say about them. Trying to complicate the story I could say that I have explored how life experiences of a group young adult Rapa Nui can be said to be colored by spatiotemporal circumstances and representations, while their practices within these structures can in turn influence what Rapa Nui becomes. Or, I could say it like this: everyone is a child of their own times and parents of the future. Inspired by Miriam Kahn's interesting use of Henri Lefebvre in her study of Tahitian identities (Kahn 2004) I have tried to understand Rapa Nui as a "third space" (Lefebvre 1991 [1974]). Kahn understands this concept as "a context that encompasses both local notions of physical land and global projections of mental images" (Kahn 2004:286).

The image of "mysterious Easter Island" is as strong in the Western imagination as the one of "paradise-like Tahiti" and although the differences between these islands are many the similarities are more. Rapa Nui perceived as a "third space" can similarly be understood as "generated within-historical and spatial dimensions, both real and imaginary, immediate and mediated" (ibid.). Further it can be said that it is in such a relational social space, which is continuously being formed "at the inter-section of global politics, mass media and local beliefs" (op.cit:303), that people "live their social life on a daily basis and gain a sense of who they are" (ibid.).

Simultaneously looking inside this "third space" from a constructionist, agent or practice perspective it seems logical that although historical, global and national influences can seem overwhelming in a small tourist destination with a turbulent colonial history like Rapa Nui, the ideas and practices of the inhabitants should of course also be seen as part of what Rapa Nui is and becomes. This approach opens up for focusing on "young people" as more than a liminal life phase and seems in line with an anthropological interest in youth studies arguing that young people can be seen as indications for a society's future (Mead 1977; Heardt & Leawitt 1998).

Despite finding interesting theories I feel that I am never going to understand my research topic and that impression might have been reinforced by being an novice in an anthropological tradition of deconstruction. Yet I am trying to trust a well-experienced fieldworker confirming that:

> Cultural analysis is intrinsically incomplete. And, worse than that, the more deeply it goes the less complete it is. It is a strange science whose most telling assertions are its most tremendously based, in which to get somewhere with the matter at hand is to intensify the suspicion, both your own and that of others, that you are not quite getting it right. But that, along with plaguing subtle people with obtuse questions, is what being an ethnographer is like (Geertz 1973:29).

So, here are some impressions of a group of individuals within the current quantitative majority of young Rapa Nui who for reasons of simplicity I call "young Rapa Nui".

These young Rapa Nui, of whom most are Chilean-Rapa Nui Mestizo, are going through a period of their lives that can be called a "vital conjuncture" (Johnson-Hanks 2002). This is a period of transformation that holds many individual possibilities and uncertainties regarding the future and the individual choices taken are both influenced by and can influence the whole Rapa Nui society. The young Rapa Nui students leave their island home where they are the ethnic majority and live for several years as an ethnic minority on the Chilean mainland. There many face fears of "losing the culture" and becoming "too Chilean" in order to be accepted as "good Rapa Nui" when returning home. Yet most seem to experience, in line with much migration research
Rapa Nui, and it seems just as genuine among the young as among the rest, even though some adults say the love for Rapa Nui is what seems to unite all young are only interested in the "fun" aspects of the culture like dancing and singing.

This is my overall impression of what I call the lived thirdspace of these young Rapa Nui and which I understand to be a historically changing space, at the intersection between the local and the global, the real and the imaginary. The young Rapa Nui becomes who they are and what they do in a dialectical relationship with these spatiotemporal structures — and they again change Rapa Nui with their actions.

An example of this is the ironic, but sadly not unique, situation of all the young people who were not taught Rapa Nui language as children, yet who now are being criticized for not speaking it and who are sometimes mocked for it by the same Rapa Nui adults that did not teach them. This can be seen as the historical result of national (and global) language politics focusing on integration and of local experiences of discrimination and lack of belief in the value of their own language. The parents did not want their children to suffer the same Chilean discrimination as themselves and they were convinced that Spanish was the language of a successful future. Now, some decades later the importance of the Rapa Nui language has been rediscovered and children can learn it in school, but the youth might seem to be a lost generation in this regard — if they do not learn Rapa Nui later in life. A consequence of this is that many young Rapa Nui speak their own "Rapa Nui Spanish" (Makihara 2005) mixing the languages and creating new words — despite this also being criticized by the most "purist" Rapa Nui speakers. And even though they value the importance of the Rapa Nui language and would like to be able to speak it, they feel that it is possible to be Rapa Nui without speaking it. This feeling and practice of the young adults will in turn probably influence what being Rapa Nui will mean in the future. Maybe what some adults today consider unimportant "fun" (like dancing, singing, styles of clothing, etc.) will become just as important expressions of identification as the language? And maybe the new Rapa Nui Spanish that Makihara calls "speaking Rapa Nui in Spanish" (op.cit:27) will be the only Rapa Nui language left?

This language situation can also be seen as a little part of a bigger historical process of "Chilenization" of Rapa Nui in the 1960s to "Rapanuization" since the 1980s (for instance Delsing 2006) — a process which the Rapa Nui also have contributed to by their responses to external forces and historical coincidences.

When the first Rapa Nui finally were allowed to travel to "Chile" (the mainland) for education in the 1950s it was seen as a great privilege. Even though Chileans called them "Indio" and discriminated them for not speaking Spanish, the young Rapa Nui students found better the living standards and social rights on the mainland and upon returning to the island they inspired a local claim for Chilean citizen rights. This led to the installation of civil administration on the island in 1966, followed by massive immigration of Chileans, intermarriage with the Rapa Nui and the introduction of what many Rapa Nui now call "bad habits from the outside". Later, as a counter reaction to this "Chilenization" (which one could say that the grand-parents and parents of the current young Rapa Nui contributed to bring upon themselves) the Rapa Nui are now "Rapanuizating" their island again, focusing on land rights, language and cultural differenced from the Chileans. The tourism business which took off in the same period has also contributed to this, of course, for example with Polynesian flower patterns, pareau and dances flying in from Tahiti and being adopted by the growing generations as part of contemporary Rapa Nui culture.

This majority of the current young Rapa Nui, the so called half Rapa Nui, half Chilean "Mestizo" might seem to stand in an uncomfortable middle position between Rapa Nui and "Chile", as they have family on both sides. And growing up in these "Rapanuicized" times (where it sometimes seems that anything Rapa Nui is something to be proud of and anything Chilean the opposite, even among certain Chileans!) I think it would be easy to favor the Rapa Nui elements of one's identity. After all, human beings are social animals that need acceptance of the group (for instance Goffman 1959). Even though there is no open discrimination, many "Mestizos" sometimes
feel less accepted than the Rapa Nui with two Rapa Nui family names. Some of these "Mestizos" are jokingly accused of acting "more Rapa Nui than a Rapa Nui" by exaggerated use of "feathers and tattoos" or eager participation on the cultural scene. If "heritage and language classes" (McCall 1998:90) had existed they probably would have been fully utilized by "Mestizos" and their participation in the Tapati festival and other cultural arenas shows that they are already trying to "recover again that lost past" (ibid). These individual identity searches and cultural involvement of "Mestizos" actually contribute to keeping the cultural heritage alive. And yet again (and even if this sounds like a terrible cliché) they will be "the Rapa Nui" of the future and what they do and how they react to local and external influences will make the Rapa Nui of tomorrow.

This might be the good and the bad of being young in such a small yet world-famous place. "Mestizo" or "Rapa Nui", students or yorgos; the young Rapa Nui are so few that each and every one of them can feel, and almost see, how they are forming the future of their home place. This is a great responsibility, but also a great possibility. And it is so much more than I can say about me and my home place — even if it is a tiny country of little importance. The only thing the anthropologist can contribute is to write down and remind the growing Rapa Nui what they said — once upon a time when they were still young — about their social role, like this young girl, studying public administration in Santiago in 2007:

You know, I have studied for many years and I have acquired useful knowledge for the future of the island. Yet, I am helpless if you put me in a fishing boat! So in order to avoid the creation of a divide between those who leave to study and those who don't or who fail in their studies I think we have to understand that the island needs all of us. We need to work together.

Maururu e ka oho riva-riva te tau re 'a re 'a Rapa Nui!

Notes

1 Following the example of most Rapa Nui, anthropologist Miki Makihara, and linguists Nancy and Robert Weber, I will use "Rapa Nui" both as noun and adjective here, although most English-speaking authors have been using "Rapa Nui" for the island and "Rapanui" for the people, the language, and as adjective. Given all this, Grant McCall might be correct in arguing that it would be more Polynesian to use "Rapanui" in all three cases.

2 There will probably never be any definite translation of this name and its origin is also uncertain. I base my interpretations on comments from different Rapa Nui and foreign researchers (for instance McCall 1976; Horus 2000; and Fischer"2005).


4 Theoretically one can, for example, divide "the young Rapa Nui" into Mestizo versus Rapa Nui and students versus fanners / fishermen I yorgos, but in practice it is difficult to generalize. "Student" and "yorgos" are temporary chosen statuses, whereas Mestizo or Rapa Nui are given by birth. The current quantitative majority is now Mestizos (because of the many mixed marriages since the 1960s) and most of both Mestizos and Rapa Nui go away to study (as it has almost become an obligation). A quantitative study might confirm the suspicion that more Mestizos than Rapa Nui succeed in their studies on the mainland and could problematize other differences X between them. Yet, I try to look at all of them as a very varied group of "young Rapa Nui" that will be "the Rapa Nui" of the future and who, as they are so few, will hopefully look beyond internal differences.

5 I use quotation marks to indicate that I am still talking about "young Rapa Nui", but in particular about those who happen to have a Chilean parent. Inside the Rapa Nui community people are often called "Mestizo" or "Rapa Nui" without much meaning attached; however, "Mestizo" is also used as a pejorative for claiming that some are "less Rapa Nui" than others.

6 I mean here Chile as a modern Rapa Nui idea of "otherness". "Chile" is the opposite of Rapa Nui and can refer to all
they dislike about this nation and culture that they see as fundamentally different from themselves.

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**References**


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Why Are We Living in the Past?

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Abstract - While archaeologists inherently focus on the past, linguistic, biological and cultural anthropologists can study either the past or present. Few of the so-called “mysteries” or “enigmas” of Rapa Nui remained unanswered. While there is continuing research on the rongorongo tablets, what caused the population decline and how the moai were moved, we now have a good idea of where the people came from, how the moai were constructed and what they represent. However, there is a noticeable lack of anthropological information regarding the modern Rapanui population, including their beliefs, economics, social stratification, impact of immigration and population gene flow, cultural change, health and well-being. These and many other issues are prominent in the anthropological research of other Pacific islands but are largely absent for Rapa Nui. In this paper we examine past trends in the last fifteen years of research concerning Rapa Nui and suggest some ideas for future investigation.

Introduction

While archaeologists inherently focus on the past, linguistic, biological and cultural anthropologists can study either the past or present. Few of the so-called “mysteries” or “enigmas” of Rapa Nui remained unanswered. While there is continuing research on the rongorongo tablets, what caused the population decline and how the moai were moved, we now have a good idea of where the people came from, how the moai were constructed and what they represent. However, there is a noticeable lack of anthropological information regarding the modern Rapanui population, including their beliefs, economics, social stratification, impact of immigration and population gene flow, cultural change, health and well-being. These and many other issues are prominent in the anthropological research of other Polynesian and Pacific populations but are largely absent for the Rapanui. In this paper the authors examine trends in the last fifteen years of research concerning Rapa Nui and present some ideas for future investigation.

Methods

Recognizing that many authors publish in other sources, this study examines papers from 1994 through 2006 published in the Rapa Nui Journal (RNJ, n=185) and in conference proceedings (n=206), commencing with the 1993 Rapa Nui Rendezvous conference in Laramie, Wyoming. Although published in the RNJ, the authors include the Laramie conference proceedings with the other conference proceedings.

The papers are categorized according to its primary theme or research area. They are classified as “archaeology” if they present excavation information or discuss results of excavations. “Cultural” papers focus on the life-ways of the Rapanui from scientific non-archaeological sources. “Environmental” papers focus on ecological, climatic and geological aspects of Rapa Nui. “Linguistic” papers focus on aspects of the Rapanui language, including rongorongo. Papers are classified as “ethnohistory” if they examine the life-ways of the Rapanui as presented by the accounts of missionaries, sailors, and other sources from 1722 to the end of the 19th century. “Biological” papers focus on topics relevant to biological anthropology, including skeletal analysis and health and disease. “Voyaging” includes papers that involve experimental and theoretical aspects of ocean voyaging, particularly pertaining to the settlement of Rapa Nui. Finally, “other” represents the papers that do not fall within one of the previous categories, including those honoring our colleagues who died.

Like most research strategies of this nature, problems are encountered. First, some papers incorporate two of the above topics as primary themes, such as archaeology and environment. In such cases half of the “credit” is given to archaeology and half to environment. Second, the RNJ includes academic papers, responses, informational
news articles, stories: and so on. For the purposes of this study, news articles, stories, etc are excluded and only papers that are deemed “major” are included. These represent papers of at least one page in length on an area of academic interest. Third, to remove inter-observer error, the categorization is made by only one researcher (Chapman) after both authors agreed upon the categories.

**Results and Discussion**

Of the 391 papers from both the *RNJ* and conference proceedings, 286 (73.2%) focus exclusively or primarily on Rapa Nui, while 105 (26.8%) highlight other areas of the Pacific. There is a notable discrepancy between the *RNJ* and conference proceedings in papers focusing on Rapa Nui: 82.7% of the papers in the *RNJ* focus on Rapa Nui compared to 64.6% of the conference proceedings. The difference likely results from authors publishing papers that do not primarily focus on Rapa Nui in other journals, such as the *Journal of the Polynesian Society*. While generally consistent in the *RNJ*, there is variation in the percent of papers focusing on Rapa Nui from one conference to another (Graphs 1 and 2). The number of non-Rapa Nui papers peaked at the Hawaii conference (58.6%) but has otherwise remained fairly constant.

**Table 1. All papers (RNJ + conference proceedings).**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Archaeology</td>
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<tr>
<td>Cultural</td>
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<tr>
<td>Environment</td>
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<tr>
<td>Other</td>
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</tr>
<tr>
<td>Voyaging</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

**Graph 1. RNJ papers focusing on Rapa Nui and other areas of the Pacific.**

**Graph 2. Conference proceedings papers focusing on Rapa Nui and other areas of the Pacific.**

Table 1 and Graph 3 highlight the subject areas of papers focusing exclusively or primarily on Rapa Nui from the *RNJ* and conference proceedings. Of note, approximately half of the “cultural” papers (11.5% of the total) focus on the post-1966 Rapa Nui and half (10.5% of the total) on the pre-1966 Rapa Nui. Also, none of the “biological” papers focus on the living Rapanui.

**Graph 3. Subject area for all papers.**
Table 2 and Graph 4 show the subject areas of papers focusing exclusively or primarily on Rapa Nui from the RNJ. Approximately 60% of the “cultural” papers (13.7% of the total) focus on the post-1966 Rapanui culture and about 40% focus on the pre-1966 Rapanui (9.8% of the total).

Table 2. Rapa Nui Journal papers.

<table>
<thead>
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<tbody>
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<tr>
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<tr>
<td>Voyaging</td>
<td>2.6%</td>
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</table>

Graph 4. Subject area for RNJ papers.

Table 3 and Graph 5 highlight the subject areas for the conference proceedings papers that focus exclusively or primarily on Rapa Nui. About 55% of the “cultural” papers focus on the post-1966 Rapanui (11.5% of the total), while about 45% focus on the pre-1966 Rapanui (9.2% of the total).

Table 3. Conference proceedings papers

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Percentage</th>
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</thead>
<tbody>
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<td>Environment</td>
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<tr>
<td>Linguistics</td>
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<td>Other</td>
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<tr>
<td>Ethnohistory</td>
<td>1.5%</td>
</tr>
<tr>
<td>Voyaging</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Graph 5. Subject area for conference proceedings papers.
The authors identify eight important trends in the published material. First, archaeological studies are the most prevalent in both the RNJ (28%) and conference proceedings (40%), remaining stable throughout the time period investigated (Graph 6).

Second, cultural studies are the next most prevalent (22%), increasing in frequency in both the RNJ and conference proceedings (Graph 7). In particular, there is an increase in studies of the post-1966 Rapanui culture during the last 15 years (Graph 8).
Third, studies focusing on issues related to ecology and the environment fluctuate somewhat over time and between the *RNJ* and conference proceedings (Graph 9).

![Graph 9](image)

**Graph 9.** Environment and ecological papers focusing on Rapa Nui.

Fourth, linguistic studies decrease over time in both the conference proceedings and the *RNJ* (Graph 10). Conference proceedings are more likely to focus on linguistic issues related to the modern society, while papers in the *RNJ* primarily focus on the *rongorongo*.

![Graph 10](image)

**Graph 10.** Linguistic papers focusing on Rapa Nui.

Fifth, ethnohistoric papers are more common in the *RNJ* (14.4%) due to a feature that focuses on early accounts of Rapa Nui, than in conference proceedings (1.5%) (Graph 11).

![Graph 11](image)

**Graph 11.** Ethnohistoric papers focusing on Rapa Nui.
Sixth, recent biological studies are lacking, reaching a peak at the Hawaii conference. Biological studies are always better represented in conference proceedings than in the RNJ: there are very few biological studies in the RNJ since 1998 (Graph 12). Finally, biological studies focus almost entirely on osteological material and not on the living population.

![Graph 12. Biological papers focusing on Rapa Nui.](image1)

Seventh, voyaging studies are infrequent, particularly in conference proceedings (Graph 13).

![Graph 13. Voyaging papers focusing on Rapa Nui.](image2)

Finally, articles on other topics decrease in conference proceedings but increase in the RNJ (Graph 14).

![Graph 14. Papers on other topics focusing on Rapa Nui.](image3)
Suggestions for the Future

An additional trend the authors observe is that the traditional “mysteries” and “enigmas”, including how the moai were moved, what the rongorongo tablets say, from where the people came, etc, have largely directed our research. These topics dominate over other important areas of anthropological research, such as the evolution of the modern Rapanui society.

The authors recognize four overshadowed areas that are important to the Rapanui people and are of interest to the anthropological community:

- the impact of Chilean culture on education and Rapanui identity
- the impact of Chilean immigration on other aspects of Rapanui society
- the impact of tourism on Rapanui heritage
- the island’s political situation

Additional areas of academic interest for which there is little or no information include:

- various social problems faced by the Rapanui (alcoholism, shortages, pollution)
- issues related to health and well-being (dengue fever, hiv/AIDS, growth and development)
- the impact of introduced animals and plants on the island’s ecosystem
- issues related to sexuality and gender (homosexuality, transgender)
- issues related to religion (survival of ancient beliefs and practices, the impact of modern missionaries)

While there is information from many other Polynesian and Pacific populations on these topics, very little exists for the Rapanui. These questions are also important to the developing Rapanui society as globalization continues. Anthropological interest in Rapa Nui originated in the famous “enigmas” and “mysteries”. However, we must ask ourselves if they represent the only items of interest on the island. We wonder how long must the “mysteries” persist to maintain our collective interest in Rapa Nui? Will anthropologists abandon the island once we satisfy our curiosity about them? It is important to remember that Rapa Nui is much more than ancient monuments and “unsolved mysteries,” it also has a vibrant living community from which much can be learned.

Concluding Remarks

In looking toward the future, one problem recognized by the authors is the language barrier. Many anthropologists conducting research on Rapa Nui are not bilingual in Spanish and English. This hinders the transfer of information from the Spanish speakers, many of whom study the post-1966 Rapanui culture, to the English speakers, and vice versa. Additionally, many Spanish-language articles are published in obscure journals or conference papers that are difficult for the English speakers to obtain, and vice versa. This could be easily resolved if more articles were published in the RNJ and if the journal would publish in both languages, with abstracts in the language not used for the article. This format is used in the Reñaca, Chile conference proceedings: English papers have Spanish abstracts and Spanish papers have English abstracts. This format allows the non-bilingual speakers to understand the main points of the article.

Another problem the authors identify is that for many different research areas one can readily identify only one principal researcher, resulting from highly specialized areas of investigation. The researcher immediately becomes the expert on the topic simply because there is no competition. This generates a bottleneck of thought and creates problems if the individual does not publish, retires, or otherwise delays his or her research. To resolve this problem we should encourage graduate students to engage in research, which can be facilitated by creating opportunities to provide them with research funding. Whether the focus is the living Rapanui population or the spectacular achievements of their ancestors, diversity of thought is an important academic stimulus.

In the last thirty years anthropologists have uncovered many of the once mysterious accomplishments of the Rapanui. While much remains to be learned about the past, there is also much to learn about the continuing evolution of Rapa Nui. Just as studying the ancient Rapanui may provide insight into the impact of overpopulation and environmental over-exploitation, the modern Rapanui can provide insight into the impact of globalization and tourism. While we anthropologists have tended to live in the Rapa Nui past, we should also now focus more than we have on the present and future.
Summary

Few of the classical so-called “mysteries” or “enigmas” of Rapa Nui remained unanswered. While there is continuing research on the *rongorongo* tablets, what caused the population decline and how the *moai* were moved, we now have a good idea of where the people came from, how the *moai* were constructed and what they represent. However, there is a noticeable lack of anthropological information regarding the modern Rapanui population, including their beliefs, economics, social stratification, impact of immigration and population gene flow, cultural change, health and well-being. These and many other issues are prominent in the anthropological research of other Polynesian and Pacific populations but are largely absent for the Rapanui. In this paper the authors, one a biological anthropologist (Chapman) and one a cultural anthropologist (Santa Coloma), examine trends in the last fifteen years of research concerning Rapa Nui and suggest some ideas for future investigation.

The authors identify several trends in the published material. First, archaeological studies are the most prevalent, followed by cultural studies, of which only about half focus on the post-1966 Rapanui population. Studies focusing on issues related to ecology and the environment fluctuate somewhat over time, linguistic articles are decreasing and voyaging studies are infrequent. Recent biological studies are lacking, and those that exist focus exclusively on osteological material. Not surprisingly, the traditional “mysteries” and “enigmas” of Rapa Nui have largely directed our research. The result is that important topics are overshadowed. These include the impact of Chilean culture on education and Rapanui identity, the impact of Chilean immigration on other aspects of Rapanui society, the impact of tourism on Rapanui heritage and the island’s political situation. Additional areas of academic interest for which there is little or no information include the various social problems faced by the Rapanui (alcoholism, shortages, pollution), issues related to health and well-being (dengue fever, hiv/AIDS, diabetes), the impact of introduced animals and plants on the island’s ecosystem, issues related to sexuality and gender (homosexuality, transgender) and issues related to religion (survival of ancient beliefs and practices, the impact of modern missionaries). In the last thirty years anthropologists have uncovered much of the once mysterious accomplishments of the Rapanui. Much remains to be learned about the past but there is also much to learn about the continuing evolution of Rapa Nui. While we anthropologists have tended to live in the Rapa Nui past, we should also now focus more on the present and future Rapanui.

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References

**Rapa Nui Journal:**
March 1994 volume 8 (1) through September 1996 volume 10 (3) and December 1997 volume 11 (4) through October 2006 volume 20 (2).

**Conference proceedings sources:**


A Museum Exhibition as a Way to Express Identity
Proposed “He a’amu tupuna, he mana’u a mu’a”

Maria Eugenia Santa Coloma
Universitat de Barcelona, Spain

Abstract - History has made an impression on all societies and cultures to varying extents, based on multiple factors. This is the case with museums, which are no longer a mere exhibition of artifacts dominated by aesthetic functions, but places of gathering where the local population can express cultural identity in different ways. A case study is the exhibit “He a’amu tupuna, he mana’u a mu’a”, prepared for the Father Sebastián Englert Anthropological Museum of Rapa Nui (MAPSE). The exhibit aims to rescue the tales of the past through the voices of the elders, providing Rapanui a place to revive their traditions and to tell their own history in first person so that those tales last in time, enabling them to reach the younger generation of the island. Set in five separate elements following a chronological order, the exhibit “He a’amu tupuna, he mana’u a mu’a” targets diverse goals such as the preservation of the Rapanui culture and the reinforcement of their identity as an indigenous group. The display allows for this identity to be expressed in different ways. Their history is told by the Rapanui themselves rather than by the writings bequeathed by the Europeans visitors to the island throughout many decades. Thus, the value of the exhibition rests more within the collective memory than in the heritage worth of the artifacts exposed, making the museum a place of memory, a space where part of the Rapanui identity is disclosed and where the singularities and richness of the cultural heritage of their people are displayed.

Introduction

The passage of time has made an impression on all societies and cultures to varying extents, based on multiple factors. This is the case with museums, which are no longer a mere exhibition of artifacts with aesthetic functions, but are now transformed into a place of gathering where the local population can express its cultural identity in different ways.

A good example is the exhibition project “He a’amu tupuna, he mana’u a mu’a”, prepared for the Anthropological Museum Father Sebastián Englert of Rapa Nui (MAPSE). The exhibit aims mainly at rescuing the tales of the past through the voices of the elders, providing to the Rapanui a place to revive their tradition and to tell their own history in first person so that those tales last in time, thus enabling them to reach the younger generations of Rapa Nui.

Set in five separate elements following a chronological order, the proposed exhibit “He a’amu tupuna, he mana’u a mu’a” targets diverse goals such as the preservation of the Rapanui culture and the reinforcement of their identity as an indigenous group. This paper describes how this exhibition might appear and what it might achieve.

The exhibition allows for this identity to be expressed in different ways. Rapanui history is told by the Rapanui themselves rather than by the writings produced by European visitors to the island throughout many decades. Thus, the value of the exhibition rests more within the collective memory than in the patrimonial worth of the artifacts exposed, making of the museum a place of memory, a space where part of their Rapanui identity is disclosed and where the uniqueness and richness of the cultural heritage of their people are there for all to see.

The General Problems of the Local Museum

The function of a local museum is to manage the heritage of a particular population in a particular place. They must be dynamic museums, places for communication and preservation of the heritage, committed to the culture of the area in which they are located. These museums need the recognition of the community, including civil society and the local government, so that the management of the heritage is within the framework of a sustainable local development, becomes a strategic element of prime importance. In these museums it is difficult to distinguish between art and culture, where the importance of their collections lies in the local traditions.
One of the problems that local museums experience is how little they can afford to change. The lack of funds is one of the common problems found with local institutions; it is not easy to maintain a permanent exhibition or its conservation. In addition, as they usually are small museums with limited resources, locals do not visit very often, and many of them fall into disuse. Thus, the question arises: what to do to avoid a local museum becoming empty and unattended? According to Pais de Brito, director of the National Museum of Ethnology of Lisbon, museums do not need artefacts but ideas. The museum must experience with feelings. It is necessary to conceive the museum as a place where voices and images are present. The knowledge is basic to preserve the heritage, and this is why museums exist. A museum is not separable from its local history. In many local museums the present time is lost, resorting only to elements of the past. It is very difficult to watch the present through artefacts; for that reason it is important to mix old and new artefacts in order to achieve continuity from the past to the present. It is necessary to try that museums display daily life instead of only a static one.

Local museums should obtain from their community products of the community. At the same time they should try to transfer elements of daily life to the not daily space of the exhibition case and hall. How does the local community participate in the museum? What does it mean for them? For the indigenous people, the heritage is the language; the artefacts are secondary. In this type of museum, artefacts should speak through local language. The museum is a place of memory and plural identities.

The function of a museum is to express local familiar pride and its rights not only through artefacts, but also through tales and dances. The heart of a museum is the way its exhibitions speak to the local population. Local museums have a lot of immaterial heritage that must be preserved as it is the oral tradition, the language, the old customs and myths. And one will wonder, how can it be preserved and displayed in a museum? As Pais de Brito stated: just ideas. The real heritage is the knowledge. In Africa it is said, “when an elder dies, a museum disappears”. But who considers the elders as cultural goods?

In spite of all the problems related to the local museums, they can also contribute benefits to the community, working as a research catalyst, a task that has derived more towards the universities and research centres. And this can be applied to Rapa Nui, where there is no university. Therefore, why not turn the museum into a research centre where the heritage is so handy that it is almost possible to touch it?

**Proposals for the Future**

Although there are always ideas for changing a museum, there are some things that are not easy to change. Usually, the space available to display as well as the budgets are fixed, so the only possibility is thinking about new proposals in order to give a new look to a museum. A formula used by some institutions is to keep the exhibition area, but change the artefacts on display. Thus, for example, if wood sculptures are displayed in an exhibition area, a possibility consists of changing the exhibited artefacts periodically, using some others from the storage room that have never been seen before. In this way, the exhibition areas are the same but the artefacts on display are different. With this strategy, the visitor who returns to the museum can admire different works of art and this makes possible that the locals repeat their visits because they are going to gaze at new artefacts.

Another approach used by some museums nowadays consists of removing the permanent exhibition and replacing it by long-term temporary ones, where different exhibition areas, within the subjects of the museum, are displayed. The temporary exhibitions are more dynamic than the permanent ones. They avoid the museum being static.

This measure has been very successful in those museums in which it has been implemented. It provides a great dynamism to the museum, which changes the exhibition very often. At the same time, it helps to display several stored artefacts that, otherwise, never would be on view because they do not fit entirely with the subjects of the museum.

Many local museums have become museums of living history, in which the villagers participate actively through different demonstrations as the production of crafts or diverse types of workshops. With this model two goals are achieved: first, to involve the local population in the life of the museum and second, to generate benefits for the population from the sale of crafts produced at the museum through workshops and public demonstrations. The creation of small companies of craftsmen who use the heritage as a sustainable development element is used to
preserve the tradition, at the same time that contributes to the development of cultural tourism. By this system, the museum becomes an instrument to pass on the knowledge and to favour the work of the craftsmen.

**The Project “He a'amu tupuna, he mana'u a mu'a” for Rapa Nui**

MAPSE was created in 1973, after the death of Padre Sebastián in 1969, in order to perpetuate his scientific work and to preserve his archaeological collection. After more than thirty years of its creation, MAPSE remains faithful to its mission: to promote the understanding of Rapanui culture as well as to contribute to keeping the identity, self-awareness and human development of local community.

Lately, MAPSE has been conscious that it was necessary to introduce changes in the museum. These changes affect the exhibition area as well as the contents. Part of this project is to develop other subjects different from the strictly archaeological ones. It is essential to make an interpretation of the island from an emotional point of view.

The project “He a'amu tupuna, he mana'u a mu'a” could fit the policy of changes of the museum. Broadly speaking, the proposal consists of introducing the contemporary anthropological aspect within the museum; in keeping with its official designation as the “Anthropological Museum Father Sebastián Englert”.

In this proposed long-term exhibition, the main figures are the Rapanui people. It deals with the reconstruction of Rapanui history from the end of XIXth century until present using the memories of the islanders. In every tale there are always two versions and the most famous about Rapa Nui is the writing reports left by the Europeans. But what do the Rapanui think about their own history? What memories do they have from the past, if either they lived it or they have learned it from their elders? This exhibition is a way to show the visitors the past and the present of Rapa Nui using the eyes and the voices of the islanders, creating an intimate atmosphere, without glass cases between observers and observed. Thus, the discourse is made from cross, different and complementary gazes, where the historic discourse prevails over the aesthetic function.

For a project of this kind it is essential to involve the locals and to make the project a part of their life. Perhaps there are aspects of their culture that do not appear in the exhibition because they give them bad memories which they prefer to forget. Nevertheless, this does not mean the history is incomplete; it is just another way to exhibit it.

This exhibition is addressed to the general public. The gaze of the visitor is important. For the Rapanui, the exhibition tells the history from their point of view, becoming a message of pride and hope. For other visitors, it is a chance to know the history of the Rapanui through a different viewpoint unknown until now.

To visit an exhibition like this it is necessary to create a speech that interrupts the aesthetic attention. A way to do it is to add quotes from the oral testimonies and memories of the elders, texts with a great evocative strength that represent the written voices of the past. The headings do not try to describe the artefacts, but to be interpretations to create a significant space between the person who makes the objects, the museum that exhibits them and the person who looks upon them. The visitor must construct cultural translations and critical meanings. In other words, what it is hoped is to approach the testimonies of a history to the objects, enabling the exhibition to create different tales and to involve the public.

This project pursues different goals. One of them is to display the objects as a place of cultural authenticity where conflict and change are present. It is also important to attract the schoolchildren to the museum and to promote didactic relations between the museum and the schools on the island.

In an exhibition of anthropological nature it is not necessary to display artefacts with great artistic value; instead, artefacts donated by the islanders are enough to achieve interest. The artefacts on display must not be only works of art but community treasures with local value and heritage.

This pursues two targets: to reduce the costs of the exhibition because it is not necessary to borrow artefacts from other museums and to produce an evocative feeling in the visitors, mainly the Rapanui, who see something familiar in them. Thus, the islanders are able to revive memories and to be actively involved in the reconstruction of their own history, becoming the main figures of the exhibition. The museum appears as a sign of pride of the local tradition, reinforcing the identity of the Rapanui, and becoming a meeting place where family stories can be displayed.
Anthropology is of interest both to the present and to the past. In the present it finds many ways to explain social phenomena and cultures of the past. With the project “He a’amu tupuna, he mana’u a mu’a”, the visitor discovers that Rapa Nui has more than a worldwide unique archaeological heritage and that the authors of the exhibition are descended from those who carved the gigantic ancient statues -the moai- for which Rapa Nui is so well-known.

The Objectives of the Proposed Exhibition at MAPSE

The aim of this exhibition is to recall Rapanui culture and to display it as the best treasure of the human spirit. The main objectives are:

1. to preserve and to value Rapanui culture
2. to reaffirm Rapanui identity as a local and long-standing presence on the island
3. to show the locals as well as the tourists how life was in the past through the voices of the elders
4. to integrate Rapanui culture within other indigenous groups of the Pacific, mainly other islands of Polynesia

Methodology

In order to analyze the possibilities of this project and the needs of the Rapanui, I have used different methods. First of all, I have applied all the acquired previous knowledge during the years I did research on the island. In the MAPSE, I also consulted the surveys that the DIBAM (Dirección de Bibliotecas, Archivos y Museos) carries out in all Chilean museums. Using the resulting answers and concentrating on the deficiencies reported by the visitors, I elaborated a survey that was left at the museum as well as the hotels and hostels. I tried to find out what kind of exhibition visitors would like in order to include all those elements of Rapanui life that visitors feel are lacking. Likewise, I did several personal interviews among the residents on the island, either Rapanui or foreigner, in order to know their opinion about the current museum and how they would like it to be.

Location

Since the beginning, this project has had the support of the MAPSE, which is the place where the exhibition will be constructed. MAPSE is located north of Hanga Roa, a kilometer apart from downtown and consists of six buildings. “He a’amu tupuna, he mana’u a mu’a” will take place in the Sala Alemana, the hall for temporary exhibitions, located next to the main building where the permanent collection is displayed (see figure 1).

**Figure 1.** Distribution of the buildings on the MAPSE grounds. 1. Information 2. permanent exhibition hall 3. Sala Alemana (temporary exhibition hall) 4. administration 5. library “William Mulloy” 6 storage room
The dimensions of Sala Alemana building are 11 m long by 7 m wide. Two of the room corners are rounded, so the total surface is 75 m².

**The Exhibition Areas**

1. **Returning to the past**

This part of the exhibition is located in a traditional house called *hare paenga* that will be built next to the Sala Alemana. Inside there will be some screens with backlight where string figures, the *kai kai*, will be shown (see figure 2). The legends related to *kai kai* will be heard through loudspeakers.

![Figure 2. Spatial distribution in the *hare paenga.*](image)

2. **The first Europeans settlers on Rapanui**

This part and the following ones will be held at the Sala Alemana (see figure 3). In this second exhibition area, the story of three European personages (Edmunds, Pont and Cardinali) who arrived at Rapa Nui at the end of XIXth century will be explained. Nowadays, their descendants carry their family name and make up a considerable proportion of the present Rapanui population.

3. **Life at Vaitea agricultural station**

This part shows a main feature of the way of life of the Rapanui during the first half of XXth century. By this time, the islanders worked on the foreign owned ranch, producing wool and other products, initially under the control of the Compañía Explotadora Isla de Pascua and later, the Chilean Navy. It was a time of confinement and during it the islanders could not leave their one village on the island without a permit. And they were forbidden to travel even away from the island. Whilst few people ever lived at Vaitea, the annual cycle of supply ship and seasonal income provided a focus for life on Rapanui in the first half of the twentieth century.

4. **Moving to modernity**

The fifties and sixties gave way to modernity. The end of the Compañía Explotadora Isla de Pascua’s activity, the recovery of the lost freedom, the arrival of the air transport⁶ and the beginning of the Tapati Rapa Nui, a celebration in which old traditions are revived, marking a new period in the modern history of Rapa Nui. It also was the period when Rapanui began to experience life and education in Chile.
5. New times, new customs

In the last part of the exhibition, the present life of the Rapanui, before and after the change of the century, is shown. The shooting of the film “Rapa Nui” at the beginning of the nineties and the arrival of larger numbers of tourists at the beginning of twenty-first century have lead to a way of life far away from the ancient one and day by day less different than any other modern society. Globalisation has come to Rapa Nui.

![Figure 3. Spatial distribution in the Sala Alemana.]

**Activities**

Within the activities schedule that will be held while the exhibition is opened to the public there will be guided visits, cycles of cinema, visits to the library “William Mulloy”, lectures, etc. During this period, I proposed that any cultural activity on the island be centred on the museum precinct.

**Budget**

Sponsors who have collaboratively previously with the MAPSE will be asked to support this proposed exhibition, as well as other institutions and foundations committed to Rapanui culture. Figures shown in table 1 from sponsorship and self-founding are similar to the income of other exhibitions organized by the MAPSE. Regarding the expenses, it is essential to use all the material and equipment available already on the island as much as possible in order to reduce the budget.
Table 1. Budget summary of the exhibition.

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<td>media and advertising</td>
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<td>production and mounting</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>9894</td>
<td>14990</td>
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**Conclusion**

In the last exhibition area, the two sides of the island at the present time, in XXIth century, will be compared by collating pictures of the life of the Rapanui and projecting them simultaneously. Thus, the visitors can experience different feelings. The aim is to invite visitors –particularly local ones- to think about life on the island today and how they would like it to be in the future. For example, the tourism and the archaeological heritage could be brought face to face, as an encounter, a point of conflict; or as complimentary. How many tourists can visit a ceremonial site at the same time? Is the development of this activity, with no limit in the number of tourists, compatible with the conservation of the heritage? How would the Rapanui like to see their archaeological heritage in the future? What seems clear is that the answers to all these questions will be different, depending on the visitor. Thus, the museum will have achieved its aim: to inform, to display and to make visitors reflect on the exhibition.

To consider if the exhibition has been a success, it is necessary that the Rapanui be involved and that they feel proud of it. This way, the exhibition will become a way to maintain the tradition and to reaffirm the Rapanui cultural identity, as well as serve as a focus for community discussion and debate with MAPSE the fulfilling its role as a vibrant and necessary local museum embedded in its island and central to the life of its surrounding population, the people of Rapa Nui.

**Notes**


2. Ib.


5. Named “Sala Alemana” because the German Government offered financial support for its construction.

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Bibliography/Further Reading


Easter Island in the Comics: 65 years of an Island’s Career in the American Imagination

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Abstract - During research for a book focusing on the cultural impact of eighteenth century Pacific explorer texts that featured “Easter Island,” one source I used for investigating the re-circulation of such books and images was eBay. Frequently my quest produced graphic texts of another kind, American comic books from 1940 to the present featuring moai, usually in situ on a wildly fantastical version of the island. Over the course of three years, through eBay and other web-based comic book re-circulation sites, I put together what is possibly the largest collection of English language “Easter Island” comics, 46 in all. This collection is now forming an important part of a project to examine the way moai and Rapa Nui have been taken up, mediated, presented, and received within American popular culture. My starting point is to identify what categories these comic images and narratives sort themselves into. With this in mind examples are offered by category in order to deal with a number of key questions. What identities of Rapa Nui, the Rapanui and their moai are imagined by “the world at large” in such an “undisciplined” medium. How do these imagined identities mediate perceptions in this context? What kinds of cultural spaces are created by such imaginings? What is lost?

Background to the Collection

During the first five years of this century, I checked eBay on a regular basis for examples of the ways ‘Easter Island’ was being represented currently in popular culture and how it has been represented in the past. eBay is a virtual cabinet of wonders for such an activity. Many different island-related items are offered for sale at any given time. Some are actually from the island, or purported are to be from the island, either natural objects such as shells, or cultural production like carvings, music, or jewelry. Most, however, are textual representations of the island created by Americans and Europeans, or popular cultural objects produced in the world at large, often in the form of moai, such as mugs, lights, games, tissue boxes, or garden ornaments. Every so often as I conducted my periodic searches, a comic book would turn up for sale. Because it was the narratives of the island that I was focused upon in my research, I began to buy these. Partway through this research process I started sharing notes with fellow collector Tom Christopher from the board of the Easter Island Foundation. We exchanged comic book lists and found that we each had comics unknown to the other. This discovery prompted us both to turn again to eBay to fill in our gaps and to keep each other informed of any new finds. In this way the collection of American comics I currently own has reached 47 separate items.

Why Look at American Comics?

I am a cultural theorist whose scholarly interests focus on the dynamics of learning; the processes by which new subjects are formed, how we learn about these subjects, how we relate to these subjects, and how they shape our understanding of ourselves in the world. The specific subject that I examine in these ways is ‘Easter Island.’ I do not study the physical island of Rapanui, or the culture of the people who colonized the island. I study the ‘geographic imaginary’ of the island, the texts by outsiders that have shaped ‘Easter Island’ as a subject since the first eighteenth-century European narratives. Enough has been written about the island that those narratives can be sorted into different categories. When writing about the fictional space/place, or geographic imaginary, “Easter Island”, I tend to place the name in quotation marks only at the beginning of a paper to signal to the reader the meaning of the name in my analysis.

By examining this collection of American comic books ranging from 1940 to 2006, I am specifically directing my analysis to narratives written for a youth market. Since the 1920s, they have formed their own distinct category and are unlike comic strips which are syndicated in newspapers and sold to a mass mostly adult demographic (Wright 2001: xiv). They form a separate subject of study from other narrative manifestations of Easter Island in the Western imagination. As part of a profit oriented publishing enterprise, comic books are directed towards a segment of the population who has the resources to purchase them. Comic books therefore tend to have a middle-class orientation (McAllister 2006: 1). And so it is middle class sensibilities that are being shaped through their content.
Comic books have helped to shape the views towards ‘Easter Island’ of several generations of American youth. Bradford Wright, who has written extensively about American comic books, in his preface to Comic Book Nation (2001), describes the educational aspect comics had for him as a young reader. He says, “... I discovered a fantasy world that made more sense than the real one ... I learned that those comic books had not only afforded me an escape from a confusing reality, they had helped me perceive reality in terms I could understand and accept” (ix). My current research is to examine a particular segment of these narratives to see just what “terms of reality” American youth were finding in these stories to understand and accept. How did these comics shape perceptions of the island, the culture and the people of Rapa Nui, for young American readers?

These comic narratives have helped young readers position themselves in relation to the subjects they portray. The readers imaginatively assume the parts of the protagonists in the stories and rehearse possible ways of relating to people geographically and culturally distant from themselves. Comics that feature Easter Island tend to fall under the rubric of Adventure comics, sending American scientists, anthropologists, or superheroes from America to the island in order to make discoveries or to acquire knowledge. In the process of that acquisition, they also encounter and resolve conflicts. In these comic narratives the Americans are cast into a specific proactive and dominating role in relation to the island and the islanders (if any islanders are being depicted. So often in these comics, the island is presented as uninhabited.) It is the Americans, rather than the Rapanui who are the central characters. As the American characters perform their prescribed roles within the stories, they are enacting particular ideological stances towards the other cultures they encounter. Young American readers, relating to these comic book heroes are learning adult roles to play, roles that are bound to particular dominating ideological stances in relation to distant Others in the world.

As American cultural ideas about social interaction shift over time, the comic books tend to reflect those changes in ideology, and so the influence that the books have on youth shifts over time as well. My intention in this paper is to trace one aspect of the ideological shift across successive decades in how the islanders themselves have been depicted, or erased from the island, starting with the 1940s.

1940s

In the first comic book to depict Easter Island, “The Three Aces,” Fog Fortune, Gunner Bill and Whistler Will, famous American Aviators, accept a paying commission from Frank Bucker to “explore Easter Island and attempt to discover who put those giant statues there” (Chad 1940:1). The three pilots, each in his own plane, land on the island with their backer, Bucker, and check in with an European island administrator to explain their exploratory intentions. The administrator responds to their plans with a warning “… that the natives have grown resentful of white explorers here! You may encounter trouble!” (1940:2). The first panel to depict the “natives” has the caption “cruel eyes peer down at the explorers....!” with the native in question saying: “Strange explorers! They must DIE!” (1940:2) (see Figure 1). This introduction of Easter Island to comic books positions the explorers as victims of the island population as villainous, anticipating many of the distortions yet to come.

Figure 1. Chad, ‘Three Aces in the Secret of Easter Island.’ From Action Comics #28 (New York: Detective Comics., December 1940.)
In the second comic from 1941, “Lance O’Casey on Easter Island,” swashbuckling sailor of fortune, and his first mate Mister Hogan, a monkey, sail in quest of high adventure in his schooner, the Brian Boru II, from his home port in Maloana in the South Sea Islands. As they pass Easter Island, Lance notices that the lighthouse has moved and is steering ships into, rather than out of, danger. He sails to the island to investigate, but has been spotted from the island by a native lookout who reports to an elderly American villain, Weasel Wiggins. Weasel has enlisted the island population to assist him in piracy and call him boss. In response to the possibility that Lance intends to land, Weasel declares, with territorial aggressiveness, “Nobody’s gonna live on this island but us” (1941:23).

Figure 2. ‘Lance O’Casey on Easter Island.’ From Whiz Comics #13. (Louisville: Fawcett Publications Inc., February 1941).

Figure 3. ‘Lance O’Casey on Easter Island.’ From Whiz Comics #13. (Louisville: Fawcett Publications Inc., February 1941).
In both of these 1940s comics, when inhabitants are depicted on the comic book versions of Easter Island, they tend to be stylized versions of non-Euro-Americans, versions that “have contributed to the normalization of racially based prejudices In some instances, those prejudices have been obviously and graphically depicted,” (Smith 2006:132) as can be seen here (see Figure 2).

The islanders here speak in pidgin English. The American hero arrives and overpowers the native inhabitants who have been helping Weasel, the villain. The natives are shown to be no match for the American heroes. In the narrative, the islanders are described as possessions of the Euro-American villain with the statement: “Weasel’s Blacks are coming.” The ‘wholesome’ American hero, Lance, wins the battle. Note how the villains and the natives are literally reduced in size after being vanquished by the larger than life Americans (Figure 3).

**1950s**

The focus of Easter Island comic narratives shifts in the 1950s. It is a decade during which American society was reacting to the development and use of nuclear weapons in the Second World War Many narratives in the popular media of film, television, pulp fiction, and comic books responded to the presence and consequences of life with the bomb. Stories about mutated monsters were one such response to the uneasiness of living on a planet that now had radiation contamination. Cyndy Hendershot, in Paranoia, the Bomb and 1950s Science Fiction Films (1999), characterizes this era as one of cultural paranoia manifesting itself, in popular culture, as a fascination with monsters, and a rehearsal of attempts to repulse monsters. During this same decade there was also an increased imaginative focus on outer space. By the mid-fifties Sputnik was launched. The combination of monsters and space informed the comic book narratives imposed on Easter Island for the next two decades. The island became a mirror for gazing on the western fascination with and concerns about life beyond Earth, space monsters, and extra-terrestrial invasion.

All but one narrative during the 1950s takes place on an island only populated with moai. Depicting Rapanui would interfere with the imaginative enterprise of using the island as an empty stage for narrating space-based fantasies. All of the 1950s stories involve moai that are actually connected with visits or invasions from other planets. Frequently the moai are stone space men here to take over planet Earth. The first comic story of the 50s, “The Secret of Easter Island” Strange Adventures (1952), features an American archaeologist who has translated “tablets” and has a theory about the secret of Easter Island. He arranges a trip there blasts a hole in a hillside and reveals a subterranean chamber replete with resident aliens who came to Earth, landing on the continent of Mu, to bring knowledge to mankind. The moai were carved on the highest peak of Mu in the aliens’ honour. But the continent later sank because of the abuse of that alien acquired knowledge, leaving only the island and statues (and aliens in their chamber) today.

“The Easter Island of Space” in Action Comics, Tommy Tomorrow (1953) is not actually about the island itself, but makes reference to carved heads on a planet that make it the equivalent of Easter Island on Earth. The third comic, “The Stone Slayer!” in Wonder Woman (1954) depicts space aliens who crashed on Easter Island while doing reconnaissance in advance of an invasion. They explain to Wonder Woman that they carved the moai, which are in their image, to signal their fellow “Lapizurians” of their marooned state. The fourth comic is “The Stone Heads!” in Mystery Tales (1954), the first person account of a writer who travels to the island to do “one of my exploration series books! I was hoping to shed some light on the origin of the giant, fantastic stone heads…” (1954:1). This writer is shown being helped by others to unload his boat when he arrives, but no reference is made to who these others are. They could be the boat crew. The next morning after he discovers that the heads have moved during the twenty year interval since they were last photographed, he decides to consult the island inhabitants. “I talked to the natives! Only a few hundred still lived on the island, but they knew nothing of the statues…” (1954:3). The writer continues his investigations and finds a space ship in the water off shore housing a plan for earthly conquest. “When I surfaced, I realized the fantastic origins of the once mystifying stone heads! They were not statues carved by human hands and placed there…they were living, alien creatures who had reached earth…!” (1954:4). With this second invasion based story, the “natives” are written in as observers rather than creators of the moai.

“The Riddle of the Runaway Earth!” in Mystery in Space (1957), again represents the moai as the manufacture of aliens, in this instance arriving to help Earth, not to invade the planet. They carve their likenesses as a tribute to themselves for moving Earth closer to the sun so the very cold inhabitants of the planet, cave men slaying mammoths, will be able to progress towards civilization more rapidly. Once again the Rapanui are removed from the island and their cultural production is placed in the hands of space carvers. In “The Stone Sentinels of Giant Island,” House of Mystery (1958), the American scientific heroes arrive at a previously unknown Pacific island that has recently emerged from the deep. It is peppered with moai and the scientists recognize a connection to
Easter Island in these giant stone statues that come to life and try to rout them. As they hide from the statues, they discover they are stone sentinels created long ago by aliens to protect a space station on the island from prehistoric beasts. Here is another benign space manifestation, but one that still removes the Rapanui from their own cultural production. The final comic from the 1950s, “I was Trapped by the Things on Easter Island!” in Tales to Astonish (1959) again erases the islanders to tell the tale of moai as stone men from space come to invade Earth who have planted themselves as motionless statues until they are given their instructions. An American who crash lands his plane and discovers their secret is thought to be hallucinating when he tries to warn the rest of the world. In this final tale of the decade, the islanders again lose their place and story on the island and the Americans are imagined as powerless to defend their world from colonization — a metaphor perhaps for Cold War paranoia.

1960s

With the 1960s we have the return of an indigenous population in two of five comics published, the result of texts and images from the Norwegian Archeological Expedition finding their way into the American public consciousness. For example, the Saturday Evening Post serialized Aku Aku in three issues during September 1958. Such articles raised American public awareness of the indigenous population on the island. Because of this information, islanders needed to be accounted for in comic narratives, but they were still not “allowed” to interfere with an imaginative vision for the island that wanted the moai to be disassociated from the culture that created them. The first comic from this decade, “Here Comes Thorr the Unbelievable” Tales to Astonish (1961), depicts what are described as a “A tribe of friendly islanders,” but ones who arrived after the moai were already in situ, “before our first ancestors came to the island” (1961:2). The second comic, “Back from the Dead!”, Tales of Suspense (1962), apparently depicts an islander, actually an alien who looks like a moai, in order to elicit the aid of a criminal castaway to help him find the lost instructions that will help him awaken his fellow aliens to return them to their home planet. “The Jaguar, The Immortal Alien” in Archie Laugh (1962) has no contemporary islanders mentioned or depicted. Archaeologists dig with pick axes “in an area near the islands famed statues…” (1962:1) to discover their origins. The archaeologists in this comic have two hypothetical questions: “Were the statues built by prehistoric men who later transported them over great distances by rolling the monuments along a path of pebbles and seaweed? Or were they hewn by space creatures who accidentally landed here years ago and left these statues as signs of their visit!” (1962:2). Current archaeological thinking about the moai or space-monster conflicts, neither question is answered in the story, which actually deals with archaeological fraud. There are no islanders in “How Lois Lane Fell in Love with Superman,” Superman’s Girlfriend Lois Lane (1964) which is situated, as Perry White explains, on an island between India and Thailand. There are, however, moai-esque statues erroneously facing, as in all these comics, out to sea.

The final comic published in the 1960s, “The Island of Buried Warriors,” Kona Monarch of Monster Isle (1965) depicts islanders. In a complex confabulation, they are buried in Rano Raraku with a large ocean-worthy canoe in a state of suspension and return to life after an earthquake and tidal wave. They are all male, all blue, all “long ears” and intent on ruling all of Polynesia. An American scientist, his family, and the hero, Kona, travel to the island to investigate earthquake damage and become the victims of the warriors. Kona rescues them and returns the warriors to the volcano to resume their stasis. Negatively depicted islanders once again offer stylized versions of non-Euro-Americans, contributing to the normalization of racially based prejudices (see Figure 4).
1970s

Eight comics have surfaced so far from the 1970s, of which five are reprints of earlier stories from the 50s and 60s. Of the three new narratives, two of them depict islanders. The first new comic, “The Rot Expedition,” Mickey Rat Comix, (Adult) October (1972), is a scurrilous parody of Mickey Mouse and of Thor Heyerdahl’s Ra Expedition which had been published in paperback in 1971, had been featured on the cover of the National Geographic Magazine (January 1971), and had come out as a documentary film in March 1972, seven months before the publication of the “Rot” comic. Mickey Rat is nursed back to health by islanders when he washes ashore after drifting to the island in a boat. He abuses his hosts’ hospitality, and he is finally rescued by a caricature of an islander who invites him to share her life, an offer he exploits by turning her into his servant-slave. The male islanders are depicted as aggressive, the females as docile and compliant. The American rat is shown as clever and calculating and exploitative in contrast.

In the second comic from the 70s, “The Super-Amazon!” Supergirl (1973), the island is described as: “Cologi Island deserted and isolated!” Despite this description, when Supergirl travels to it on a mission to collect a life-saving plant, she encounters three witch doctors hiding in hollow moai-ish heads. After they rob her of her powers, she is rescued by a character called Fong who claims the island as his. No other islanders are depicted. There are also no native inhabitants in the final 70s version of the island, “The Common Enemy!” in The Mystery and Madness of Weird War Tales (1975). Here a battle between a shipwrecked American soldier and a shipwrecked Japanese soldier is carried out in front of a moai who is awakened by their firepower, summons a space ship and departs. In this comic set during and after WWII, the American soldier is depicted as a normalized white male while his Japanese foe is biliously yellow with extremely bucked teeth — again affirming that non-Euro Americans depicted on the comic book versions of Easter Island tend to be stylized caricatures which re-inscribe socially sanctioned prejudices of white America.

1980s

In the 1980s, of seven comics, five have narratives set on Easter Island and four of these make reference to islanders. In the first, “Encounter on Easter Island!” Incredible Hulk (1981), the Hulk swimming for his life, finds he has come ashore on Rapa Nui which he recognizes from having read Aku Aku. He mentions his awareness of the existence of a small community on the other end of the island from where he has landed, but does not encounter them in his adventure with the Absorbing Man. While held prisoner in an island cave he recounts what he describes as Heyerdahl’s theory of South American long ears in residence on the island carving statues and their subsequent immolation by invaders. In the second story from the 80s, “A Kingdom Lost!” The Mighty Thor (1982), Thor flies to the island to help save the native population from a tidal wave. When he arrives Americans are already on the scene rescuing the islanders by helicopter. One says to him: “You see those statues Thor? There’s nothing else like ‘em on earth. This island must’ve been a great kingdom once hosting an advanced race who were somehow sent into decline.” The American goes on to say, “So okay, now there’s only a relative handful of people here, and we’ve managed to save their lives… it would be a real shame, don’t you think, if their town had to be wiped out . . .?” (1982:7-8). The islanders are in the story only to be rescued by Americans.

All characters in “The Secret of Easter Bunny Island!” and “The Bunny from Beyond!” (1982a) Captain Carrot and his Amazing Zoo Crew! (1982b) are animals. An American Indiana Jones-type character parachutes into the midst of natives on the island. He discovers that much earlier invaders from space forced the islanders to carve bunny-shaped stone heads as markers to protect alien eggs planted under them. The current natives are being forced by European invaders to dig up all the Stone Heads and retrieve the eggs. The American Jones character resolves the various ensuing conflicts. In space invasion comics, the islanders, if they are included in the story, invariably either did not carve the moai on the island, or are depicted as carving them under the direction of invaders. Either way, they are not given credit for the creation of their own cultural heritage.

The final comic of the 80s is in fact a six part series in which Easter Island features in the first three volumes: “In the Clutches of Darkseid!”, “When Past and Present Meet!”, and “Terror on the Island of Living Stone!” Super Powers 1, 2, 3 (1985). The story line does not have any present day islanders, but does have a time travel sequence which features Rapanui. Several superheroes head to Easter Island to confront an evil space seed that is rooting there. The island is described as “shrouded in mystery” where “the soft Pacific winds mask the sound of cold stone shifting in the sand behind the heroes…” (1985/2:8). We are told that “it’s hard to believe primitive islanders could erect such magnificent monuments…” (1985/3:1) which were “Discovered by Europeans in 1722.” (1985/3:1). The story proceeds to prove they did not erect them. Soon the super heroes have gone back in time, well before 1722, to meet space creatures who look like moai and who have the island population in thrall.
Islanders are shown to cringe in fear before the aliens and also before the super heroes, (see Figure 5) who assure them they are on the island to help.

An islander explains to the superheroes, one of whom is an anthropologist in his regular identity, that the stone invaders “are gods from the land of the sun” (1986/3:15) who must be obeyed. The superheroes freeze the aliens, creating the moai we see on the island today, and, in the process, they free the islanders. While still on the island, they return to the present and discover that the grateful natives have erected statues of them for their rescuing efforts. The superheroes proceed to destroy those statues of themselves so no one will know they are the actual creators of the moai. Here we see comic narratives managing to acknowledge the presence of islanders at the same time as they once again deny them the creation of their own cultural heritage and simultaneously centre the Americans as the creators of the moai and heroes of the story.

Disney has four comics set on versions of Easter Island. The first, “The Mystery of Easter Island” Walt Disney’s Uncle Scrooge Adventures (1988), is the last of the comics from the 80s. When the Ducks land on the island they come ashore into the midst of islanders selling souvenirs. That is the last reference to the Rapanui. The rest of the tale has to do with villains who are conducting evil schemes in caves under the moai.

1990

The second Disney comic, “A Tuft Luck Tale” Walt Disney’s Donald Duck Adventures (1991) is the first from the 1990s. It has an islander character who announces to the Ducks that they “are in the custody of the Rapa Nui Police Department, Mayor, local Barber and customs agent!” all in one person and the only islander met by the Ducks.

“The Eyes of Rapa Nui” Jonny Quest the Real Adventures (1997) is the only other American comic I have found from the 1990s. Jonny, an American teen, accompanies his father to the island where he encounters two islanders. When he causes the first to lose his cart load of sweet potatoes, Jonny thrusts money at him to solve the problem and runs after his dog. In the process he befriends a Rapanui teen named Miguel, who is skipping school. Jonny learns about the past of the island culture from the boy, who is shown to embody wisdom, and has dinner with him at the end of the adventure.

21st Century

The new century has produced five Easter Island comics so far; two are multi-book series. The first of these series is “World War Three Mageddon!” The World’s Greatest Super-Heroes! (2000), an extreme six part example of American heroes using the island as a stage for their own narrative. There are no islanders present, and the moai, because it makes for good special effects, are used as conduits for the heroes’ super powers which shoot skyward through their eyes. Another superhero comic is “The Balance,” Batman Adventures (2003). Again, there are no islanders and the island serves as a backdrop only. Batman disregards the moai as cultural
artifacts as he claws his way over them and they dramatically crumble under his hands and feet as he battles his villain.

This century has already produced two more Disney narratives using Easter Island. The first, “Not Distant Enough” Walt Disney’s Donald Duck and Friends (2004), places an island with stone heads off the coast of North America and calls it Arbor Island and uses it as a parody of Easter Island. It is now without natives, but they are theorized as having migrated to America and settled it. The second Disney comic, “The Easter Mystery” Walt Disney’s Donald Duck and Friends (2005), plays on Easter Island as the home of the Easter bunny and his Easter egg producing poultry. It, too, is an island with *moai*, but without islanders. Another 2005 comic in three parts, *Seaguy*, features Easter island in the second part, once again with *moai* (in this comic they smoke and talk) and without islanders.

The lack of islanders in these first four tales of the 21 century points towards two differing American cultural conditions. One may be the discomfort authors feel depicting non-Americans without creating caricatures. A simple way of dealing with this discomfort is to eliminate the Rapanui from stories set on the island. Another reason may be a narrative stance we have seen taken so frequently since the 1950s in these comics. It is easier to create heroic stories about *moai* and Americans, than islanders and Americans.

The final comic series of the 21st century points in another direction. It suggests a real possibility of change in the way Rapa Nui is depicted in this popular narrative form. These comic images are from a series called *The Ineffables*. There are six comics in it so far: “First Issue” (2001a), “Behold the Second Fabulous Issue” (2001b), “The Third Issue” (2002), “Patriot Act Issue Four” (2004a), “Parallel Universe Issue 4” (2004b), and “Political Science” (2006). They tell the tales of a group of four indestructible beings who step in to save the world from faulty scientific reasoning. Unlike the majority of the earlier comics, this series is not from a mainstream publisher, but the work of an individual, Craig Bogart, who self-publishes and sells the comics through his website. This counter cultural comic series is an example of the way entrenched Western understandings of the island are now adapting themselves to changes in the American sensibility. The story begins on the island where someone (Rapanui? American?) is selling souvenirs, but is only seen in the opening sequence, and then removed from the narrative background, to be replaced as usual by an emphasis on the *moai*. In this case, however, the *moai* is not a monster, but a hero. As cultural voices are raised in America to counter the conservative political agenda, the *moai* is being called upon in this series to be an embodiment of ancient wisdom in the form of one particular *moai* called Mason (see fig. 6). The *moai* as space invader is transformed into a leader who repeatedly saves America from politicians using bad science to ill effect. As Mason says of himself, he is manifested as what the form of the universe around him demands that he be (*The Ineffables ‘Political Science’* 2006:14).

![Mystery Tales From the Borders of Comprehension](image)

*Figure 6. Bogart, Craig, “First Issue” From *The Ineffables*. (Columbus: Rick’s Café Publishing, 2001a).*
In American comic books that feature Easter Island ranging across 65 years, we see that Rapa Nui the island, the Rapanui people, and their moai heritage have a lack of narrative stability and take on whatever popular cultural narrative need is ideologically current. That need in the past has often been to foreground American concerns and interests at the expense of the interests and cultures of Others. Perhaps comic book narratives in this century will lead the American imagination toward a new ideology where readers will learn to view Rapa Nui and the Rapanui as visible and viable—new narratives that can shape the values and understandings that youthful readers may have about Others with whom they share the planet.

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**References**


Bogart, C. 2006. Political Science. The Ineffables. Columbus, Mystery City Comics.


Kirby, J. 1959. I was Trapped by the Things on Easter Island. Tales to Astonish. New York, Marvel Comics. 1 No. 5. September

Kirby, J. 1961. Here Comes Thorr The Unbelievable. Tales to Astonish. New York, Marvel Comics. 1 No. 16. February

Kirby, J. 1970. This is Thorg! The Monster Who Waited a Million Years to Destroy the World! Where Creatures Roam. New York, Marvel Comics. 1, No. 3. November


Comparative Structural Analysis of *Rongorongo* Script and Rapa Nui Songs

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**Abstract** - Easter Island’s rongorongo script, surviving on twenty-six wooden artifacts, has attracted significant scientific interest since its discovery in the second half of the 19th century. In the framework of a possible phonetic nature of the script, statistical analysis remains one of the most promising methods for comparative studies of rongorongo and surviving Rapanui lore. To perform such investigations it is necessary to use an improved glyph transliteration methodology that yields a numerical corpus with proper accounting for the spelling variants of rongorongo signs and the matching sets of legends, songs, etc. This paper is dedicated to the partial solution of the aforementioned questions. Rongorongo corpus, transliterated into glyph elements, was subjected to a recurrence plot analysis allowing extraction of the repetitive passages and outlining the “independent” continuous text. Taking into account the passages shared between the inscribed artifacts, a new improved proximity diagram for rongorongo artifacts was proposed, allowing definition of two distinct inscription groups. Investigation of the corpus of Rapa Nui songs (published in Barthel 1960, Campbell 1971, Blixen 1979) revealed that they possess the properties similar to those characteristic to the Easter Island script, supporting the hypothesis of probable presence of songs or chants in rongorongo texts.

Inscribed tablets of Easter Island remain one of the intensively investigated aspects of Rapa Nui heritage. The research is complicated by the small number rongorongo artifacts that have survived and the absence of direct reference between the inscribed texts and known monuments of Rapa Nui lore. It was suggested that the inscriptions may contain genealogies (Englert 1948:321, Butinov 1960:79), lists of wars and murdered men ( Routledge 1919:248), songs for the gods (Barthel 1971:1168), cosmogenetic chants (Fischer 1997:258-261), prayers (Métraux 1940:395), magical spells (Routledge 1919:249), agricultural texts (Fedorova 2001:77-88). It is also plausible to suggest that some inscriptions may have contained the texts intended to help the soul in the travel through the underworld (Barthel 1990:73, Horley 2007:31), as according to the island lore rongorongo artifacts were buried with a deceased person (Routledge 1919:246); possible confirmation of the latter can be seen in tablet fragments discovered in association with human remains in the caves (Fischer 1997:236). The vast existing repertoire of Rapa Nui legends (Métraux 1940, Fedorova 1978, 1988), as well as chants and songs (Barthel 1960, Campbell 1971, Blixen 1979) significantly outnumbers the texts appearing on the inscribed tablets. Therefore, for the further comparative analysis it is required to perform a proper selection of a narrower set of the reference texts possessing the same structural and statistical properties similar to those observed in the inscriptions. Classification of Rapa Nui oral tradition regarding the topics covered or literary genres used was already performed in the literature (e.g. Fedorova 1993:213-223, Campbell 1971:33-38), and can be utilized to form several reference sub-corpora for testing the distributions of the words/syllables or highlighting the structure of the text. To the contrary, the similar classification of rongorongo inscriptions is a far more complicated task, which should be performed via the internal analysis of the survived texts.

This paper is dedicated to the partial solution of the aforementioned problems. I will refer to the tablets, lines and glyphs using Barthel’s notation. Glyph numbers are padded with leading zeros to a three-digit form to distinguish them from two-digit glyph element codes (Horley 2005:112). Inscription fragments and tablet outlines presented in the paper were traced by the author from photos of the original artifacts (Chauvet 1945, Heyerdahl 1975, and a photo of Honolulu Tablet 3629 taken by Scott Nicolay). Portions of the text inscribed on the Santiago staff were drawn after Barthel’s tracings (1958).

To perform classification of rongorongo artifacts according to the structure of their texts, many parameters should be taken into account, which hopefully may give an insight regarding the possible genre of the inscription. Thomas Barthel suggested the following classification (1958:168):

- Gr-E-N, partially C and S – texts featuring the sequences 380.001.003;
- Gv-I-T – texts with the pronounced usage of the glyph 076.
This classification was summarized in the proximity table for the rongorongo artifacts, Fig. 1. To simplify the discussion, additional information regarding the presence of the main structured lists was added to the figure using the designations from Horley (2007:26-27); the presence of the sign 076, frequent in the texts Gv, I and T (Fischer 1995:309), is denoted with the visually-similar letter β. As one can see from the figure $\beta\beta$, consideration of the structured lists influences Barthel’s classification: text A should be at least partially included to the group Gr-E-N, while existence of the list items 022f.243 (denoted as ix) suggest stronger connection between the topics addressed in the inscriptions A, C, E, and H, which belongs to the both groups of “Great Tradition” and the texts featuring the lists delimited with a ligature 380.001.003.

More complete analysis can be performed accounting for parallel sequences, shared between the different rongorongo artifacts (Kudryavtsev 1949, Butinov and Knorozov 1956:83-89, Barthel 1958:151-157, Guy 1982:445-6, Pozdniakov 1996:301, Nicolay 2000:Fig.1-3, Sproat 2003, Horley 2007:26). Recurrent plot analysis of rongorongo corpus transliterated regarding glyph elements confirmed the close relation between the texts N and Ev suggested by Pozdniakov (1996:299), and highlighted the significant similarities between the texts R and A (Horley 2007:25). Detected parallel passages offer significant help in understanding allographic variations and ligature formation rules characteristic for rongorongo script. For example, the sequence appearing in the lines Ra2 and Aa6 (Fig. 2) reveals the allographic nature of one-of-a-kind glyphs 468 and 476, containing the elements 49 (a head with gaping mouth and a long neck) and 06 (arm with an open palm). Further on, the body of the sign 748 can be distinguished as the lower part of the complicated anthropomorphic glyph 266. The ligature 200.047 repeated twice in the line Ra2 and followed by the glyph 069 is written as a sequence 200.02-097-069-097-069-097 in Aa6, suggesting the interchangeability of forked-based and hand-based glyphs 047 and 097, thus supporting Pozdniakov’s hypothesis about the close proximity (or probable equality) of the forked and open-palm hands (1996:295). Surprisingly, there is also evidence suggesting that the gaping-mouth and lozenge-shaped heads of anthropomorphic signs can be used interchangeably (see, e.g. 207=387 and 226=326, Figure 2).
The abundance of the parallel sequences also helps in recovering the text from the damaged parts of the artifact, if the latter occur within the known passage. One of the examples is illustrated in the Figure 2 for the Barthel-Butinov sequence including the signs 004-522-700-600 (Barthel 1958:157, Fischer 1997:506), which appears on seven tablets B, E, G/K, H, M, and R (Butinov 1982:55). The underlined passage 067.010f-244-027 was absent in Barthel’s drawings of rongorongo corpus, but can be identified from the photos of the artifact appearing in Thomson’s account (1891:Plate 38) or from modern illustrations (e.g. Heyerdahl 1975:Fig. 58h) after computer image enhancement. It is worth a special mention that many parallel sequences feature alternative joint/disjoint writing of the glyphic groups (e.g. 077, 034 and 700, 600, Figure 2). Curiously, the sign 059f appearing in the line Ra5 inherits the leg of the anthropomorphic sign 324, as if representing a cursory way to write the group 059f-324 from the line Ev6.

Recurrence plot analysis of Gv, I and T inscriptions in glyph element representation revealed the surprising presence of numerous parallel and similar-looking passages shared between the texts I and T, so far not described in the literature to the best of the knowledge of the author. Several examples of such passages and the schematic structural diagram of the tablet T are shown in the Fig.3. Given the fragmentary nature of Honolulu tablet, these parallels suggest the important conclusion that texts I and T are related not only due to the frequent use of the sign 076, but also because they deal with essentially the same (or very similar) subject.

The fragments appearing in the lines I4 and T5 show the alternative ways to write the doubled anthropomorphic glyph with two bodies (sign 208) or heads (sign 209); a similar practice can be also observed in other parallel passages (e.g. Pr1/Ra6, Nicolay 2000:Fig.1; Bv5/Bv6, Butinov and Knorozov 1956:83). One of the most severe problems with rongorongo inscriptions consists in seemingly harmless mirror-flipping of the signs, displayed here as the ligatures 020.010 and 010.002. Curiously, in some instances (e.g. Qv7/Pv6) the sign 020 also becomes used as a probable short-hand form of 002; additional investigation is required to clarify this question. The parallel passages in the lines I7 and T7 suggest the tentative duplication of the sign 027 forming the glyph 084. The fragments I3/T8 also represent parallel sequences, clearly revealed upon changing the order of Fischer’s triads composing them (Figure 3). It is important to highlight that the text T lacks the elaborate depiction of the anthropomorphic sign 530 characteristic to the Santiago staff, i.e. with forked-palm hands (e.g. Fig. 3, line I7) and adornments eventually attached to its shoulders. This fact may lead to the assumption that the calligraphy of the Honolulu tablet shows the sign 530 in its basic form. The glyph 451 from the line I3 is vertically-mirrored in the line T8, thus being assigned with Barthel’s number 079. Three joined anthropomorphic signs 570.200.300, appearing further, are presented by the elements 43d and 02d (corresponding to their heads) in the line T8.

Based on the results of the analysis performed, an alternative proximity diagram for rongorongo inscriptions was suggested taking into account parallel passages shared between the different tablets (Figure 4). The quotations between the texts are marked with arrows; the “original” or “quoted” attributes were assigned to the passages to minimize the segmentation of the resulting independent text. As one can see from the figure, the tablets A-C, E, Gr/K, H/P/Q, M, N, R, S are most closely related, sharing the multiple parallel passages and containing two types of structured lists with the similar entries (Horley 2007:28). The strong relation of the small texts R and N to the inscriptions A and E is highlighted. Three artifacts A, B and H hold the largest continuous independent texts and therefore can be suggested to form the “core” of the discussed inscription cluster. As the lines Hv10-12

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(making the text of the Large Santiago tablet longer than that of Large St. Petersburg tablet) are mainly composed with the quotations to the other tablets (Horley 2007:26), it was decided to consider the artifact P as representative for H/P/Q inscription due to its better preservation state, further calling the continuous independent text extracted from these three tablets as B-A-P sub-corpus.

The second group of inscriptions featuring the strong similarity between each other consists of the texts Gv, I and T with the high usage of the glyph 076; at the moment, I were unable to detect any parallel passages shared between this group and B-A-P cluster. In this paper, only the text of Santiago staff was considered to represent the inscription cluster Gv-I-T. Moreover, as calculated usage frequency of the sign 076 overcomes those for the most frequent syllables in the reference Rapa Nui corpora in about 1.5 times, it was assumed safer to construct the reduced I-text omitting this sign, similar to the approach used by Sproat (2003).

The remaining artifacts D, F, J, L, O, U-Z are fragmentary and do not feature parallel sequences seen in the other texts. While being good objects for paleographic and allographic studies, these inscriptions were not included in the corpus for further statistical analysis.

Comparing rongorongo text proximity diagrams shown in the figures 1 and 4, one can see that consideration of the parallel passages revealed two isolated inscription groups B-A-P and Gv-I-T featuring the longest continuous texts. Assuming that the jointly written glyphs in the tablets represent separate Rapanui words, one can estimate lexicon richness (the ratio between the number of different words and the total number of words in the text) for both B-A-P and reduced I texts as 0.31 and 0.21, respectively. The lower value for Santiago staff pointing to more word-unified character of its text can be tentatively interpreted as a statistical property suggesting that this inscription may represent the collection of chants or songs (Englert 1948:321, Barthel 1971:1168, Fischer 1995:316); indeed, in comparison with the legends, songs will feature lower vocabulary diversity. Structural studies of rongorongo texts revealed the presence of textual fragments with the size comparable to syllabic length of kaikai and ‘ei songs, arranged in the list-like structures in the inscriptions A, Bv, and Er (Horley 2007:26, 31) that cite the texts of other inscriptions. The same behavior is observed for short songs, charms and prayers embedded into Rapa Nui lore; alternatively, these textual fragments may be collected according to the
genre to form a “prayer tablet” or a “song tablet”. But, the existence of the continuous inscription potentially composed with songs would offer much wider possibilities for the further analysis.

To verify the latter suggestion, the corpus of Rapa Nui songs (RNS) appearing in the works of Barthel (1960), Campbell (1971), Blixen (1979), and Fedorova (1978, 1993) was subjected to the structural and statistical analysis aiming to reveal the features similar to those observed in rongorongo inscriptions. As it turned out, RNS corpus also contains quotations of individual text passages featuring subtle variation of parallel passages. Fedorova (1993:233,237-238) illustrated such differences appearing in the songs collected by Geiseler, Barthel and Felbermayer; I expanded her example of the chant Ko Akuru comparing the texts by Geiseler and Blixen, underlining the substitution of individual words and syllables and marking the inserted words with underlined boldface script:

Tuu Apina, tuu Hangaroa  
O Rere Morio tangi karanga mai uta  
O Heke Makau mai hahi  
Tomo Hanga Morio, puti e puta ete

(Fedorova 1993:233 after Geiseler)  
(Blixen 1979:50-51)

Moreover, some songs appear to merge the parts of the different chants, resulting in a “mini-texts” structure reminiscent to that of rongorongo inscriptions:

**Short recitation J**

ka tangi no nga heva rikiriki  
i runga i te opata i tatangi ai  
heha korua e tatangi ena  
mo tomatau haana  
a hau marumaru

**Ko Vie Moko, Ko Vie Kena (akuaku song)**

ka tatangi a roa ngaheva rikiriki  
irunga i te opata e tatangi ena  
kihe korua, e tatangi ena?  
(Tamai (riu song))

**hakaturu hai kupenga mata patapata**  
**ka turu te kupenga mata varavara e**  
**mo rarau mai o te ika timo nei**

(Fedorova 1963:89)  
(Campbell 1971:134)

Therefore, it sounds feasible to suggest that both songs and legends, passed verbally from one generation to another, were affected by the similar text changes including misplacement, omission or insertion of words and passages, merging of several texts together, or borrowing the whole phrases from other texts. The latter mechanism is very probable because the short expressions used as charms or prayers would increase the mana of the resulting song. The same modifications can be also traced in the parallel passages appearing in rongorongo script.

Duplications used for word-forming purposes (Du Feu 1996:191) are important structural characteristics of the text in Polynesian language. The duplications may affect complete words (mea – fish gills, meamea – dark red) or only their first syllable (tea – dawn, tetea – whitish). Moreover, some grammatical constructions may result in duplication of three successive syllables (te raa, te raa – many days (passed), Fedorova 1963:89). The usage frequencies for the duplications following the patterns AAB, ABAB and ABCABC per number of syllables/glyph elements are presented in the Table 1 for rongorongo inscriptions and Rapa Nui lore, assuming the probable syllabic nature of the script (Macri 1996:185, Pozdniakov 1996:297, Horley 2005:112).
As one can see from the table, the probability of monosyllabic duplication in both rongorongo sub-corpora gravitate around 5%, while the respective values for the Rapa Nui lore are between 3 and 4%. The legends feature lower AA duplication quantities than the songs, and the same thing is observed in comparison of the texts B-A-P and I. As it was expected, triple-syllabic duplications have the negligibly small percentage; it is somewhat larger in rongorongo corpus due to its smaller size in comparison with RNL and RNS corpora.

Bi-syllabic duplications show a good correspondence between BAP and RNL texts. It is important to emphasize that the songs corpus RNS feature roughly twice higher number of ABAB patterns. Surprisingly, the Santiago staff inscription has only 0.35% two-element duplications, which is low even in comparison with RNL corpus. One of the possible solutions of this statistical deviation suggests the presence of a certain duplicator sign “×”, which upon being prefixed (or suffixed) to the word will make it duplicated (i.e. ×rongo or rongo× will be read as rongorongo). Hypothetically, the usage of such sign may depend on the personal preference of the carver, so that it could be extensively used on the staff but appear in more modest quantities in the rest of the surviving inscriptions. In any case, the possible existence of a duplicator sign will introduce significant complications.

Therefore, structural analysis of the rongorongo corpus enabled a new improved inscription proximity diagram to be composed accounting for the parallel passages shared between the artifacts, which in turn highlighted two main clusters of the inscriptions: one dominated by the texts B, A, H(P) and the other by the Santiago staff. Applying the recurrence plot analysis to the corpus transcribed regarding glyph elements, several parallel sequences shared between the text I and T were detected. Significant difference in the lexicon/word number ratio for BAP and reduced I corpora suggests that the inscription of the Santiago staff is more unified regarding word usage, potentially being able to represent a collation of songs or chants. Analysis of Rapa Nui songs revealed the increased monosyllabic duplication usage relative to the corpus of legends; the same effect is observed by comparison of the texts B-A-P and I. The number of bi-syllabic duplications in the songs is roughly two times higher than that in the legends, while the number of similar patterns in the reduced text I is incomparably smaller, possibly suggesting the existence of a glyph element denoting the duplications; additional research is required to verify this option.

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References


Campbell, R. 1971. La herencia musical de Rapanui. Santiago: Editorial Andres Bello

Chauvet, S. 1945. La Isla de Pascua y Sus Misterios. Santiago: Zig-zag.


Preliminary Internal Evidence for Series of Procreation Triads in Easter Island’s Rongorongo Corpus

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Abstract - For a decade and a half it has been almost universally accepted that most, but not all, of Easter Island’s rongorongo texts comprise repetitive triads of three main, attached and/or compounded signs conveying X-Y-Z procreations. That is, sign X (often with phallus) copulates with sign Y (no phallus) and the issue is sign Z (no phallus). Evidence for these structural triads being contextual procreations has hitherto been external: the detection of the same X-Y-Z structure in an authentic rongorongo chant recorded in 1886. Now, preliminary internal evidence for procreation series is forthcoming, following rongorongo’s longest and possibly oldest inscription, that incised on the celebrated “Santiago Staff” (RR 10).

In March 1993 a remarkably simple structure of repetitive triads was discovered to underlie the rongorongo inscription on Easter Island’s “Santiago Staff” (RR 10). Incised with around 2,320 glyphs—short for “hieroglyphs”—the former battle-staff displays 103 arbitrarily placed vertical lines which divide the text into segments of varying length (Fischer 1997:451-457).

Each glyph to the right of a vertical line—and rongorongo reads exclusively from left to right—bears, or consists of, a phallus. In most cases, the two glyphs following the phallus-bearing glyph lack a phallus. Ultimate and penultimate glyphs in a division, with very few exceptions, lack a phallus. No division contains fewer than three glyphs, the first with a phallus followed by two without. The entire inscription on the “Santiago Staff” can therefore be epitomized by the formula X1 Y Z, whereby X represents the phallus-bearing glyph, subscript 1 represents the phallic attachment, and Y and Z are the two subsequent glyphs without phallus. This X1 Y Z structure occurs over 700 times on the “Santiago Staff”.

Two further inscriptions, “Honolulu 3629” (RR 11) and much of the “Small Santiago Tablet” (RR 8), revealed an identical structure. It was appreciated that X1 Y Z also epitomized the textual statement of the procreation chant that Easter Islander Daniel Ure Va’e Iko chanted to a photograph of a rongorongo tablet for the Americans in 1886:

“Hēnua ki ‘ai ki roto ki ‘ā Ruhi Hakamāruhi: ka pū te ra’ā”

“Land copulated with the fish Ruhi Paralyser: there issued forth the sun”

X1 Y Z

Figure 1. Half of one line of the inscription on the “Santiago Staff” (RR 10:12).

Figure 2. One of 44 procreation items chanted by Daniel Ure Va’e Iko in 1886.
That is, “X copulates with Y and the issue of the copulation is Z.” In view of identical structure, social context, era, and informant proximity to original rongorongo chants and artefacts, it was manifest that these three inscriptions—the “Santiago Staff”, “Honolulu 3629”, and the “Small Santiago Tablet”—conveyed similar procreation chants: in other words, glyph X, with the phallus, was copulating with glyph Y and the issue of the copulation was glyph Z.

This theory—which constituted the structural and contextual decipherment of Easter Island’s rongorongo script—was presented at a linguistics conference in Leiden, Holland, in 1994 where it met with universal approval among colleagues; it was subsequently published (Fischer 1995a). The ensuing identification of the same triads, some verbatim, on many other rongorongo tablets—which however failed to display the phallus on the X glyph—prompted the realization that nearly all the Easter Island inscriptions, but for some fifteen percent, convey procreations reproducing the formula X Y Z; this discovery was then also published (Fischer 1995b). The world press immediately seized upon this, and special attention was awarded to it in the periodicals Science, Nature, New Scientist, Archaeology, Bild der Wissenschaft, Sciences et Avenir, Science et Vie, Corriere della Sera, The Times in London, and many more; television and radio interviews followed, which continue to this day.

It then became possible, in view of the inscriptions’ identified content, to state that structural X Y Z was in fact, to borrow relevant terminology from linguistics, contextual “Agent plus Patient yields Issue.”

However, up to the present day only external evidence has been forthcoming. That is, only what the Rapanui informant Daniel Ure Va’e Iko chanted for the Americans in 1886 has been the objective correlative, reproducing as it does the same X Y Z structure that is evident in rongorongo’s isolated triads of glyphs.

In this paper, the first preliminary internal evidence is being offered as well, as a measured response to those critics who have alleged that Daniel Ure Va’e Iko’s procreation triads are not analogous. Every theory in science must be falsifiable; it must stand up to—or fall to—rational, logical testing. The decipherment of the internal structure, and much of the content, of around 85% of the rongorongo corpus is presented here with two challenges, two models that make specific, falsifiable predictions. If most of the rongorongo inscriptions are what they appear to be—procreation chants of the type “Agent-Patient-Issue”—then the following two predictions should obtain:

Prediction 1: Rongorongo’s feminizing attachment—three lines on the left (only very rarely right) side of a glyph’s head—will show a statistically higher frequency of appearance in the “Patient slot” and a statistically lower frequency of appearance in the “Agent slot”. In other words, the female glyph will not bear but receive the phallus.
Prediction 2: The only two other clearly identifiable gender distinctions on Easter Island—the moato'a ‘cock’ and ‘uha ‘hen’—in rongorongo inscriptions will, respectively, align contrarily in the “Agent slot” and “Patient and/or Issue slots”. In other words, the ‘cock’ will bear the phallus and the ‘hen’ will receive the phallus.

Figure 5. The moato’a ‘cock’ (left, with phallus) and ‘uha ‘hen’ (right, no phallus).

The present study restricts itself to the “Santiago Staff”, rongorongo’s longest inscription. Prediction 1. It has long been accepted, from information supplied to Tahiti’s Bishop Tepano Jaussen by his Rapanui informant Metoro Tau’a Ure in 1873, that an attachment of three lines to the left of a glyphic head feminized that glyph: the three lines functioned, then, as a feminizing marker (Figure 4). If the “Santiago Staff” contains procreation chants of the type Agent-Patient-Issue, then one should expect that all glyphs bearing this frequent feminizing attachment occur most often in the “Patient slot” of glyphic triads, as recipient of the phallus. And this is precisely what the distribution analysis reveals.

<table>
<thead>
<tr>
<th>Position of feminizing attachment</th>
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<tbody>
<tr>
<td>Agent</td>
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<td>///</td>
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<tr>
<td>/////</td>
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Figure 6. Distribution of the feminizing attachment in specific procreation slots on the “Santiago Staff”.

On the “Santiago Staff”, glyphs with the feminizing attachment appear only once in the “Agent slot”, 62 times in the “Patient slot”, and seven times in the “Issue slot”. The distribution of the feminized glyph does support the theory that structural X1 Y Z here represents contextual Agent-Patient-Issue.

Prediction 2 was that the moato’a ‘cock’ and ‘uha ‘hen’ will statistically show the former to occur predominantly in the “Agent slot” and the latter to occur predominantly in the “Patient and/or Issue slots”.

<table>
<thead>
<tr>
<th>Position of moato’a ‘cock’</th>
</tr>
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<tbody>
<tr>
<td>Agent</td>
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<tr>
<td>/////</td>
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</tbody>
</table>

Figure 7. Distribution of the moato’a ‘cock’ in specific procreation slots on the “Santiago Staff”.

Out of its 36 occurrences on the “Santiago Staff”, the moato’a ‘cock’ appears 30 times in the “Agent slot”, once in the “Patient slot”, and five times in the “Issue slot”.

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Out of its eleven discrete occurrences, the ‘uha ‘hen’ does not appear once in the “Agent slot”, but five times in the “Patient slot” and six times in the “Issue slot”. Prediction 2 is therefore confirmed, once again supporting the theory of procreation triads.

What conclusions might one draw from the foregoing? If rongorongo were alphabetic or syllabic, then one might expect three consecutive glyphs to display a statistical frequency of 30 to 35% in any given position. (In an open syllabic script, vowels would of course claim a higher frequency when first of a triad of glyphs.) If rongorongo, however, comprised logographic procreation chants, then each slot within a series of three consecutive glyphs becomes context-sensitive: that is to say, glyphs would have to apportion themselves according to gender, among other contextual constraints. For example, masculine glyphs would dominate the “Agent slot” and feminized glyphs would most often occur in the “Patient and/or Issue slots” yet would hardly feature in the “Agent slot”, if at all. With the “Santiago Staff” one must acknowledge that the distribution strongly argues for logographic writing, indeed for a logography conveying procreation triads:

1. Feminizing attachment: Agent Patient Issue
   ![Image]
   1.5% 88.5% 10%

2. Moato’a “cock”:
   Agent Patient Issue
   ![Image]
   83.5% 2.5% 14%

3. ‘Uha “hen”:
   Agent Patient Issue
   ![Image]
   0% 45.5% 54.5%

Those glyphs displaying a feminizing attachment occur only 1.5% in the “Agent slot”, 88.5% in the “Patient slot”, and 10% in the “Issue slot”. The moato’a “cock” occurs 83.5% in the “Agent slot”, only 2.5% in the “Patient slot”, and 14% in the “Issue slot”. The ‘uha ‘hen’ occurs not at all in the “Agent slot”, 45.5% in the “Patient slot”, and 54.5% in the “Issue slot”.

Rongorongo cannot be alphabetic or syllabic; it must be logographic. Main signs convey things that are to be named. Rongorongo’s internal gender distinctions display a distribution that transcends statistical coincidence. They also confirm the earlier external evidence for procreation triads: in other words, what Daniel Ure Va’e Iko was chanting for the Americans in 1886 was indeed the same sort of rongorongo text, at least in structure and genre, that has been incised on the “Santiago Staff”. Other rongorongo artefacts display this gender distribution as well, evidencing that they are also procreation chants sharing the same rhetorical statement: Agent copulates...
with Patient, resulting in Issue. For the first time we can read rongorongo with a certain amount of reliability, above all when we draw upon Daniel Ure Va’e Iko’s Old Rapanui formula for such structurally apparent procreations:

\[
\text{Agent} \quad \text{plus} \quad \text{Patient} \quad \text{yields} \quad \text{Issue}
\]

\[
\text{“Te manu mau ki ‘ai ki roto ki te ika: ka pū te ra‘ā”}
\]

\[
\text{“All the birds copulate with the fish: there issues forth the sun”}
\]

**Figure 10.** How one might read a rongorongo inscription in Old Rapanui.

When reading rongorongo, the Old Rapanui expert would supply the complete text of any given chant through unwritten supplementation on the basis of traditional rhetorical formulae: in this case, glyph \( X_1 \) (Agent) copulates with glyph \( Y \) (Patient) and the result of the copulation is glyph \( Z \) (Issue).

This effort is posited only as preliminary internal evidence for procreation texts in the rongorongo corpus. Future work with rongorongo should concentrate on isolating more phonetic values within the individual procreation triads (for both main signs and for dependent attachments and fusions), and on determining what genres occur in those approximately fifteen percent of rongorongo passages which, though they may share the same artefact, do not convey procreations.

**Notes**

1. Metoro identified figures displaying the three cephalic lines as types of “femmes”, as detailed for example in Jaussen 1893:259. See a detailed discussion about this feminizing attachment in Barthel 1958:259-260, which attachment also distinguishes Barthel’s series of glyphs 530. It is further identified as such by Fedorova 1995:113.

2. A small number of glyph variants are not included here, as their exact assignment remains doubtful.

3. That a feminine Agent can occur once with a phallus is perhaps strange, but not entirely unknown: among the 44 copulations in his procreation chant “‘Atua Mata Riri”, Daniel Ure Va’e Iko includes “Lizard Woman copulated with White Woman: there issued forth the white booby (Sula dactylatra)” (Fischer 1997:98).

4. Uniquely among early historical Easter Island’s birds, the chickens’ gender was distinguished not only by name but also by graphic expression: in the rongorongo the moato’a ‘cock’ appears also in “Patient and Issue slots”, retaining its phallus. It is evident that, with this, the rongorongo scribes sought to underscore a distinction between the moato’a ‘cock’ and the ‘uha ‘hen’, which fowl was nearest to and most prevalent among ancient Rapanui. In this distribution analysis are included also fusional variants of the type  and  , which are considered to be a qualified moato’a ‘cock’ and ‘uha ‘hen’, respectively; the compound glyph would read from bottom up, with the altered head and any other appendages comprising the special qualification(s). Note that gender distinction is still maintained despite fusional composition.
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References


Deciphering Old Catalogues: Rediscovery of the Rapa Nui Figures from St.-Petersburg’s Kunstkamera or Leon Waxel’s Gifts in the History of the Peter the Great Museum of Anthropology and Ethnography (Kunstkamera) in St. Petersburg. Preliminary Remarks

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Abstract - The main purpose of the paper is to present some new information on the three earliest Rapa Nui figures held in St. Petersburg’s Kunstkamera (MAE) from the beginning of 19th century. Some previously unknown documents were discovered in Russian archives making it possible to interpret these items as a part of the Cook voyages collections.

Three Easter Island wooden sculptures from the Peter the Great Museum of Anthropology and Ethnography (Kunstkamera) must have received enough attention in literature to be well known artifacts amongst the students of early Pacific culture all over the world.

The above-mentioned group of items became a subject of hot discussions, thanks to David Attenborough who was likely the first person to call them the first figures to be collected from Easter Island. In 1990 he put forward the hypothesis that two figures, namely 736-204 and 736-205, were initially brought from Easter Island to Tahiti by the second James Cook expedition in 1774 (due to their unbelievable similarity to the items in Admiral Isaac Smith’s album) and then, many years later, in 1820 they were purchased by Captain Bellingshausen’s expedition to Tahiti (Attenborough 1990:41-50).

Regardless of whether this theory is true or not, from the point of view of morphological analysis, there seems to be little doubt about the first contact origin of these objects. In Kaeppler’s expert opinion, too, it is likely from their obviously ancient style, and lack of evidence of post-contact techniques, that the three above-mentioned artifacts can be safely thought to be the "earliest-known Rapa Nui figures to reach Europe" (Kaeppler 2001). She also emphasizes these three items would be "the earliest documented human figures from Rapa Nui in any collection" (Kaeppler 2001; emphasis mine). Nevertheless, Kaeppler is in no way satisfied to accept that these items would have any relation to Cook's voyages, and considers these items to have originated from Captain Lisiansky’s visit in 1804. In her papers, the first strategy consists of advocating their coming from the Lisiansky expedition, the second is denying any relationship to the Cook voyage. So, here I will try searching for some evidence to find a solution to the dilemma: Cook or Lisiansky (Attenborough or Kaeppler)?

Let’s take a look at one of her articles where she postulates her ideas in rather an explicit way:

The two most likely [Russian] expeditions are those of Captain Urey Lisiansky in 1804 or Captain Otto von Kotzebue in 1815. Trading relations were not very good during Kotzebue’s stop in Rapa Nui, but items were traded during Lisiansky’s visit. They, too (like Captain Cook), anchored near Hangaroa Bay, land of the high-status descent groups of the Ko Tu’u. There has been speculation that these figures derive from Cook’s voyage, but this is unlikely. Two of the figures appear in a drawing in a volume now in the Mitchell Library, Sydney, which belonged to Isaac Smith (d.1831). Isaac Smith, a cousin of Mrs. Cook, sailed on Cook’s first and second voyages and went on to become a Rear Admiral in the British Navy. The volume of drawings has a handwritten index that lists the thirty-four folios associated with Cook’s voyages. The drawing of Rapa Nui artifacts is on folio 36 [on folio 35] and is not mentioned in the index, suggesting that it was a later addition. Although this drawing was included with the rest of the drawings of this volume in Rudiger
Jopprien and Bernard Smith's book on Cook-voyage drawings, in our earlier correspondence about this drawing, Smith notes that he suspects "that they belong to Isaac Smith's later career in the British Navy" (Smith, personal communication 1983) — with this I agree. (Kaepppler 2003:24)

To begin with, it is absolutely impossible to agree with Kaepppler's words about Rapa Nui figures as having been traded by Russian navigators in 1804. The process of exchanging items was described by Lisiansky in every single detail. Attenborough refers to this place in Captain Lisiansky's diary: "One of his lieutenants eventually managed to get ashore, taking trade goods with him, but no mention is made in the account of the voyage of his acquiring or even seeing any small carvings" (Attenborough 1990:42). On my part, it would be probably useful to add two things more. On the one hand, according to Lisiansky, Lieutenant Povalishin got only two items, a cane raft and a woven bag (nothing else!). On the other hand, in Russian archives the lists of artifacts given by the members of Lisiansky expedition to the Admiralty and the Academy have survived. There is not even a little hint about Easter Island wooden sculptures in here (МАЭ РАН, ф. К-IV, оп. 1, д. 1; pp.104-105; ИФА РАН, ф.1, оп. 2, 1807, § 20, п. 5-7; ПГА ВМФ, 215.1.762; pp. 2,4).

The question about Isaac Smith's album may prove to be more complicated. At the first glance, in discussing the problem Kaepppler seems not to deny an astonishing similarity between two images in Isaac Smith's volume with St. Petersburg figures. As Jopprien and Smith have it, "Dr. Adrienne Kaepppler drew our attention to the similarity between the drawing and the carvings at Leningrad. She is of the opinion that the carvings were collected on the voyages either of Lisjansky (1804) or Kotzebue (1816) (Jopprien & Smith 1985:264). I believe very much the reverse. She did draw our attention away from their similarity because of interpreting this fact in favor of their coming from collections made by the Lisiansky expedition in 1804.

Under current circumstances the only way of her remaining immune to this fact is to ignore that there are any reliable sources to make her main opponent right. It is about the methods of dating the drawing of Rapa Nui objects on folio 35 in the Mitchell Library album. For example, John Elliott, a midshipman of The Resolution wrote in his Memoirs that there was a little school for drawing in Cook's cabin where Elliott himself, Henry Roberts and Isaak Smith had been copying drawings for Cook or for themselves (see Jopprien & Smith 1985, Vol.11:5). This seems to be the best way to explain how the Rapa Nui images happened to get into the Isaac Smith's album at all. The drawing on folio 35 is a work of his own — not of Roberts as commonly thought to be until now. From this point of view, it became very interesting to know that the drawings of several tools and weapons "apparently Melanesian" on folio 36 made in the same manner virtually follows J.R. Forster's sketches of clubs of Tana (ibid:233, 263). Why do we not recognize this argument to justify the decision that both drawings from Isaac Smith's album were made by himself on board of the Resolution?

As a whole, Kaepppler's logic assumes that during Cook's visit in 1774 no wooden carvings were taken from Easter Island, except a club with a human head now in the Exeter Museum, and the wooden hand presented by Johann Forster to the British Museum. Consequently, the importance of records in George Forster's account concerning to the carved human figures "too long to be natural" is not taken into account a priori.

Though, eventually, there may have been other Easter Island sculptures to rival those from MAE in terms of dating their first arrival at Europe. For example, in the Sale Catalogue of the Leverian Museum (1806) one can find an interesting lot No.411 called "Curious idol, formed of a dark, heavy wood from Easter Island" (Leverian Museum 1979:20). Yet this "curious idol" has been lost for two hundreds of years, and, at the moment, no one can say exactly what this sculpture looked like and what region it came from. But the very existence of such a lot is a real fact. And the description itself should indicate that the described object was from Easter Island because of the characteristics of the material out of which it was made, namely, "dark, heavy wood". In the context of the second Cook voyage itinerary, the presence of "dark, heavy wood" rather than light-colour or red wood may be considered an accidental feature particular to Rapa Nui wooden carvings to compare them with carved human figures from George Forster's account who wrote about "dark-brown" wood ("like that of the casuarina").

Certainly, Kaepppler might conceivably be far beyond anyone in morphological analysis of the Polynesian material culture. But she doesn't involve herself to try to interpret old Russian documentation. The first question is to what extent she is correct in making her conclusions? What materials did she really find in Russian archives or other institutions? It makes itself quite clear from the following statement which describes her (or her correspondent’s) acquaintance with the inventory numbered 736: "...the collection in St. Petersburg to which the figures belong is prefixed 736 — which consists of a series of Russian Admiralty collections..." (Kaepppler 2003:25). Therefore, Kaepppler refers to the old museum inventory which is consistent with the collection No. 736 (303 ethnographic pieces) (Figure 1). She argues that objects in the MAE with the prefix 736 must have been from Russian voyages before 1826 and had been given by Admiralty to Kunstkamera in 1830 (Kaepppler
But it would be a serious mistake to consult this index to give the St. Petersburg's Easter Island figures Admiralty Museum provenance.

The main point is, the inventory in question, signed by Junior Ethnographer Eugenia L. Petri, dates only from 1903. It being known that the collection numbered 736 is just a mixture of many various collections or some their parts not only from the Admiralty Museum (to be correct, “the State Admiralty Department Museum”, which existed in St. Petersburg from 1805-1827), but from Kunstkamera's own collections acquired before 1828.

Figure 1. Inventory 736.
This year represents the only correct date of the events related to transmission of the Admiralty Department Museum collections to the Academy of Sciences Museum under the Emperor's decree (ukase) on October 19, 1827 (Belkov 2007:48-2). This fact is crucial to understand the problem we are dealing with.

Indeed, on the first page of this document we can read the following inscription: "from the Admiralty Museum". Inside this inventory one of the entries says: "Three small idols (Easter Island)". Their numbers are: 736-203, 736-204, and 736-205 (Figure 2a,b,c). There are yet other entries with descriptions of anthropomorphic wooden carvings to mention: three items from New Zealand (736-118, 736-119, and 736-120) (Figure 3a,b,c) and one item of the same kind from Tahiti (736-226) (Figure 4). This addition is geared to give the reader a further orientation to the Polynesian sculptures held in the collection numbered 736 as a whole.

What is more interesting in this respect is the title page of this document. At the first place, L.G. Rozina put down the date "1830" taken from the inventory book called « Инвентаръ Коллекціямъ » ("Inventar' Kollektsiyam"). Some time later this date was replaced by "1826" which fits a copy of so called "Checklist for the Curiosities Transferred from the Former Museum of the State Admiralty Department to the Imperial Academy of Sciences" held in MAE (Figure 5). This checklist covers the transfer of the collections from the "Admiralty Museum" to the Academy. Unfortunately, the both dates are incorrect; they are results of mistakes in rewriting some original documents. Kaeppler especially insists that the Rapa Nui figures couldn't reach St. Petersburg via Tahiti and Kamchatka in 1779 as a part of the gift of English sailors to Catherine the Great or via Tahiti in 1820 as a part of products traded to Captain Bellingshausen (Kaeppler 2003:25). First, there is a quite accurate list of the objects from the 3rd Cook voyage given to the Governor of Kamchatka, Major Magnus Behm (so called "Behm's list"), where "there is no entry to which they can be related". Second, the collection in MAE consisting of Russian Admiralty field collections is prefixed 736, while the collection corresponding to Cook voyage is prefixed 505. Third, the Rapa Nui figures in St. Petersburg cannot be documented before 1826 (Kaeppler 2003:25).
In this connection, it should be particularly noticed that in reading Kaeppler's papers on St. Petersburg collections, the main difficulty is to tell the real facts from interpretations made on incomplete data. She is absolutely right in referring to "Behm's list" to exclude Rapa Nui artifacts from the collection given by English sailors in 1779 (these items arrived in St. Petersburg in 1780). As for prefixes 736 and 505, they cannot be in any way used as a hard line to separate the Cook voyages from Russian circumnavigator's collections in MAE just because of their late appearance in the history of the museum. The collection No. 736 was filed by Petri in 1903 (see above) and the collection No. 505, also was filed by her several years earlier, in 1899 (here I ought to apologize to colleagues for a misprint in one of my previous papers which has "1889"; see Belkov 2006:8). Recently, two Tongan clubs from the list of Major Behm were rediscovered among the items from the collection No.736 (Ivanova 2005:225-234). These objects, namely 736-253 and 736-256 correspond to "Wooden mace with carving" (15) and "Black wooden spade" (36) (Svet & Fedorova 1978:17-18). Ironically, during her last visit to MAE in 1997 Kaeppler herself did manage to elicit and practically determine that two Cook items from 1780 in the collections numbered 2328 (Tongan belt, 2328-268) and 765 (Tongan flute, 765-51) see Belkov (2006:8). It should be particularly stressed here that the two above-mentioned Tongan clubs were identified in a written way for the first time as very ancient Tongan artifacts in the same 1997 visit by Kaeppler, too. As it was just stated, knowing the history of MAE collections, such a geographical identification is a certain indication that they originated from Cook voyages. Russian seafarers never visited Tonga during the period of history we discuss here. To put it another way, if we find Tongan artifacts in the old Kunstkamera collections it would be associated with Cook legendry in general.
This indicates the legends (mythography) and inscriptions in the inventory No.736 should be reconsidered. In any case, this inventory cannot be treated literally as ahistorical evidence on the provenance and date of acquisition of the ethnographic specimens this document lists.
Kaeppler's catalogue edited as an appendix to her paper "Sculptures of Barkcloth and Wood from Rapa Nui. Symbolic Continuities and Polynesian Affinities" (Kaeppler 2003: 1 1-69) is titled "Inventory of Rapa Nui Sculptures Made of Barkcloth or Wood and their Documentation". I am just trying to say that Petri’s inventory is not the documentation in respect to three Rapa Nui pieces which it lists.

In searching for any available sources to impart information relating to the history of Rapa Nui wooden figures now housed in Kunstkamera, I came across the reference in Friedrich Russow’s historical review of the Museum of Anthropology and Ethnography collections: "1809 von Herrn Waxel drei Götzen (sic!), eine Waffe und Rindenzeugproben von verschiedenen Südsee-Inseln" (Russow 1900: 20-21).

This remark is nothing but a copy of the note in the 19th century museum book labeled Journal des Ethnographischen Museum Anno 1837 bis 1877” (the Ethnographical Museum was named in 1836 and integrated into the Museum of Anthropology and Ethnography on its foundation in 1878): « M de Waxell envoyé pour le Musée... 9) 3 Idoles des lies de Falkland, tahai et Sandwich, 10) un Patou.Patou des memes lies, 11) quelques échantillons d'étoffe du iaruspapyrifera des memes lies » (МАЭ РАН, ф. К-IV, л.1, л.45).

The above-mentioned inscription dates back to the records of proceedings of the Imperial Academy of Sciences related to 11 October 1809: « ...M de Waxell envoypour le Musee académique le objets suivans qu’il a apportes avec lui de Londres: ... 9°)Trois idoles des lies de Falkland, Tahiti & Sandwich, 10°) Un Patoupatou des memes lies; 11°) quelques echantil- ns d'étoffe du Murus papyrifera des memes lies. Tons ces objets seront envoye a Musée » (ПФ А РАН, ф.1, оп. la, No. 20, л.99).

Subsequent research in this field confirmed that "three small idols (Easter Island)" from the inventory of 1903 do indeed comprise “trois idoles des lies de Falkland, Tahiti & Sandwich” received from "M de Waxell de Lenders’” in 1809. To begin with, there is an original document which is especially valuable for us in the respect under consideration, because it represents a direct evidence of the transfer the items from the “Admiralty Museum” to the Academy in 1828. This document is named "Checklist for the Curiosities Transferred from the Former Museum of the State Admiralty Department” (see above). Strange as it seems, the very existence of this catalogue had never been a secret in Kunstkamera.

Figure 6. Leon S. Waxel (17767-1816).
The essence of this list is that it features no items suspected to be three Rapa Nui figures. The geographical identifications need not concern us here, because such inaccuracies are somewhat common place in old museum catalogues. For our purposes, what is most important is that only four sculptures are present in "Checklist for the Curiosities", i.e., three idols are missing in comparison with seven in Petri's inventory of 1903. Four sculptures from the Museum of Admiralty Department correspond to three now well-identified items: 736-226 ("Idol from Morai of Otahaiti"); and 736-1 18 and 736-1 19 ("Idols of Various Forms" from New Zealand). Unfortunately, the current whereabouts of the third New Zealand figure (if it really was from New Zealand) are unknown.

The absence itself of three idols now known as the St. Petersburg's Rapa Nui figures in the body of "Checklist for Curiosities" is undisputable evidence of their non-Admiralty Museum origin. In its turn, this fact means that Attenborough's surmise that two Rapa Nui figures in the MAE are related to Cook's voyages at once proves true.

Now, the following question, probably, arises: who was "Mr. Waxel from London"? Leon Waxel (1776-1816) (Figure 6) was the grandchild of Swen Waxel, the famous Russian navigator of Swedish nationality who entered the Russian Navy in 1726 and was one of the Vitus Bering officers during his voyages. From 1802 up to 1809 (with only a short return to Russia at the end of 1805 and early 1806) Leon Waxel lived in London. Trained as a war engineer, he was sent by the Russian Emperor to England with a special mission to study paving methods in constructing docks and went on to become a Colonel of the Corps of Railway Engineers. Being an illustrious collector during the period of 1805-1806, he gave to the Museum of the Admiralty department about three thousand items: geological, botanical, zoological and other objects, historical manuscripts, as well as, a whole library on antiquity. As a Member the Correspondent of Academy of Sciences he sent hundreds of very, valuable items to the Academic Museum. Zoology and antiquity were his favourite subjects. In 1806 he was going to be present for the sale of the Levering Museum. But on the voyage from St. Petersburg to England Waxen fell ill in Denmark. For this reason, he didn't get to London in time. Nevertheless, afterwards he continued his hunting for "curiosities", making acquaintances of buyers who took part in the auction.

Thus, all information of this kind associated with the name of Leon Waxel provides enough evidence to suggest a new theory as to the history of the three Rapa Nui figures in MAE. In the case that this theory is correct the next task would be to discover the circumstances of the journey of these objects to London and/or the Leverian (or Parkinson) collection.

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References


МАЭ РАН, ф. К-IV, оп. 1, №. 16 / 1,2,3. Museum of Anthropology and Ethnography of the Russian Academy of Sciences.

ПФА РАН, ф. 1, оп. 1а, д. 20. Протоколы. 1809. Peterburg's Outfit (Filial) of the Archive of the Russian Academy of Sciences.

ПФА РАН, ф. 1, оп. 2, 1807, 4. 2, § 20. Peterburg's Outfit (Filial) of the Archive of the Russian Academy of Sciences.

Virgin’s Birth on Easter Island: Revisiting Maria, Madre de Rapa Nui...Again!

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Abstract - Material for this paper was gathered on Rapa Nui fifteen years after the island's master carvers had produced "Maria, Madre de Rapa Nui" from the Trunk of a Miro Tahiti tree (Melia azederach). Her birth occurred during the Fall of 1970, the turbulent election year of Salvador Allende to the presidency of Chile. At that time rumors of divisive activities among the islanders had upset a nervous mainland, and the Catholic Church was asked to help. Archival reports about the week's evangelical event in Chile's Templo de Maipú varied considerably from those supplied by several of the participating artisans with whom I spoke. This episode illustrates once again how difficult it is for citizens of the West to communicate with people from pre-industrialized societies. Most of the old master carvers no longer are with us. The new generation of Rapa Nui carvers has been exposed to modern tools, and, by 2002, the painted eyes of "St. Michael" and "St. Francis" had been newly varnished along with the rest of their bodies. Nevertheless, as long as the islanders recall the birth of their Rapa Nui "Virgin", she will continue to spread her mana.

Prologue

Research for this paper was done on Rapa Nui over twenty ago about an event that occurred a decade earlier than that. Much of this material first Appeared as "Contemporary Public Religious Art on Rapa Nui" at the I Congreso Internacional Isla de Pascua y Polinesia Oriental held in Hanga Roa in September of 1984, and has since been published repeatedly in the Rapa Nui Journal (Seaver Kurze 1987/88, 1988).

So why revisit it again now? The simplest answer is that there are some new pieces in the church. In my opinion, however, the master carvings on Rapa Nui of the Catholic saints of Chile presents a current example of how swiftly pre-industrial people can adapt to foreign concepts presented to them by the western world. In other words, acculturation. But at the same time, they can maintain important elements of their own culture's belief system; and as in this case, continue to display them. It also clearly demonstrates how different the Western view of an event can be from that of the indigenous population involved.

The election of Salvador Allende to the presidency of Chile in 1970 electrified the country. It was not, however, the only stunning event that year in the austral country. Two thousand miles away on the island of Rapa Nui, carvers were working communally for the first time in many centuries to produce ceremonial "art" — and after 100 years of Christian missionization.

In prehistoric times, around AD 1500, ancient priests had demanded images called moai (Figure 1), such as these, for their stone altars (ahu). In 1970 however, the petition for a new deity did not come from Rapa Nui priests but from Chile’s Catholic clergy. A trio of priests flew across the sea from Santiago with a disappointing message for the Rapa Nui who were waiting on the tarmac at Mataveri Airport to greet the statue of Chile’s patron saint, the Virgen del Carmen. Although on a religious progression throughout Chile, the Virgen del Carmen would not be visiting the Rapa Nui after all. Instead, the priests said, the islanders were to carve their own saint.

Fortunately the delegation’s leader, Padre Raul Hasbun, was an articulate man, certainly a good thing since his work was cut out for him on that Wednesday, May 16, 1970. First he must calm the disappointed Rapa Nui; then he must persuade them to accept the new project suggested by Santiago. This project was to so engage and unify the islanders that their focusing on it would leave no time for them to augment rumors of divisive activities on Rapa Nui that now were rampant on a mainland, already nervous in this election year. People in Santiago evidently were quite unaware of the often argumentative style of Polynesian politics.

Note that all images marked with 1970 are from the archives of the Templo de Motive de Maipú on the mainland of Chile. Padre Raul, stepping forward at Mataveri with new carving tools,” persuaded the islanders” (Figure 2)
to find and fell an appropriate log for the Virgin's statue taken to the caleta (fishing Harbor), the log would be carved (Figure 3) into a statue of the Virgin Mary and Her Son within six days. Finally, following Biblical time, the Virgin would be escorted up the road to the Church of the Holy Spirit on the seventh (Figure 4a,b) and installed to the right of the altar (Figure 5). Once there she has always been accessible to the islanders (Figure 6).

During the carving week the island's spiritual leader (Figure 7), Father David Reddy, blessed the artisans' hands and their tools in order to ward off any possibility of satanic influences. Not only did the carvers pray daily, but evening services held in the church placed whatever feature of the Virgin had been carved that day into a theological context. For example, on the day that Maria's eyes (Figure 8) were inlaid, they were declared sacred at the evening Mass since they represented the eyes of God. Inlaid eyes on Rapa Nui figures usually were made of a small obsidian pupil surrounded by a circle of fish vertebrae, and they signified a sacred individual. Maria's inlaid eyes actually duplicate those on small wooden figures (Figure 9a,b) made for tourists today.

Originally some of these figures represented Rapa Nui ancestor spirits whose unpredictable behavior often caused the islanders to fear them. Eyes of coral with obsidian or red scoria pupils probably were inserted into the sockets of *ahu moai* during the prehistoric ceremonial events that took place before European contact (Figure 10). They may indeed have activated the individual statue's chiefly or even divine power. It's unclear how much original inserts actually resembled these modern, some say cartoonish, eyes.

"Art on Easter Island embodied and signified *mana*, the supernatural power of the gods (atud) and of the chiefs (ariki) considered to be their descendants on earth" (Kjellgren 2001). The same inlaid eyes appear on male ancestor spirits depicted in the male skeletal, wooden *kavakava* (Figure 11). These figures greatly intrigued the early explorers and thus have ended up in the museums of Europe and New England.

Another prominent feature of prehistoric Rapa Nui design were long, slender- fingered hands, the sign of an aristocrat or ariki who does not work in the fields. Appearing both in petroglyphs (Figure 12a,b) and three dimensional pieces, the hands of the *ahu moai* also are slim. Note that the hands of the traditional, wooden female figure called pā ‘a pā ‘a (Figure 13) are held in a position similar to those of the Virgin Mary. The Virgin's hands are reversed, of course, to accommodate the Christ Child carved from a limb on her left side.

Leftover chips of the *Miro* Tahiti used to carve the Virgin were burned on the last day of carving (Figure 14); the traditional way in Polynesia to de-sanctify objects that were *tapu* (or powerfully dangerous) was by fire. When asked in 1984 about the reason for burning the excess wood in 1970, one of the carvers simply replied, "It just had to be done".

During the work-week a young Rapa Nui strolled down to the caleta strumming his guitar and singing his new composition. That song, Maria de Rapa Nui, became a hymn that accompanied the saint as she journeyed up the road to the church, and is often sung at Sunday Mass today.

No one remembered rain, a common occurrence on Rapa Nui, during that week in May 1970. However both carvers interviewed in 1984 and church documents recalled something else significant about the caleta event. Very little communication seemed necessary among the carvers during the work days; carving simply continued without benefit of plans, blueprints, or even prolonged conversations. Men came and went in shifts, picked up their tools, and quietly carved where their predecessors had stopped. Such insignificant details as the Virgin's foot protruding beyond the hem of her gown, often were assigned to novice carvers. This, of course, was how techniques of carving were taught to the next generation.

Those artisans interviewed in 1984 said they had lacked time in 1970 to formulate a new design for the Virgin's statue (Figure 15). So, they simply modeled her on what they saw around them, the *ahu moai*. In traditional Polynesian fashion the rest of the community was charged with feeding the workers and their families during that week. Fourteen years later people still remembered children carrying meals cooked by their mothers and aunts to the men working at the caleta.

The birth of Maria, Madre de Rapa Nui (Figure 16) is still celebrated annually on a certain Sunday after Easter. Decorated by the islanders, she is returned in procession to her birthplace at the caleta (Figure 17a,b) where the exact spot is marked by a stone engraved with the petroglyph of a sooty tern. Sooty terns replaced frigate birds as the main species of birds whose eggs were gathered at the sacred site of 'Orongo during the ancient Birdman ceremony. Eventually, frigate birds stopped visiting the island due to over-hunting of their eggs, of which only one is laid every two years.

According to documents in Chile, Padre Raul Hasbun's plan in 1970 (Figure 18) was a great evangelical success.
Indeed the church's plan was well conceived in its respect for certain aspects of Rapa Nui traditions - communal
carving, for example, as well as the food preparation for the workers.

Juan Haoa Hereveri, a strongly religious man and one of Rapa Nui's master carvers, agreed with that view.
Choosing the right tree trunk, to him, was the result of a divine revelation and the act of carving the Virgin and
Child a deeply spiritual event. In fact, Haoa told me that his own vision was to fill the church with his carvings
of Catholic saints. However, some of the other carvers interviewed held different views.

One artisan with some artistic training on the Continent was bothered by the project's haste. He predicted that the
still green trunk of the chosen Miro Tahiti would crack (something almost expected in contemporary Rapa Nui
wood carvings) and thus would show disrespect for the Virgin. He also thought the log's ungracious shape with its
laterally protruding limb; although out of that piece of wood came the Christ Child (Figure 19). He didn't like
having to camouflage what he considered to be the "awkward" proportions of Maria's head and neck and the
necessity of placing thirteen pure vaka (cowrie shells) above the Virgin's forehead. The chosen shells had been
bleached to imitate the blonder, more highly regarded, but unavailable Cypraea engleri.

Another master workman, Benedicto Tuki Tepano, hoped the saint's statue would advertise his own skills as a
carver - especially to tourists when they visited the church; perhaps even leading to future commissions (Figure
20). Indeed Tuki Tepano later produced small replicas of the Virgin and Child, which islanders placed in
individual shrines around the island. Eventually tourists did commission some of these carvings.

Other carved statues of saints soon followed the Virgin and Child. Father David, recognizing Tuki Tepano's
talent, commissioned him in 1978 to create a statue (Figure 21) of the Sagrado Corazon. Tuki Tepano called it a
personal obligation to the Catholic Church and, as the solo artisan, even autographed the piece – as far as I know,
the first time a Rapa Nui artist had signed his work.

Even more recently, one of Juan Haoa's sons carved a similar Sacred Heart which stood for quite a while in his
sister-in-law's living room in Hanga Roa.

In 1980 Juan Haoa revolutionized traditional Rapa Nui carving. Instead of creating an entire figure from only
one log like the Virgin and the Sagrado Corazon, possibly following the technique for carving stone statues from
volcanic tuff he began adding extra pieces to the figure's main trunk. For example, arms, wings and, originally, a
sword all were added to the main figure of St. Michael and the Dragon (Figure 22). Although St. Michael was
carved in honor of the wedding of one of Haoa's sons, his inspiration for this new form may have come from the
church's former traditional statue given to him by Father David (Figure 23). Note the eyes on Haoa's St. Michael
(Figure 26). No longer the sacred, inlaid ones of a Rapa Nui deity, they have, instead, become the new, painted
eyes of Christianity.

Soon several other statues appeared that followed Haoa's carving style (Figure 24). St. Francis holding a seabird
in his outstretched left hand was carved by a neighbor of Haoa's. Haoa, pursuing his vision of filling the church
with his statues of saints, soon carved another statue (Figure 25); this time a frigate bird with a four-foot
wingspan to represent the Espiritu Sanctu (Holy Spirit). Unfortunately the seven dowels representing the "earthly
gifts" of the Holy Spirit that had been placed around the statue's groin are missing today. Father David's
concern about the reaction of the Bishop of Santiago about the figure's unorthodox form seems to have been
unnecessary. The visiting prelate evidently approved, since he neither raised an eyebrow nor said a word.

These statues were meant for a Catholic congregation, but the designs carved on them often have the shape of
prehistoric Rapa Nui petroglyphs (Figure 27). The design of a Birdman, and the eyes of Make make the island's
main god in late prehistoric times, decorate the robe of the Sagrado Corazon (Figure 28a,b,c). These statues also
display the prehistoric significance of birds to islanders. Sooty terns from the crowns of Maria, Her Son and the
Sacred Heart while the Holy Spirit as a seabird flies onto the head of the crucified Christ. In ancient times
Polynesians thought birds brought messages from the gods as they flew to and from their islands.

Then, in the late 1980s some of the old Rapa Nui carving traditions reappeared (Figure 29). The Holy Family,
carved from just one log, displays three pairs of inlaid human eyes and the bird (Figure 30a,b). Inlaid eyes
appeared again on the church's four-foot candlestick placed to the left of the altar and carved by Marcus Rapu.
The eye masks are those of Make make, and recall many of the island's petroglyphs, found particularly at
Orongo, site of the Birdman ceremonies.

Since the 1970s a tidal wave of Western traditions has flooded Rapa Nui. Now, once dusty roads are paved;
several modern hotels have been built by mainland companies; thousands of tourists pour off of cruise ships to spend a few hours on the island; the large number of cars, including radio taxis, comes close to producing traffic jams; affluent Rapa Nui seek higher education for their children on the Continent, in the United States, or in Europe; the influence of Hollywood after the 1993 filming of Kevin Costner's movie, Rapa-Nui, is especially visible in the costumes and staging of the island's annual folk festival or Tapati Rapa Nui; and though live chickens, once important items of wealth and status, still wander the island, only frozen ones flown from the Continent are served for dinner today.

Perhaps some of the more recent pieces appearing in the church would cause Father David to turn over in his grave since they do not necessarily represent Rapa Nui culture (Figure 31a,b). In fact, one such piece with a rather vague provenance, arrived by plane from Tahiti, unclaimed and unannounced. It holds the host in the Hanga Roa church and probably was carved by a Marquesan from Tahitian wood. However we do know that the breadfruit, featured here, never took hold on Rapa Nui! But this piece does symbolize, in a way, the prehistoric cultural connection that unites South Pacific islanders.

Epilogue

Some of the master carvers interviewed in 1984 no longer are with us. The new generation of Rapa Nui carvers has been exposed to modern tools, so the once sacred significance of an adze may have been diminished. Now women carve the delicate Rongorongo boards for tourists ... and, of course, market their men's wares.

By 2002 the wooden bodies of St. Michael and St. Francis had been newly varnished ... along with the whites of their eyes. Nevertheless, teaching the Rapanui language in the island school has encouraged its resurgence, and aspects of Rapa Nui culture continue especially through carving and dance groups ... if mainly for tourists. As long as the Rapa Nui recall the birth of their Maria, Madre de Rapa Nui, however, the Virgin will surely continue to bestow her mana on the islanders.

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Notes


2 Records at Maipu state that new carving tools were given to the Rapa Nui, but artisans interviewed in 1984 did not remember receiving them. Also, the adze of a Rapa Nui master carver often is revered for its mana which may stem from its former owner; something Hasbun may not have known.

3 “Approximately twenty” artisans volunteered to work according to the Maipu records, but in 1984 Rapa Nui carvers remembered it was only four to six primary artisans. Both figures are probably correct since older artisans often consulted without actually carving. Indeed one master carver remembered a sleepless night of discussion among the artisans as to whether they should take on this new project.

4 These gifts were fortitude, wisdom, learning, council, intelligence, piety, and fear of God.

References


Figure 1-5

Figure 1. Seven moai at Ahu Akivi.

Figure 2. Carvers hunt for the proper tree.

Figure 3. Artisans work at the *caleta*; in May, 1970.

Figure 4a. Hanga Roa’s Church of the Holy Spirit, 1984.

Figure 4b. Hanga Roa’s Church of the Holy Spirit, 1994.

Figure 5. Hanga Roa’s Church of the Holy Spirit, 2006.
Figure 6-11

Figure 6. An islander venerates the Virgin.

Figure 7. Father David Reddy was the Priest on Rapa Nui c. 1965-1985.

Figure 8. Maria's inlaid eyes, 1970.

Figure 9a. Moai moko or Lizardman carved for tourists in 1985.

Figure 9b. A tangata manu or Birdman carved the same year.

Figure 10. The moai with eyes at Ahu Ko Te Riku, Tahai Complex.

“Art on Easter Island embodied and signified mana, the supernatural power of the gods (atua) and of the chiefs (ariki) considered to be their descendants on earth”.

— Eric Kjellgren

Figure 11. A kavakava ancestral spirit carved for a tourist c. 1981.
Figure 12a-15

Figure 12a. Hands on a prehistoric petroglyph at 'Orongo.

Figure 12b. Hands of a wooden moai moko carved in 1985.

Figure 13. Long-fingered hands on a moai pa'a pa'a carved for a tourist in 1993.

Figure 14. "It just had to be done". Removing tapu in 1970.

Figure 15. Maria faces her model in 1970.
Figure 16-21

Figure 16. Maria, Madre de Rapa Nui returns to the caleta in 1984.

Figure 17a. Maria’s “birthstone” at the caleta.

Figure 17b. Maria’s “birthstone” at the caleta.

“...if my mother has a dark complexion and others see that as ugly, I will see her as beautiful, and it’s the same with the Holy Mother”.

— Alberto Hotus

Figure 18 & 19. Virgin & Child. Shells (pure vaka) adorn Maria’s crown.

Figure 20. A small replica of Maria and Her Son stands in an islander’s shrine, 1984.

Figure 21. Sagrado Corazon, carved life-size, was commissioned by Father David in 1978.
Figure 22-26

Figure 22. The arms and wings were added to this life-sized figure of St. Michael, carved in 1980.

Figure 23. Haoa’s daughter and the model of St. Michael her father used.

Figure 24. A seabird perches on the left hand of St. Francis’ appended arm.

Figure 25. Wings, crown, and seven dowels were added to the Espiritu Sanctu symbolized by a Frigate bird.

Figure 26. Haoa’s St. Michael now has painted “Christian” eyes.
Figure 27. Petroglyph designs decorate the Santo's robe.

Figure 28a,b,c. Sooty Terns appear atop the crowns of Maria, Her Son, and the Sacred Heart. The Holy Spirit flies onto the head of the crucified Christ.

Figure 29. Inlaid eyes re-appear on Pakarati's Holy Family carved traditionally from one log.
Figure 30a-31b

Figure 30a. The sacred eyes of Makemake.

Figure 30b. The sacred eyes of Makemake.

Figure 31a. A Tahitian piece carved by a Marquesan; note non-indigenous breadfruit.

Figure 31b. A Tahitian piece carved by a Marquesan; note non-indigenous breadfruit.
All Abord the “Scholar-Ship”

Marla Wold
Easter Island Foundation, USA

The Easter Island Foundation (EIF) began awarding scholarships to deserving Rapanui students in 2002. Our scholarship program endeavors to assist students of Rapanui heritage to further their studies and ultimately promote the conservation and preservation of the Rapanui culture. About 2007, the EIF has awarded eleven scholarships and it is the hope of the Foundation to provide funds for scholarships for many years to come. Our only requirements are that the student be of Rapanui heritage, under 30 years of age, and enrolled in an institution of higher learning.

The scholarship program has been administered through the Provincial Governor's Office on Easter Island; the original scholarship committee consisted of Governor Enrique Pakarati Ika, Viki Haoa Cardinali, and Ricardo Tuki Hereveri.

The first student to win a $2000 (in US dollars) scholarship was Alfonso Rapu Cardinali in 2002. Alfonso studied architecture at the University of Development in Santiago and received his Title of Architect in 2003. He has participated in a proposal for the airport terminal on Rapa Nui and worked with UNESCO-Japan from 2003-2004. In 2004, Alfonso opened the first architect's office on the island and has been involved with the analysis of the Regulatory Plan for Easter Island. In 2005-2006 he specialized in urban development.

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The year 2003 was a big one for the EIF scholarship program. Alberto Patricio Genskowsky Pinochet (who is known by the nickname "Terongo") was awarded $2,000 during his 4th year of engineering study at the Departamento Universitario Obrero Campesino (DUOC — the University Department for the Working Farmer) in Vina del Mar, Chile. Alberto studied implementation of tourism for the island.

This same year the Wiegand Family Foundation of Burlington, Ontario, Canada, generously agreed to fund a scholarship award to a deserving Rapa Nui student $2,000 for four years. The first Wiegand scholarship went to Ioan Haumoana Soler Hotu. Ioan began studying computer information systems at El Camino College in Torrance, California, and received his Associate Degree in Business there. He was on a team that developed the first Web page for Rapa Nui and he is now continuing his studies at Brigham Young University of Hawai'i. He works part-time for the Polynesian Cultural Center on O'ahu. He participated in a summer internship on Rapa Nui in 2007 and will graduate from Brigham Young University, Hawai'i, in December 2008. Noelani Rapahango Lagos received the Easter Island scholarship in 2004.
Noelani studied foreign commerce in Vina del Mar. Her studies dealt with globalization, economy, business, banking, customs, airports, shipping, and importation and exportation. She is now back on the island and hopes that, as tourism increases, the island will not become another Tahiti or Hawai‘i. Also in 2004 the Wiegand Family again offered to fund another $2,000; or four years on behalf of a female Rapa Nui student. Juana Luna Atamu, a medical student at the University of Aconcagua in Mendoza, Argentina, was the recipient. She is in her fifth year of study and has one more year as an intern and then plans to specialize in clinical medicine. She hopes to return to Rapa Nui to help to improve the health system there.

In 2005, the EIF began naming its various scholarships: The "Easter Island Foundation Scholarship", the "Directors Scholarship", and the "Nicolas Haoa Sr. Memorial Scholarship" (partly funded by Sonia Haoa Cardinali in loving memory of her father). The Nicolas Haoa Sr. Memorial Scholarship was presented to Tahira Edmunds, who studied chemical environmental engineering at the University of Chile in Santiago. She has written a paper entitled "Estimating Environmental Contamination" and has worked with the Corporation Nacional de Desarrollo Indigena (National Corporation of Indigenous Development or "CONADI") and the municipality with regard to the island's waste management problems. Currently she is working with Sonia Haoa Cardinali on an important archaeological survey.
Juana Luna Atamu in 2004.


The EIF scholarship program underwent many changes in 2006 beginning with the appointment of a new Easter Island governor, Carolina Hotus Hey, who now serves on the committee along with Sofia Faundez Hey, who works in the Governor’s office in the capacity of Social Assistant, and Viki Haoa Cardinali, who continues on the committee as its Coordinator. The EIF is very grateful for their hard work in helping to select deserving Rapa Nui youth to receive these scholarships. In 2006, the Nicolas Haoa Sr. award went to Daniela Araki Gonzales. At this time she was in her 2nd semester of a 3-year program studying early childhood education, pre-school, and kindergarten. She expressed much appreciation for the scholarship as she believes strongly in the importance of early education. Also in 2006, a scholarship was granted to Antonio Munoz Tuki, who was in his 3rd year of studying law at the University Pedro Valdivia in Santiago. He recognized the responsibility that comes with a scholarship and thanks the EIF for its support. Antonio re-applied for a scholarship in 2007 and was received the Directors’ Award to continue his 4th year studying law. The Directors’ Award in 2006 went to Tiare Aguilera Hey who also is studying law in Santiago. She was an exchange student in Spain at the European University of Madrid from February 2007 until July 2007. Her thesis will be on Rapa Nui property rights and she hopes to practice in the Corporacion Judicial de Isla de Pascua, which helps provide free legal services for islanders. She is encouraged by the island’s youth and sees much work to be done on Rapa Nui. She believes that education is the key ingredient in respecting, conserving, and defending the Rapa Nui culture: “We haven’t inherited the land from our ancestors”, she has said, “but have loaned it to our children. They are our future and reflection of ourselves, and the most important thing, when a people is united, no one can destroy it”. She would like to see the scholarships program better publicized.

In 2007 the EIF increased the dollar value of each of its scholarship awards to $3000 with the first recipient of the year being Viviana Hereveri Figueroa. Viviana is in her 2nd year of hotel and restaurant administration at the Professional Institute INACAP in Valparaiso. She graduates at the end of 2008 and would like to go to Europe or the United States to further study hotel administration and acquire some other languages. Ultimately, she wants to return to Rapa Nui and use her knowledge and skills there. Also in 2007, Akivi Atan Soto received the Easter Island Foundation Scholarship. He is in his 3rd year of study in Physical Education at the Pontifica Catholic University of Valparaiso. Akivi would like to become a physical education teacher on Rapa Nui. He recognizes the abilities of the Rapanui youth and believes he can help them to become world-class athletes. He would also like to work with people of all ages, from children to adults.

As one can see, the Easter Island Foundation’s scholarship programs are making a difference not only in the lives of the individual recipients but for Easter Island itself. As is also evident, scholarship recipients are varied and are committed to the preservation of the Rapa Nui culture. The EIF actively seeks donations for its very worthwhile program.

**Correspondence:**

Anyone that would like to join in this effort is encouraged to contact the Easter Island Foundation’s scholarship program by e-mail (scholarships@islandheritage.org) or by visiting www.islandheritage.org.
Chapter 4

East Polynesian Archaeology and Polynesia / New World Contacts
Archaeological Art at Nu’u, Maui, Hawaiian Islands: Rock Images within a Polynesian Settlement Landscapes

Sidsel Millerstrom
University of California at Berkeley, USA

Abstract – This paper discusses and analyzes the frequency, distribution and site context of petroglyphs that have been recorded, in 2005 and 2006, at Nu’u Mauka Ranch, southeastern Maui, the Hawaiian Island Group. This work was carried out as part of a settlement pattern survey. Four rock art sites were recorded within the survey area and some sampling was carried out at one site situated in the vicinity. More than 693 individual images were documented. While 19.3 percent of these images represent anthropomorphs, the majority, or 74.2 percent, depict geometrics: mostly parallel and randomly placed lines, many of which cover anthropomorphs. Do these overlapped figures suggest a change within the local Hawaiian social structure or are they just vandalism done in recent times?

Introduction

In November 2005 and May 2006, professor P. Kirch, University of California, Berkeley, sponsored a small archaeological team to survey and excavate at Nu’u Mauka Ranch, a traditional land-division (ahu’pu’a) located on southeast Maui Island. During these two short field projects we recorded, in the context of a Polynesian settlement landscape, four rock art sites within the ranch proper and part of a site in the vicinity, all situated along a mountain range running north-south from the beach and several miles inland. The sites are found in three clusters: 1) near the coast; 2) inland approximately 50 meters and; 3) the center of the valley approximately 320 meters above sea level (masl).

In this article I will discuss the five sites and examine if the cultural and environmental context are reflected in the rock art repertoire, or if other forces are at play. I am especially interested in the superimposed, and what appears to be randomly placed, incised lines, found in great numbers at Nu’u Mauka Ranch.

Nu’u Rock Images

Site Nu’u 94

Nu’u 94 is by far the most impressive site within the survey area. More than 507 individual petroglyphs are placed along the eastern cliff faces of the mountain range. There are 94 anthropomorphs, seven dogs, one turtle, six historic letters, and more than 371 parallel and randomly placed lines. Twenty-six figures are unidentifiable. A third or 35.1 percent of the anthropomorphs lack limbs and heads. It is unlikely that this is due to deterioration over time (Figure 1).

The petroglyphs are arranged on 28 panels, which are ordered in four distinct clusters (Figure 2). The cliff wall is circa 35 meters meter long and about 3 to 5 meters (10-16 feet) high. On the south and middle portion of the cliff face the panels are located some 2 meters above the ground. Towards the northern end they are placed just above an approximately 13-meter long shallow rock shelter, and the images are placed some 1-meter above the surface. A large rock fall is situated to the north. It is unknown if more petroglyphs were at one time located in this area. A bulldozer has leveled the area to the east of Nu’u 94 but remains of old agricultural field systems are visible along some of the edges.
Figure 1. Site Nu’u 94C. Incised headless triangular image.

Figure 2. Site Nu’u 94. Profile of cliff face with the location of panels marked (scale drawing by P. V. Kirch).
Sites Nu’u 173, 174, and 248

The other three sites (sites Nu’u 173, 174, and 248) are located further inland on the same mountain range as Nu’u 94. Site Nu’u 173 and 174 face east and overlook a swale. Cliffs on two sites hem in the swale. These panels contain 24 anthropomorphs and one turtle. On Nu’u 173 randomly placed lines overlap the figures in some places and criss-cross each other in other areas (Figure 3). It is as if an enthusiastic individual went wild with a metal tool but were unable or unwilling to make circular shapes.

Site Nu’u 248 is located on the opposite side of the swale, some 30 meters across from sites 173 and 174. Site Nu’u 248 is located on a cliff wall and depicts an anthropomorph approximately 1 meter above the ground (Figure 4). The eastern edge of the petroglyph panel shows flake scars. A small rock shelter (Nu’u 246) with some midden is located some 10 meters to the northwest. Agricultural terraces are visible within the swale.

![Figure 3. Site Nu’u 173A. Various image types with incised lines.](image-url)
Site Nu’u 130

We spent half a day examining archaeological sites some 50 meters inland from Nu’u Beach. The main reason for including this site is because the petrolyphs are located on the same mountain range as the other sites within the Nu’u Mauka Ranch. Highway 31 divides sites Nu’u 130 and 94. We recorded 12 anthropomorphs (including four reddish painted pictographs), one turtle, and a few associated geometric figures were recorded on four panels on a range of cliff walls. One anthropomorph is situated immediately above a fishermen’s shrine (koa). Both petroglyphs and pictographs are located on the same range of cliff faces. This is probably one of the sites visited by Emory in the early 1920s as discussed in “Sites of Maui” (Sterling 1998:184). Although Emory and his team “did not examined the cliff closely” they estimated that approximately hundred pictures were placed on some 45–46 meters (150 feet) of cliff walls (Sterling, 1998:184). They also concluded that the pictures were very old as they dug into the base of the cliff and found several uncovered images.

While the coastal petroglyph site was examined, only a fraction of the many figures were documented (of different reasons). Compared to the petroglyph sites within the Nu’u Mauka Ranch the figures at site Nu’u 130 are different in several ways:

- Nu’u 130 contains both petroglyphs and pictographs.
- Some of the figures are large and prominently placed on the cliff face (Figure 5). Two of the largest figures measured 60 and 64 cm (23.6 and 25.2 inches) in height.
- All the figures examined appeared to be finished.
- No incised parallel and randomly placed lines occur

Because of the size and the placement on the cliff face, the anthropomorphs are clearly visible, probably from some distance. It appears as if the figures at Nu’u 130 have been done by a different group of Native Hawaiians and for different reasons than those at the Nu’u Mauka Ranch.
Discussion

Nu’u Mauka Ranch is a relatively small traditional *ahupua’a* of approximately 5,000 acre. As of 2006 we had located and recorded some 250 sites (house foundations, ritual and agricultural sites) including a large number of images. Relatively little is known about the environment at Nu’u Mauka Ranch lying in the leeward side of Haleakala Mountain. The survey area ranges from the coastal terrace to ca 762 masl. Although the amount of rainfall is unknown at this time we know the area receives more rainfall than, for example, Kahikinui, a traditional district (*moku*) located to the west (Millerstrom and Kirch 2002, 2004). The landforms are old volcanic flow, thus the soil development is relatively rich. None of the rock art sites have yet been excavated.

In total 693 individual images were documented (Table 1). All of the images are located on cliff faces and the majority of the panels face south and southeast. Some are associated with rock shelters. While 19.3 percent of these images represent anthropomorphs, the majority, or 74.2 percent, are geometric shapes such as parallel and randomly placed lines many of which are superimposed over anthropomorphs. Dogs and turtles, the only zoomorphs presented at Nu’u, make up 1.4 percent (Table 2).
What took place in the past at Nu’u? The archaeological images occur near the coast and in the prehistoric-historic settlement region about 150-323 masl. Both prehistoric and historic images are found at site Nu’u 94. Flaking scars are associated with two sites (Nu’u 130 and 248). The rock art are incised, pecked and/or bruised, and painted with red pigment. Pecking was done in three different ways: 1) short slashed lines; 2) pecking with a sharp pointed tool leaving small 1 mm round marks; and 3) pecking with a blunt tool leaving 3-4 mm size dots (Figure 6). A few figures were repeatedly abraded with a tool leaving a whitish area.

The Nu’u sites are directly linked to agricultural field systems. This in part may reflect the relatively fertile land. The anthropomorphic images at Nu’u probably served as the link between the ancestral spirits in the otherworld and the people living on the land. Ultimately the ancestor’s spirits are present in both places to ensure a good crop and healthy people. But how can we understand the numerous overlapped incised lines?

It appears that the images at Nu’u served different function in different places in time. Thus several forces were at work at Nu’u. Both the prehistoric and the early historic periods are distinctly reflected at two Nu’u sites. Do the great number of overlapped incised figures suggest a change within the local Hawaiian social structure or are they just vandalism done in the recent past?

Superimposition illustrates that the older petroglyphs at Nu’u are the pecked traditional Hawaiian motifs such as anthropomorphic stick figures, naturalistic figures, figures with a triangular torso with or without muscles, dogs and turtles (Figure 7). Stick figures, considered to be the oldest type of Hawaiian petroglyphs are few in number (Cox and Stasack 1970; Lee and Stasack 1999).
Table 2. Distribution, frequency, and percentage of image types at Nu’u Mauka Ranch as of 2006.

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<th>Image Types</th>
<th>Number of Image Types</th>
<th>Percentage of Image Types</th>
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<td>7121 curved lines(s)</td>
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</table>

Native Hawaiians in the Post European Period used the same cliff faces, perhaps because of the mana they contained, to incise triangular and stick figures on top of the pecked figures. However, they did not stop with superimposing their drawings on pecked figures but with a great display of enthusiasm they criss-crossed the panels with parallel and randomly placed lines. Sites Nu’u 94 and 174 display an unusual amount of such randomly placed incised lines (Figure 8).

The early Post-European contact period is characterized by Roman lettering that reflects early missionary efforts at literacy (Figure 9). Documented sources speak of a “frenzy” of interest on the part of Native Hawaiian to learn to read during the 1820s and 30s (Sahlins 1992; Schütz 1994). Writing took a little longer to master (Sahlins, 1992:93 Table 4.2). This burst of energetic activity to practice their writing skills and to gain skills in the use of metal tools, I believe, took place at sites Nu’u 94 and 174. Furthermore, it was, perhaps, a way for some to apply influence and authority over old practices by introducing old figures in a new way.

I argue that these superimposed incised lines and figures can be thought of as the earliest form of Hawaiian graffiti. By doing so I draw inspiration from a provocative published article by B. David and M. Wilson named *Spaces of Resistance: Graffiti and Indigenous Place Markings in the Early European Contact Period of Northern Australia* (2002:42-60). According to the same source “The words graffito and graffiti originate from the Italian “graffiare” (to scribble), “graffito” and “graffito” (a scratch), and ultimately from the Greek “graphein” (to mark, draw, or
Figure 7. Site Nu’u 94Q. Dogs petroglyphs.

Figure 8. Site Nu’u 94J. Pecked and incised triangular figures.

Figure 9. Site Nu’u 94Z. Roman letters.
write). As David and Wilson (2002:43) points out: “Today “graffiti is imbued with a polluting and vandalistic quality because it is usually placed in public spaces and regardless of its potential decorative value.” I do not wish to diminish the importance of the historic petroglyphs found at sites Nu’u 94 and 174 by referring to them as graffiti or vandalism, but in marking a place whether it is with petroglyphs, pictographs, or contemporary graffiti, ownership is claimed over a particular space and the right to use this place. As discussed by David and Wilson (2002:43) “graffiti in its final form offers insight into the relationships between inscriber, inscription, and social power relations.”

Some claim that all markings are indicators of social values and major changes taking place within the society (Stocker et al 1972, cited in David and Wilson 2002:44). Assuming the incised petroglyphs are post-European contact, I believe, that the sites Nu’u 94 and 174 especially reflect the tremendous turmoil and cultural changes that took place in the islands in the early historic period as the indigenous Hawaiians had to adjust to a different way of life and a new belief system.

Acknowledgment

I wish to thank Parick V. Kirch for inviting me to be part of two of the Nu’u projects, for his inspiration and unwavering enthusiasm. It is always a pleasure to work with John Holsen a teammate on both projects. We are all grateful to Andy and Bernie Graham, the owners of Nu’u Mouka Ranch, for inviting us to work on their land and to provide housing.

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References


Time and Temples: Chronology of Marae Structures in the Society Islands

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The Kon-Tiki Museum, Norway

Paul Wallin
Gotland University, Sweden

Abstract - In this paper we give an overview of the chronological evidence from four field seasons of excavating marae sites on Huahine, in the Leeward group of the Society Islands. We also briefly discuss our findings in light of earlier work, mainly done on the islands of the Windward group. Since the beginning of scientific research in Polynesia it has been assumed that the Society Islands marae complex developed early. This may not be the case, and it is possible that these temple sites did not play an important part in Society Islands religious practices or socio-political structure until after AD 1500.

Introduction

This paper is based on the results of a recent series of fieldwork sessions on Huahine in the Leeward group of the Society Islands, French Polynesia. The purpose of the fieldwork was to date the emergence and development of marae structures on the island of Huahine, and to establish a larger chronological database on marae complexes in the Leeward group as a whole. In addition to presenting our data and discussing their significance for the development of the temple sites in the Leeward Islands, we will compare these results to earlier work done on Windward Islands ritual structures. A picture now begins to emerge concerning the origin and development of the Society Islands marae complex.


The primary publication on Society Islands temple sites is Kenneth P. Emory’s Stone Remains in the Society Islands (1933) which was a result of extensive fieldwork and survey in the mid-1920s. A new classic typology was developed by Emory where he divided the Windward Islands marae into three types: coastal, inland, and intermediate. All the Leeward sites were a variation of the coastal type. Emory did not perform any excavation and only to some degree did he detail the internal stratigraphy or reconstruction at individual sites. He therefore had no direct means for chronological control over his typology. After Emory, empiric research on ritual sites in the Society group did not continue until a new generation of archaeologists began to work these islands in the late 1950s and early 1960s. From the B.P. Bishop Museum Yoshihiko H. Sinoto began survey and restoration of marae sites, first on Huahine and then on Raiatea and on Mo’orea (Sinoto 1969). On the latter island he excavated two marae structures in 1961-62 (Emory and Sinoto 1965). At the same time Roger C. Green was active surveying and excavating in the ‘Opunohu Valley on Mo’orea, where he conducted the first settlement pattern investigation in Polynesia (Green et.al. 1967). However, it was José Garanger who did the most extensive and detailed examination of marae structures in the Society Islands when he investigated the Tautira Valley on the north side of Tahiti Iti in 1963-64 and excavated the marae Marae Ta’aata complex on the borders between
<table>
<thead>
<tr>
<th>Island</th>
<th>Marae</th>
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<th>Year</th>
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<td>1963-64</td>
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**Total:** 36
the districts of Paea and Punaauia, Tahiti, a decade later (Granger 1964, 1975, 1980). In the early 1970s, Sinoto and Patrick McCoy investigated the small atoll of Teti’aroa (Sinoto and McCoy 1974), then owned by the American actor Marlon Brando. All these investigations produced only 16 radiocarbon dates and, with the exceptions of a date on marine shell from Taputapuatea, Raiatea, and one date from the VAI-1 site in the Papeno’o Valley, Tahiti, constituted the entire chronological framework for Society Islands marae structures prior to our project (see Table 1) (Wallin 1993; Wallin and Solsvik 2005b, 2006a). Several of these $^{14}$C dates from the 1960s and 1970s indicate activities at these sites in the 15th century, but all of them date activity prior to marae construction (Solsvik n.d.:205-210; Wallin 1993). Interestingly enough, very few radiocarbon dates associated with ceremonial architecture in the Society Islands stem from reconstruction work, in contrast to the situation on Easter Island (Table 1). The structural simplicity of the Society Islands marae as compared to the Rapa Nui ahu complexes is quite pronounced. This allowed for a simpler approach to restorations, where the extent of structural interference was much less, suggesting to the authorities and researchers that the archaeological integrity of the structures could be preserved. Consequently, most reconstruction work in the Society Islands has been undertaken without previous archaeological excavation of the marae itself.

**Background to the Project**

The rationale for this project begun back on Easter Island in 1986-88 when The Kon-Tiki Museum excavated at ahu Naunau, Anakena. An early ahu structure with a design of a classic Society Islands marae was located and dated, at the time, to around AD 1100 (Skjolsvold 1994). Reviews of both the excavation, the record of radiocarbon dates from Easter Island, and new dates (Wallin, Martinsson-Wallin & Possnert 2010 this publication) have since pushed the date for the construction of this early ahu to between AD 1200 and AD 1400. Paul Wallin and Helene Martinsson-Wallin returned to Easter Island in 1996, 1997 and 2002 for a series of targeted excavation of various ahu structures, turning up dates for initial construction in the 14th century (Martinsson-Wallin and Crockford 2001; Martinsson-Wallin and Wallin 2000; Martinsson-Wallin et al. 1998, Martinsson-Wallin 2003). During this time Kolb had finished his study on Maui heiau structures (1991) and Yamaguchi undertook an investigation of Cook Island ritual structures (2000). These works indicated that early dates for monumental ritual architecture were to be found at the far north-eastern or eastern edges of the Polynesian triangle and not in the centre, as assumed by most researchers.

Reviewing radiocarbon dates from Society Island marae complexes, mostly collected and analysed in the 1960s, also revealed unexpectedly recent dates for monumental architecture (Wallin 1993). How could we account for these data? Were they representative or were they simply a result of sample strategy? The problem with sample size was certainly real. Many more ritual complexes and platforms had been excavated both on the Hawai’ian islands and on Easter Island than either the Cook Islands or in the Society group. In the Society Islands not one single reliable date existed from the many structures in the Leeward group, at one point in time thought to be the centre for marae architecture of that island group. The next logical step was to begin excavating ritual architecture from an island in central East Polynesia to collect more data. The project Local Developments – Regional Interactions were set up with funds from the Norwegian Research Council, through the Oceania Project lead by Ingjerd Hoëm, from the University in Oslo, Culture Historic Museums, and the Kon-Tiki Museum. The project collaborated with Dr. Yoshihiko H. Sinoto of the B.P. Bishop Museum and his associates Eric Komori and Elaine Rogers-Jourdane (Solsvik 2002, 2003, n.d.; Wallin et al. 2003, 2004; Wallin and Solsvik 2003, 2004, 2005a, 2005b, 2006a, 2006b).

**Settlement Chronology of Huahine Island**

Huahine Island provides a unique opportunity for investigating the question of architectural chronology (Figure 1). During the last five decades Dr. Sinoto, and, later, his associates Eric Komori and Elaine Rogers-Jourdane, worked on the islands excavating early settlement sites, testing other sites, as well as surveying a large portion of the ancient settlement at Mata’ire’a Hill, in the Maeva region of the island (Sinoto 1969, 1977, 1988, 1996, 2002; Sinoto and Han 1981; Sinoto and Komori 1988; Sinoto et al. 1981, 1983). This means that a chronology for colonisation and settlement of the island exists which supplements the data from excavations of marae structures.

The Vaito’otia / Fa’ahia site located close to the port town of Fare on the northwest coast is the earliest settlement on the island. Investigations on the site initially begun as salvage excavation when the Bali Hai Hotel was built in 1972 (Sinoto and McCoy 1975), but both Sinoto and a French team continued excavations, totalling eleven field seasons and excavating more than 800 m$^2$ (Pigeot 1987; Sinoto 1977, 1979, 1988; Sinoto and Han
During many fieldwork seasons extensive areas were excavated and two main settlement phases were identified. From radiocarbon dates the two settlement phases were determined by Sinoto to begin AD 850 and AD 1000 respectively (Sinoto and McCoy 1975). More recent radiocarbon determinations, by Anderson and Sinoto (2002) place the beginning of these two settlement phases at AD 1200 and AD 1350 respectively (Cf. Solsvik n.d.:115-120, Fig. 4.5).

From 1979 to 1983 Sinoto initiated an intensive survey of a hill settlement on the northeast part of the island on the Mata’ire’a Hill behind the Maeva Village (Sinoto 1996; Sinoto et al. 1981, 1983). Here, more than 44 marae structures where found together with a number of house terraces/platforms, garden features, and burial structures. In 1986 Eric Komori undertook test excavation in a small area of this settlement, called Te Ana (Sinoto and Komori 1988). Testing documented settlement from the 14th century, although the surface structures dated to the 16th and 17th centuries (Cf. Solsvik n.d.:120-122).

In 2001 and 2002 Mark Eddowes surveyed the island outside the Maeva district (Eddowes 2003). One of the most interesting finds from this additional survey was that very few marae structures, except for the larger coastal sites already surveyed by K.P. Emory (1933) were located. In the valleys even fewer marae structures were located, except for some very small, almost miniature marae. This means that a decent sampling of the sites on Mata’ire’a Hill would give a rather accurate indication for initial marae construction for the whole island.

**Sampling and Dating Strategies**

Having had field work experience excavating monumental architecture on Easter Island we initially thought that a similar behavioural practice of deposition and firing had taken place on Huahine marae, so that it should be easy to date at least initial construction or early use-phase of these structures. We also assumed that we would find evidence for re-building at these sites, given that researchers estimated that Society Islands marae had been built and used for 700-900 years. To deal with this a strategy for sampling and dating were devised (Solsvik n.d.:124-125, 163-170 and 175-181; Wallin and Solsvik 2006a).

The main objective for this project was to date the initial construction at these sites, and by implication gather data to discuss the temporal framework for the island group as a whole. It was decided to test for cultural activity underlying the structures to complement any remains deposited as sacrifices. As a consequence we also choose to date a variety of materials, not only charcoal, resulting in sampling and dating of four different material groups from different contexts:
1. Charcoal from well-defined features, as umu underlying the structure, fire-pits, or general burn-off layers. All dating pre-construction contexts.

2. Human bone from sacrificial contexts, dating a use-phase.

3. Pig bone from both domestic and sacrificial context, dating pre-construction and use-phase respectively.

4. Coral from the rubble fill of large coastal marae, assumed to have been taken directly from the sea when building the ahu. If the assumption is correct this would date the actual construction of the marae.

In most cases we retrieved samples from both a pre-construction context and from the use of the marae, and consequently we were able to roughly frame the period of construction. Charcoal samples from the last two field seasons were sourced by Dr. James Coil (2005), then at the Archaeological Research Facility at Berkeley, and short-lived species were selected for dating when they constituted part of the sample.

**Dates from Excavated Marae Complexes**

During four field seasons ten marae structures were excavated, out of which the construction phase of nine could be dated (Solsvik n.d.:126-152; Wallin and Solsvik 2005b, 2006a). Six of these are located on the Mata’ire’a Hill; one, marae Manunu, across the lagoon from Maeva Village; one a few kilometres south of Maeva Village on the northeast coast; and two in the district of Fare (Figure 2). In addition coral from the rubble fill of three other structures, two from Huahine Iti and one from the Mata’ire’a Hill, was analysed in order to see if this could date their construction (Solsvik n.d.:153-155). In total, this study has produced 23 new radiocarbon dates (Table 2).

![Figure 2: Map of Huahine with the location of investigated sites.](image)
Huahine had three *marae* of the highest order, two of them located in the Maeva district on Huahine Nui: *marae* Mata’ire’a Rahi on the summit of the small hill with the same name, and *marae* Manunu on the coral islet across the lagoon from the village of Maeva (Wallin and Solsvik 2005a). We were able to excavate and date both these latter structures. In addition three medium sized, probably lineage *marae* and two smaller, specialised structures were investigated, all of them in the Te Ana land division (Figure 3).

Table 2. New $^{14}$C dates from excavated *marae* structures in the Society Islands.

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<th>Lab. No.</th>
<th>Marae</th>
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<th>Age A.D. (2 sigma)</th>
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<td>Wk-14604</td>
<td>Sch-2-19</td>
<td>Pre-construction</td>
<td>387±38</td>
<td>AD 1459-1629</td>
<td>Un-sourced charcoal</td>
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<td>Wk-14605</td>
<td>Sch-2-19</td>
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<td>225±38</td>
<td>AD 1641-1882, 1923-1951</td>
<td>Pig tooth/bone</td>
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<td>Wk-14606</td>
<td>Sch-2-19</td>
<td>Use (re-dedication)</td>
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<td>AD 1669-1894, 1918-1951</td>
<td>Human bone</td>
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<td>Wk-16789</td>
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<td>Pre-construction</td>
<td>190±39</td>
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<td>AD 1649-1891, 1923-1951</td>
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<td>Sch-2-18</td>
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<td>AD 1672-1894, 1919-1951</td>
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<td>Sch-2-62-1</td>
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<td>Use</td>
<td>116.7±0.5% MT</td>
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<td>Beta-177606</td>
<td>Sch-2-65-2</td>
<td>After abandonment</td>
<td>170±40</td>
<td>AD 1674-1740, 1798-1953</td>
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<td>Pre-construction</td>
<td>387±34</td>
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<td>AD 1589-1842</td>
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<td>AD 1436-1510, 1554-1621</td>
<td>Sourced charcoal</td>
</tr>
<tr>
<td>Wk-17063</td>
<td>Tuituirorohiti</td>
<td>Pre-construction</td>
<td>438±32</td>
<td>AD 1437-1511, 1549-1622</td>
<td>Sourced charcoal</td>
</tr>
<tr>
<td>Wk-16470</td>
<td>Tuituirorohiti</td>
<td>Use (from fill of ahu)</td>
<td>2429±36</td>
<td>192 BC – AD 42</td>
<td>Coral</td>
</tr>
<tr>
<td>Beta-177605</td>
<td>Sch-2-62-3</td>
<td>Pre-construction</td>
<td>500±60</td>
<td>AD 1398-1517, 1538-1625</td>
<td>Un-sourced charcoal</td>
</tr>
<tr>
<td>Wk-13176</td>
<td>Sch-2-62-3</td>
<td>Pre-construction</td>
<td>244±38</td>
<td>AD 1628-1837-1879, 1924-1951</td>
<td>Un-sourced charcoal</td>
</tr>
<tr>
<td>Wk-16786</td>
<td>Anini</td>
<td>Use (from fill of ahu)</td>
<td>639±35</td>
<td>AD 1591-1830</td>
<td>Coral</td>
</tr>
<tr>
<td>Wk-16787</td>
<td>Ohiti Mataroa</td>
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<td>637±34</td>
<td>AD 1596-1833</td>
<td>Coral</td>
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<tr>
<td>Wk-16788</td>
<td>Water Tanks</td>
<td>Use (from fill of ahu)</td>
<td>536±35</td>
<td>AD 1711-1951</td>
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<td>Wk-17522</td>
<td>Marae Ta’ata</td>
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<td>194±41</td>
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<td>Un-sourced charcoal</td>
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<tr>
<td>Wk-17523</td>
<td>TT-03-A</td>
<td>Pre-construction</td>
<td>347±35</td>
<td>AD 1485-1646</td>
<td>Un-sourced charcoal</td>
</tr>
<tr>
<td>Wk-18805</td>
<td>Marae 206</td>
<td>Use</td>
<td>260±52</td>
<td>AD 1504-1883, 1923-1951</td>
<td>Un-sourced charcoal</td>
</tr>
<tr>
<td>Wk-18807</td>
<td>Marae 206</td>
<td>Use</td>
<td>177±76</td>
<td>AD 1648-1953</td>
<td>Un-sourced charcoal</td>
</tr>
<tr>
<td>Wk-18806</td>
<td>Marae 208</td>
<td>Use</td>
<td>115±37</td>
<td>AD 1689-1728, 8105-1953</td>
<td>Un-sourced charcoal</td>
</tr>
</tbody>
</table>
Initially, we had expected a rather long age range for some of the marae structures in this area, based upon both typological argument and oral history connected to marae Mata’ire’a Rahi as the founding marae on the island. When all these structures produced later dates than expected, we were forced to rethink our strategy. Could it be that the Maeva area was established as a chiefly and ritual area at a later date? Therefore, the last field season was spent excavating three marae structures outside the main Maeva area, two of them medium-sized lineage marae (Wallin and Solsvik 2006b).

![Map of Maeva Village and the Mata’ire’a Hill locating investigated sites.](image)

In total ten marae structures were excavated and radiocarbon samples were retrieved from nine of these. In the case of a very small shrine-like marae on land called Tiamaue just southeast of Fare no charcoal or bone material was recovered (Wallin and Solsvik 2006b). From the remaining nine temples twenty radiocarbon dates were analysed spanning the time period from late 13th to the mid-19th century (Wallin and Solsvik 2005b, 2006a). None of these sites showed definite evidence of use for religious or ceremonial purposes prior to the construction of a rectangular stone/coral structure on the site (Solsvik 2002, 2003; Wallin et al. 2004; Wallin and Solsvik 2003, 2004, 2006b). Earth-ovens or burn-off layers were encountered under several of the marae structures, but it is not possible to state with confidence that this is evidence for ritual practices. On several sites, midden-like deposits were found but they may be domestic in origin. A human skull was found crushed under one of the corner slabs at ScH-2-19, marae Mata’ire’a Rahi (Wallin and Solsvik 2005a). We interpreted this as a ritual sacrifice, but it was connected to a late reconstruction at the site and the practice is also mentioned in oral histories.

In interpreting the radiocarbon record from these excavations (see Table 2) two things become obvious. First, all samples indicate construction activity after AD 1400 to AD 1450. Consequently – at the present – AD 1450 seems to be the earliest occurrence of marae construction on Huahine, although it could be later. Secondly, both the small auxiliary marae, ScH-2-62-3 and marae Manunu, one of the two national temples, was constructed around or after AD 1650. At about the same time, or somewhat later, the other national temple, marae Mata’ire’a Rahi was rebuilt into an “intermediate” type marae.
Dating of Coral from Un-excavated Marae Structures

Large marae structures with ahu built of huge limestone or coral slabs can be found along the coast of all of the Leeward Islands. These structures are frequently associated with the spread of the ‘Oro cult from the island of Raiatea, where marae Taputapuatea was the cult centre. The ahu enclosures of these temples are filled with massive amounts of pieces of coral. In most cases these coral lumps seem to be taken fresh from the sea, which means that the time of the construction of the marae can be dated by dating these pieces of coral. During fieldwork it was decided to collect samples from a few structures in order to test this theory (Solsvik n.d.:153-155). Of the four samples analysed, three (Wk-16786, Wk-16787, and Wk-16788) returned age assays within the expected range. Both marae Anini and marae O’hiiti Mataroa were constructed between AD 1600 and AD 1800, based on these dates (Table 2). These two marae are large coastal structures associated with the ‘Oro cult and should be built around the same time as marae Manunu (ScH-2-18).

Emergence of Marae Structures in the Leeward Islands

During restoration work on marae Taputapuatea, Opoa, on the island of Raiatea in the early 1960s, Yoshihiko H. Sinoto and Kenneth P. Emory dated some marine shells found embedded on one of the coral slabs making up the ahu face (Emory and Sinoto 1965). The sample, GaK-299, returned a date of 700±100, which calibrated with a marine calibration curve and the Southern Pacific regional average marine reservoir correction value of δ33.0±21.0 (Reimer and Reimer 2001) at 2 sigma, and produced an age span of AD 1503-1722 and AD 1793-1799. About eighty meters west of the ahu an archery platform is located, with its front pointing towards the famous marae. Here, Sinoto excavated a test trench between the archery platform and the house foundation next to it. A sample, GaK-403, pre-dating the archery platform produced a date of 360±90, or calibrated at 2 sigma to AD 1417-1697 (Emory and Sinoto 1965-65-66, Fig. 67, p. 71; Wallin 1997; Wallin and Solsvik 2006a:27). It is possible, then, to suggest that marae Taputapuatea and the other marae at the area called te po were constructed after AD 1600. Giving that te po is the centre for ‘Oro worship in the Society Islands, it fits the data from similar structures on Huahine.

What do the above data tell us about the origin and development of marae as ritual space in the Leeward Islands? In the case of Huahine, the data is comprehensive enough to suggest that on this island, marae structures were not built until between AD 1450 and AD 1500. Whether this translates to the other islands in the Leeward group cannot be ascertained at the present since comparable data does not exist from the other islands. Huahine is one of the few islands in French Polynesia that established an independent chiefly and ritual centre in Maeva on the northeast coast of the main island, and this could have contributed to a late introduction of the marae concept on this island. However, as radiocarbon dates clearly show that marae structures were built as early outside as inside the chiefly centre of Maeva, we argue that our Huahine data is not a reflection of the establishment of Maeva as a specialised political and ritual centre. In conclusion, marae construction probably did not take place in the district of Maeva, Huahine, until after AD 1500. All the medium-sized marae on the Mata’ire’a Hill were built between AD 1500 and AD 1650. Some of the marae in the area, like marae Mata’ire’a Rahi and marae Tefano clearly show evidence of being rebuilt during pre-historic or proto-historic times. In other cases the evidence for reconstruction is more subtle, only consisting of an enlargement of the courtyard. In most cases no radiocarbon data exists to accurately date such scenarios, but if these structures were in use during a time-span of up to 250 years, reconstruction should be expected. Close examination of the architecture together with targeted test-trenching should be the standard procedure for documenting these structures. A second trend in the data is that the large coastal marae associated with the ‘Oro cult, like marae Taputapuatea on Raiatea and marae Manunu on Huahine, seem to have been constructed fairly late in Society Islands history. We now have five radiocarbon dates from four such marae in the Leeward group: marae Taputapuatea on Raiatea; marae Anini and marae O’hiiti Mataroa on Huahine-iti; and marae Manunu on Huahine-nui. All these five radiocarbon dates support the theory that ‘Oro type marae structures were being built between AD 1650 and AD 1750, or even later.

New Radiocarbon Dates from Windward Islands Marae

While investigating early settlement sites, Polynesian archaeologists have become aware of problems tied to radiocarbon dates from the 1960s and 1970s (Anderson 1991, 1995; Dye 2000; Higham and Hogg 1997). Two factors in particular might be mentioned. First, there might be a high inbuilt-age in old charcoal samples, due to the fact that sourcing of wood species was, and still is, not routinely applied. Second, early dates up to the 4000-series from the Gakushuin Laboratory in Tokyo have been considered as suspect by some writers (i.e. Spriggs
1989). Since most of the radiocarbon dates from temple complexes in the Windward Islands are from the sixties it would be valuable if samples from previous investigations were re-dated (Cf. Table 2) (Solsvik n.d.:157-160).

One of the most well-known excavations of Windward Islands temple complexes is the investigation of marae Marae Ta’ata by José Garanger, where a series of three superimposed ahu were exposed (Garanger 1975). Three charcoal samples in a stratigraphic series were sent for radiocarbon analysis to the Laboratoire de radiocarbone du Commissariat à l’Energie Atomique et du Centre National de la Rescherches Scientifique, Centre de Faibles Radioactivités de Gif-sur-Yvette, in France. All these dates came out as ‘modern’ and have never been reported in detail (Garanger 1975; Garanger 2005:53-54, footnote 24). What exactly is meant by ‘modern’ in this context is not entirely clear. Logically, the samples must either have to be truly modern as in containing more than 100.0% 14C in relation to the international standard used, or the ages of the samples were less than the error of the sample (Cf. Green, et al. 1967:139). Unfortunately, no excess charcoal exists from the original samples sent to Sacley Laboratory\(^1\), so there is no way to check the previous radiocarbon dates. However, one excavation unit outside the marae produced a thick charcoal layer and this sample was sent by us to University of Waikato, Radiocarbon Dating Laboratory, New Zealand, for age assay. The calibrated date for this sample is AD 1653-1951 at 2 sigma (Table 2). The date only proves that cultural activity took place there in the 17\(^{th}\) or 18\(^{th}\) century, but could also indicate an early use period at marae Ta’ata in light of other dates from Tahitian temple sites.

During his investigations of the district of Tautira, Tahiti, Garanger (1964, 1980) excavated a number of structures and the oldest date was from B-747 of 410±100 BP from marae TT14, with a calibrated age range at 2 sigma of AD 1392-1682 and 1730-1802. This sample dated activity prior to marae construction at the site and it indicates that people began constructing marae in valleys of Tahiti between AD 1450 and 1680. However, other radiocarbon age assays produced dates such as 0±200 BP (Gx-1296) and 0±240 BP (GaK-449), indicating problematic aspects of either sample selection or laboratory procedures. A number of samples from excavations in the valley of Aiurua, Tautira district, on the island of Tahiti, were received from José Garanger and one of these samples (from marae TTA-03-1) was sent for age assaying at the Waikato Laboratory. The sample came from an earth-oven located beneath the enclosing stone wall of the marae and, therefore, must have been fired not too long before this stone wall was built (Garanger 1980:88, fig. 9). Wk-17523, the charcoal sample from this earth-oven, produced a calibrated age range at 2 sigma of AD 1485-1646, indicating that this marae was built in the beginning or middle of the 16\(^{th}\) century, some time earlier than the 17\(^{th}\) or 18\(^{th}\) century date Garanger assumed (Garanger 1980:84).

In the 1980s and 1990s several major archaeological projects took place in the Papeno’o Valley on the island of Tahiti and a number of sites were surveyed and excavated. Most of these investigations have not been published and data on possible analysed radiocarbon dates are not existent\(^2\). Marae sites 206, 207, and 208 is part of a complex in the Tahinu section of the Papeno’o Valley excavated by Marimari Kellum in the fall of 1990\(^3\). Three samples, two from marae 206 and one from marae 208 were submitted to the Waikato Laboratory, for analysis. The two samples from structure 206, Wk-18805 and Wk-18807 returned dates of 260±52 BP and 177±76 BP respectively. The sample from marae 208, Wk-18806, returned a date of 115±37 BP. All these samples probably originate from use-phase context and only indicate that these marae were constructed sometime around AD 1600 or later.

**Marae in the Society Islands**

At present we have forty-two 14C dates (Table 2) from marae structures in the islands of Tahiti, Mo’orea, Tetiaroa, Huahine, and one date from marae Taputapuatea on Raiatea\(^4\). Having data from only four of the twelve main islands in the Society group make this discussion somewhat preliminary. On the positive side, we do have data from the two largest islands in the Windward group. From Huahine, the only island in the Leeward group where many of the major ritual structures were located in one symbolic significant area in which all the chiefs of the island had an vested interest (Wallin 2000), twenty-three radiocarbon dates have now been age assayed. From these data, then, a general trend emerges. The same trend observed locally on Huahine is also found on the big island of Tahiti and the small low island of Tetiaroa (Sinoto and McCoy 1974; Solsvik n.d. 2005:210). No radiocarbon date indicates any marae construction before AD 1400-1450 and probably not before c. AD 1500 (Figures 4 and 5).
Figure 4: Box-plot of $^{14}$C dates on charcoal from Society Islands marae sites dating a pre-construction context.

Figure 5: Box-plot of $^{14}$C dates on charcoal from Society Islands marae sites dating a use phase context.
The current temporal data on *marae* structures from the island of Tahiti is not a representative selection of Tahitian ritual structures, however, the data from this island corresponds to the data from both Huahine and Tetiaroa. On the other hand, it could be argued that Huahine was a special case. The village of Maeva constituted a kind of political and ritual centre (Wallin 2000), where all chiefly families on the island had invested interest. If this chiefly area was established relatively late in history, it may be that earlier *marae* structures can be found in other places on the island. However, two *marae* structures were excavated outside the central Maeva area and these two sites produced similar dates as the Maeva cases. In addition, two larger *marae* sites were dated by pieces of coral found as part of the rubble fill of the *ahu*. These samples produced similar dates as from comparable structures in Maeva. To us, this suggests that our data from Huahine are representative. Also, the settlement site of Vaito’otia/Fa’ahia on Huahine dates to between AD 1000 and AD 13-1400. This site has no ritual space that can be said to be the precursor of the classic Society Islands *marae*. The earliest dates on midden-material found in the Te Ana section of the Mata’ire’a Hill indicates that settlement here began between AD 1300 and AD 1400, before the surface structures, including the *marae* complexes were built. Based on our own investigations at Maeva and the additional dates from Tahiti and Tetiaroa, construction began around AD 1400 to 1450 at the earliest in the Society Islands, and began at the same time in both the Leeward and the Windward groups.

Numerous investigations on Easter Island clearly indicate that *ahu* platforms were constructed on this island from around AD 1300 (Martinsson-Wallin and Crockford 2001). Kolb had put forth similar claims for the island of Maui in the Hawai’i archipelago (Kolb 1991). However, because few detailed cross-sections and plan drawings have been published, it is difficult to assess these claims (Solsvik n.d.:214-225). Most of the investigations on Maui revealing early radiocarbon dates are also the result of limited test-trenching, and, consequently, it is difficult to identify the function of these sites. That *heiau* structures were built and used by AD 1400 is not unlikely, however, making ritual architecture appear earlier in Hawai’i than in the more central located islands of East Polynesia. In 2001 Atholl Anderson and Roger Green reported on the dating and interpretation of a site at Emily Bay on Norfolk Islands (Anderson and Green 2001; Anderson et al. 2001). Here a pavement with an upright basalt stone, interpreted as a simple *marae* structure, was found dating to the 13th or 14th century. At the same time, available data from both the Cook Islands (Yamaguchi 2000) and the Society group, as discussed above, strongly indicates a late development of the classic *marae* complex in these islands. The authors, therefore, would like to suggest that the development of ritual architecture in East Polynesia, or of the so-called *marae-ahu* complex might have occurred in the south-eastern edge of the region rather than in the central archipelagos of the Cooks, Tuamotus, and Societies.

Acknowledgements

Our thanks goes to Dr Yosi Sinoto for sharing his great knowledge on marae structures in the Society Islands and for great times together on Huahine during some of the field sessions there. We would also like to thank Eric Komori, Elaine Rogers-Jourdane, Toru Hayashi, Mark Eddowes and Pierre Verin for their collaboration and good friendship through the years. A special thanks to the families of Maeva for help and patience with us while we were investigating their *marae*. The Project was funded by The Kon-Tiki Museum and the Norwegian Research Council.

Notes

1 Personal communication 23. May 2005.
2 Personal communication with Mark Eddowes (part of some of the excavations) and Henry Marchesi, then the head of Department of Archaeology at the Service de la Culture et du Patrimoine, Punaauia, Tahiti, 2003.
4 Jenny Kahn has, during the past few years, carried out a re-survey of ‘Opunohu Valley on Mo’orea, including test-excavation of various structures. Radiocarbon dates from these excavations should be forthcoming in the near future.
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References


Evidence of an Early Amerindian Contribution to the Polynesian Gene Pool on Easter Island

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Abstract - Current data strongly suggest a Polynesian origin of the population of Easter Island (Rapa Nui). There is, however, also evidence of an early South American contact such as the presence of the sweet potato and the bottle gourd long before the island was discovered by Europeans in 1722; i.e. in “prehistoric” time. Previous genetic studies of the population have failed to demonstrate an early American Indian (Amerindian) contribution to its gene pool. To address this issue, we carried out molecular genetic studies of blood samples collected in 1971 from reputedly non-admixed native Easter Islanders. The samples were typed for mitochondrial DNA (mtDNA) and Y chromosome markers, as well as for all currently known HLA class I and II gene variants (> 2500 alleles). All individuals carried mtDNA types and HLA alleles previously found in Polynesia, and most of the males carried Y chromosome markers of Polynesian origin, further supporting an initial Polynesian population of the island. The HLA gene investigations, however, also demonstrated in some individuals HLA alleles which have previously almost only been found in Amerindians. Similar findings were made in studies of new blood samples collected in 2008 from other Easter Island individuals. Our results demonstrate an early Amerindian contribution to the Polynesian gene pool of Easter Island. Exactly when these Amerindian alleles were first introduced on the island cannot be established in our studies, except that it in all probability occurred before the Peruvian slave raids in the early 1860s. Our combined data suggest, however, that some of these Amerindian HLA alleles were introduced on Easter Island already in prehistoric time. The results of our investigations have recently been reported in detail elsewhere (Lie et al. 2007, Thorsby et al. 2009). They are summarized and extensively discussed here, also in relation to other recent investigations in the area.

Introduction

Available data strongly suggest that Easter Island was first colonized by Polynesians from the West (Martinsson-Wallin and Crockford 2002), possibly as late as around AD 1200 (Hunt and Lipo 2006). However, there is also evidence of an early South American contact, such as the presence of the sweet potato (Yen 1974, Wallin et al. 2005) and the bottle gourd (Green 2000), which were grown on the island long before it was discovered by Europeans in 1722 (Wallin et al. 2005). This and other evidence, such as the similarities between the large stone statues (moai) and their platforms (ahu) on Easter Island with pre-inca stone statues and platforms in Tiahuanaco at Lake Titicaca in Bolivia, led Thor Heyerdahl to propose that Easter Island was first populated by Amerindians (Heyerdahl 1952). So far, however, no studies have been able to demonstrate an early Amerindian contribution to the gene pool on Easter Island or other Polynesian islands, prior to the Peruvian slave trades in Polynesia in the early 1860s, which resulted in an admixture of Amerindian and European genes in the area (Hurles et al. 2003).

Previous Genetic Investigations on Easter Island

Already during the first expedition of Heyerdahl to Easter Island in 1955-56, blood samples were collected from some of the inhabitants and typed for a limited number of blood group antigens. However, no proof of a close genetic relationship with Amerindians could be established (references in Thorsby et al. 1973).

In 1971, the 5th International Histocompatibility Workshop decided to use HLA typing in anthropological studies of various populations around the world. We collected blood samples from 69 Easter Islanders, where no foreign admixture could be detected. The selection of the studied population and their genealogy, based on medical and historical records, have been described in detail elsewhere (Thorsby et al. 1973). Typing was carried out for the very limited number of HLA antigens (see text box 3) known at that time, using serological methods having a very low resolution. Thus only some very “broad” HLA antigens could be determined. The data obtained, also including typing for some blood groups and serum types, did not convincingly reveal an early contribution of
Amerindian genes on Easter Island (Thorsby et al. 1973). The remaining sera from these investigations were, however, stored in liquid nitrogen.

In 1994 Erica Hagelberg and her associates carried out typing of mtDNA markers (see text box 1) of specimens obtained from prehistoric skeletal material from the island. The results showed typical Polynesian mtDNA markers with no genetic traces of Amerindians (Hagelberg et al. 1994). More recent investigations of Alu insertion polymorphisms in chromosomes from native Easter Island individuals revealed a possible Amerindian contribution, which, however, was assumed to be the results of the repatriation following the Peruvian slave raids in the 1860s (Gonzalez-Perez et al. 2006). Also the presence of some native American Y chromosomes (see text box 2) on another island in Polynesia, Rapa, was assumed to be the result of the repatriation following the Peruvian slave trades in the area (Hurles et al. 2003).

Genetic Traces of Amerindians

In 2005-6 we thawed the serum samples from our 1971 investigations and were able to extract and amplify DNA from 48 of the samples. The genealogy of the studied individuals, as it had been established in 1971, was slightly modified on the basis of new information from Langdon (Langdon 1988) and McCall (McCall 1976). The revised genealogy appears from Figure 1. It can be seen that most of the investigated individuals belonged to one large family, descending from Pacomio Maori (PM) and his two wives. We cannot completely exclude that further revisions of the genealogy depicted in Figure 1 may be necessary. The genomic HLA data (see later) are, however, fully compatible with the genealogy given in Figure 1. The DNA was typed for mtDNA and Y chromosome markers as well as for all known HLA alleles using high resolution sequencing. Detailed results of these investigations have been reported elsewhere (Lie et al. 2007), also containing relevant references.

mtDNA Data (see Textbox 1)

Nineteen unrelated or distantly related individuals were sequenced for the hypervariable control region and the 9-bp deletion of mtDNA. Seventeen carried the previously described full ‘Polynesian motif’. Two individuals carried a slightly different motif, with an A to G transition at position 16247, also seen in Polynesia. These results support a Polynesian origin of the population of Easter Island. No traces of an Amerindian contribution could be detected.

Y Chromosome data (see Textbox 2)

All males (n=26) were genotyped for biallelic Y chromosome markers and some short tandem repeat (STR) polymorphisms. Most of the men had the C to T transition that characterizes haplogroup C-M208, abundant among Polynesian men. Five of the men (no. 1 and his male offsprings nos. 3, 4, 68 and 69; see Figure 1) belonged to the R-M173 haplogroup typical of Europeans and had a Y-STR haplotype found in middle and southern Europe. These results provide further support of a Polynesian origin of the population of Easter Island, but also demonstrate an European contribution to the gene pool (see below). Again no traces of an Amerindian contribution could be detected.

Textbox 1

MtDNA is present in the mitochondria in the cytoplasm, and consists of approx. 16,500 DNA bp, which are only inherited from the mother. There are some variations in the mtDNA between different individuals, caused by mutations. Individuals belonging to the same ethnic group often share the same mtDNA mutations, compared with individuals from other ethnic groups.

Textbox 2

All males (n=26) were genotyped for biallelic Y chromosome markers and some short tandem repeat (STR) polymorphisms. Most of the men had the C to T transition that characterizes haplogroup C-M208, abundant among Polynesian men. Five of the men (no. 1 and his male offsprings nos. 3, 4, 68 and 69; see Figure 1) belonged to the R-M173 haplogroup typical of Europeans and had a Y-STR haplotype found in middle and southern Europe. These results provide further support of a Polynesian origin of the population of Easter Island, but also demonstrate an European contribution to the gene pool (see below). Again no traces of an Amerindian contribution could be detected.
**Textbox 3**

HLA genes are closely linked and localized to the HLA complex on chromosome 6. Those typed for in this study encode molecules (also called HLA antigens) consisting of an $\alpha$ and a $\beta$ protein chain, which present peptides to T lymphocytes. They are subdivided into two classes, I and II. Class I genes encode the $\alpha$ chain of the HLA-A, -B and -C series of molecules, while class II genes encode the $\alpha$ and $\beta$ chains of the HLA-DR, -DQ and -DP series of molecules. Each series of genes is extensively polymorphic, resulting in a very large number of alleles, of which more than 2,500 are known to day. The different alleles are named by their series, an asterisk and a number; i.e. HLA-A*0212, DQA1*0401, DQB1*0402 etc. Because of the extensive polymorphism unrelated individuals usually carry different HLA alleles. Individuals belonging to the same ethnic group may, however, have HLA alleles which are not found, or only found in very low frequency, in other ethnic groups.

**Genomic HLA Data (see Textbox 3)**

The results of the high resolution HLA genotyping of the studied population are given in Table 1. A total of 11 different HLA haplotypes (particular combinations of HLA alleles; see text box 4) were found (see Lie et al. 2007 how they were established). The probable origin of these haplotypes is given in Table 1.

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<td>4010</td>
<td>040301</td>
<td>03</td>
<td>0302</td>
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</tr>
<tr>
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<td>0403</td>
<td>4010</td>
<td>080201</td>
<td>0401</td>
<td>0402</td>
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</tr>
<tr>
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<td>0401</td>
<td>4001</td>
<td>040301</td>
<td>03</td>
<td>0302</td>
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</tr>
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</tr>
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<td>0702</td>
<td>3901</td>
<td>1401</td>
<td>0101</td>
<td>0502</td>
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</tr>
<tr>
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<td>4801</td>
<td>080302</td>
<td>0103</td>
<td>0601</td>
<td>Polynesian</td>
</tr>
</tbody>
</table>

*The letters in the first column refer to the HLA haplotypes found and relate to the letters given underneath each genotyped individual in Figure 1. Note that the haplotype designations differ slightly from the designations used in Lie et al. 2007. Individual 27 (see Figure 1) has received a recombinant HLA haplotype from her father (no. 94), where the ACB part is from haplotype $f$, while the DRDQ part is from haplotype $a$.}
1. Polynesian HLA Alleles.

All investigated Easter Islanders carried HLA alleles previously observed in Polynesia. The alleles included some which are characteristic of Southeast Asian and Oceanian populations, such as B*4001, B*5502, B*5602, DRB1*0803, DRB1*1401, and DQB1*0502 (see Solberg et al. 2008 and www.pypop.org/popdata, which report the distribution of HLA alleles in 497 populations, based on more than 66,800 individuals investigated). With the exception of HLA haplotype a (which may be an Amerindian haplotype; see below), all detected haplotypes carry HLA alleles which have previously been observed in Polynesia. Thus, also the results of the HLA analysis are in line with a mainly Polynesian origin of the population of Easter Island.

Figure 1. Genealogy of the Easter Island individuals included in our molecular genetic studies of the serum samples from 1971. The numbers of the individuals are the same as used in Lie et al. 2007, while the haplotype designations are slightly different. The most probable HLA haplotypes (see Table 1) are listed under each genotyped individual. The two haplotypes carrying Amerindian HLA alleles, haplotypes a and b, are coloured red and yellow respectively. Haplotypes carrying European (i.e. haplotype c) or Polynesian HLA alleles are coloured gray. Open circles or squares (white) mean that the individuals have not been investigated.

Textbox 4
HLA haplotypes. The particular combination of HLA alleles which is found in the HLA complex on a given chromosome 6. They are usually listed in their order from the telomer; i.e. HLA-A,-C,-B,-DR,-DQ,-DP. Each individual thus have two HLA haplotypes. As for HLA alleles the HLA haplotypes also show ethnic variations. Individuals belonging to the same ethnic group may have particular haplotypic combinations of HLA alleles which are not found, or only found in very low frequency, in other ethnic groups.
2. European HLA Alleles.

One HLA haplotype, \( c \), carried HLA alleles typical of Southern Europeans and Africans; i.e. the haplotypic combination A*290201-C*160101-B*440301 (Solberg et al. 2008). However, haplotype \( c \) also carried Polynesian DRB1, DQA1 and DQB1 alleles, and may thus be a recombinant European/Polynesian haplotype.

PM is the likely source of the European/Polynesian haplotype \( c \) in the studied individuals. This is supported by the fact that some descendents of PM with both of his wives carry this haplotype (see Figure 1). Since PM was born in approx. 1816, the ACB part of this HLA haplotype was most probably introduced on Easter Island in the early 1800s, or earlier. The European Y chromosome haplogroup R-M173 was also found in individual 1 (the son of PM) and his sons, providing further evidence for a European contribution of genes in this family. The primary source of these European alleles may be European crew members on ships visiting Easter Island before the early 1800s. The particular haplotypic combination of the broad A*29 and B*44 alleles (including C*1601), detected as A29-B12 by our low resolution serological typing in 1971 (Thorsby et al. 1973), has, however, the world highest frequency among Basques (10%; see www.allelefrequencies.net) and are much less frequent in Asia, among Amerindians and in Polynesia. This led Langdon to consider our results to lend further support to his theory that some surviving Basque crew members of the Spanish caravel San Lesmes, lost in Polynesia in 1526, may have reached Easter Island before it was discovered by Roggeveen in 1722 (Langdon 1988).

3. Amerindian HLA Alleles

The HLA haplotypes \( a \) and \( b \) carried the HLA alleles A*0212 and B*3905, which have previously been found in Amerindian populations and people of Native American ancestry, but which are rare or absent in Polynesian and other non-Amerindian populations (Solberg et al. 2008, other refs. in Lie et al. 2007). The distribution of B*3905 is shown in Figure 2 (Solberg et al. 2008). It can be seen that this HLA allele is found in high frequency among Native Americans, and hardly in other populations. A similar distribution is found for A*0212 (Solberg et al. 2008). Thus, the A*0212 and B*3905 alleles are typical Amerindian HLA alleles.

Figure 2. The frequency of the HLA allele B*3905 in various populations (Solberg et al. 2008). The allele frequencies are given in different colours to the left.
The other HLA alleles on haplotype $a$; i.e. C*070201, DRB1*080201, DQA1*0401 and DQB1*0402 are also frequently found in Amerindians. The particular combination of HLA alleles on haplotype $a$ is therefore likely to be an Amerindian haplotype. Interestingly a more broadly defined haplotype, $A^*02-B^*39-DRB1^*0802-DQB1^*0402$, which therefore might be identical to haplotype $a$, has previously been found only in Aymara Amerindians from Bolivia, living in the Lake Titicaca area (Arnaiz-Villena et al. 2010). However, high resolution typing of the $A^*02$ and $B^*39$ alleles of this Aymara haplotype revealed that it carried the $A^*0201$ and $B^*3906$ alleles respectively (Arnaiz-Villena, personal communication) and not the $A^*0212$ and $B^*3905$ alleles found on haplotype $a$. Thus this Aymara Amerindian haplotype is similar, but not identical in its ACB part to the Amerindian haplotype $a$ found on Easter Island.

Haplotype $b$ also carries the Amerindian HLA alleles $A^*0212$ and $B^*3905$. The HLA alleles in the DRB1-DQA1-DQB1 part of this haplotype are also found in Amerindians, but are more frequent in Polynesians (see haplotype $f$ and $g$). Thus haplotype $b$ may be a recombinant Amerindian ACB/Polynesian DRDQ haplotype.

**When Were the Amerindian HLA Alleles Introduced on Easter Island?**

Our investigations cannot answer this question with certainty, except that the Amerindian contribution to the gene pool of Easter Island must have occurred early. First we have to establish that these Amerindian alleles did not arrive as a result of the repatriation following the Peruvian slave raids in the 1860s. Since the key ancestors of the large family depicted in Figure 1, PM and his two wives, were all dead and thus not available for HLA typing, it is impossible to establish with certainty the origin of the Amerindian haplotype $a$ in the family. Furthermore, only one of their children (individual no. 1) was HLA typed, in addition to several of their grandchildren and great-grandchildren. Given the validity of the family structure depicted in Figure 1 (as stated above, we have no evidence to the contrary), the most likely interpretation is that PM carried the haplotype combination $c/f$ and that his second wife, MA, carried the haplotype combination $a/e$. MA is therefore the most probable ancestor of the Amerindian HLA haplotype $a$. Since MA was born on Easter Island in approx. 1846, this interpretation of the HLA data entails that the Amerindian haplotype $a$ was introduced in Easter Island in good time prior to the Peruvian slave raids. Following this interpretation, individual 94, married to the granddaughter (no. 24; see Figure 1) of PM and MA also carried the Amerindian haplotype $a$. The results of the HLA investigations in this large family fully fit with these interpretations.

It should be added that there are additional interpretations of the available HLA data. One is that PM carried the Amerindian haplotype $a$ (in addition to the European/Polynesian haplotype $c$). If PM carried haplotype $a$ one would have to postulate an extramarital child in his large family. In any case, this would also place the introduction of the Amerindian haplotype $a$ to Easter Island in very good time prior to the Peruvian slave raids. Another possibility is that neither PM nor MA carried the Amerindian haplotype $a$, but that it was introduced in the family by the husbands of two of their daughters (no. 86 and their other daughter depicted to the far right in Figure 1) as well as by individual no. 94. If so the four investigated children of PM and MA must have inherited exactly the same haplotypes from their parents (i.e. being $c/e$), which is quite unlikely (the chance is 1.5 %). Furthermore, Langdon states that all children of PM and MA married partners whose pure Easter Island ancestry may be traced back to the earliest church records (Langdon 1988). Thus, should this latter much more unlikely interpretation of the HLA data be true it would also strongly suggest an introduction of the Amerindian haplotype $a$ on Easter Island in good time prior to the Peruvian slave raids.

The next question is how much earlier than the Peruvian slave trades in the 1860s the Amerindian HLA alleles may have been introduced on Easter Island. The following evidence suggests an early introduction:

1. The Amerindian HLA alleles $A^*0212$ and $B^*3905$ were found on two different haplotypes; $a$ and $b$, and both haplotypes are found in some unrelated individuals (see Figure 1 and discussed above). This suggests that the Amerindian alleles have been present on Easter Island for many generations.

2. Haplotype $b$ also carries the DRB1*040301, DQA1*02 and DQB1*0302 alleles which are more frequently found in Polynesia, as is also witnessed by their presence on the Polynesian haplotypes $f$ and $g$. As discussed above, haplotype $b$ may therefore be a recombinant Amerindian ACB/Polynesian DRDQ haplotype. Since the HLA genes are very closely linked on chromosome 6, recombinations in the HLA complex are rare and occur in only approx. 1% of meioses. A recombinant Amerindian ACB/Polynesian DRDQ haplotype therefore also suggests that the Amerindian alleles must have been present on Easter Island for many generations.

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3. The Amerindian HLA alleles A*0212 and B*3905 occur together on the same haplotypes (a and b) on Easter Island. In Amerindians today these alleles are more often found on separate haplotypes; i.e. not together. However, Native Americans usually exhibit low allelic, but high haplotypic diversity (Hollenbach et al. 2001). Thus the haplotype combinations of HLA alleles in present day Amerindians may have diverged since the Amerindian HLA alleles reached Easter Island, also suggesting an early introduction on the island.

Exactly when these Amerindian HLA genes were introduced on Easter Island cannot be established by our studies. Taken together, however, our data are fully compatible with an introduction of Amerindian genes on Easter Island already in prehistoric time, but probably after the island was inhabited by Polynesians. Wallin and co-workers suggest that the South-American sweet potato was not part of the original colonists’ cultural and agronomic baggage and arrived later, but long before the island was discovered by Europeans (Wallin et al. 2005), which would fit with this interpretation (see later).

Investigations of New Blood Samples from Easter Island

To try to confirm our molecular genetic findings in the serum samples from 1971, new blood samples were collected in 2008 from 21 individuals who had not been included among those who gave their blood samples in 1971. They were carefully selected to be of Easter Island origin for many generations by information from several local persons with knowledge of the genealogy of early families of the island, and from written sources (Hotus et al. 1988). Some of the investigated individuals are related to some included in our previous investigations.

The new blood samples were investigated for genomic markers similar to the investigations of the 1971 samples, except that DNA was now extracted from a pellet of leucocytes. The results are reported in detail elsewhere (Thorsby et al. 2009) and will only be briefly summarized here.

MtDNA Data

All investigated individuals carried the full ‘Polynesian motif’. Two individuals had a ‘private’ substitution (C) at position 16126. No traces of mtDNA common in Amerindians were found, as was also the case in our investigations of the 1971 samples.

Y Chromosome Data

The Y chromosome typing of the 11 males included in our investigations revealed that five of them had the C to T transition that characterizes haplogroup C-M208, abundant among Polynesian men. The others had Y chromosome markers possibly of European origin. Again no traces of Y chromosome markers common in Amerindians were found.

Genomic HLA Data

Since the 21 investigated individuals were unrelated their HLA haplotypes had to be estimated, using methods described in Thorsby et al. 2009. Seven of the probable HLA haplotypes found were identical to some found in our previous studies, including haplotype c (see above). Eight HLA haplotypes not detected in our previous investigations were also found, six of which were of probable Polynesian or European origin. Two haplotypes, however, carried some HLA alleles which most probably are Amerindian.

The latter two haplotypes are given in Table 2. Haplotype 7, found in one individual, carried B*3909 and DRB1*0802, which have previously almost only been found among native South Americans (Solberg et al. 2008). The C*0702 allele carried by this haplotype also has a very high frequency among native Americans, but is also found in some populations in Southeast Asia and elsewhere (Solberg et al. 2008). Thus the CBDR part of this haplotype is probably of Amerindian origin. Arnaiz-Villena et al also reported another haplotype, A*02-B*39-DRB1*0901-DQB1*0303, which has also been found only in Aymara Amerindians (Arnaiz-Villena et al. 2010). By high resolution retyping of this haplotype it was found to carry the alleles A*0201-C*0702-B*3909-DRB1*0901-DQB1*0303 (Arnaiz-Villena, personal communication); i.e. the same ACB alleles as carried by
Easter Island haplotype 7. Thus Easter Island haplotype 7 may have been derived from this Aymara Amerindian haplotype by an ACB/DRDQ recombination.

<p>| Table 2. Two HLA haplotypes with Amerindian alleles found in the samples collected in 2008. |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|</p>
<table>
<thead>
<tr>
<th>Haplotype</th>
<th>HLA-A</th>
<th>HLA-C</th>
<th>HLA-B</th>
<th>HLA-DRB1</th>
<th>HLA-DQA1</th>
<th>Probable origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>0201/0209</td>
<td>070201</td>
<td>3909</td>
<td>0802</td>
<td>0401</td>
<td>Amerindian (CBDR)</td>
</tr>
<tr>
<td>8</td>
<td>2402</td>
<td>0303</td>
<td>1507</td>
<td>0404</td>
<td>030101</td>
<td>Amerindian (BDR)</td>
</tr>
</tbody>
</table>

Haplotype 7 was found in one individual, haplotype 8 in another.

Haplotype 8, found in another individual, carried the HLA allele B*1507, which is found in high frequency among natives in South America and barely elsewhere (Solberg et al. 2008; see Fig. 3). The DRB1*0404 allele on this haplotype has a high frequency among native Americans and with lower frequency in other populations (Solberg et al. 2008). Thus the BDR part of this haplotype is probably also of Amerindian origin.

From the genealogy of the two individuals carrying haplotype 7 or 8 respectively, we cannot ascertain when these haplotypes were introduced on Easter Island. However, since both haplotypes may be the result of recombinations it is possible that they were introduced early and later recombined with other haplotypes on the island. It should also be noted that the Amerindian HLA alleles found in these recent investigations differ from those found in the 1971 samples, which may indicate that an early Amerindian contribution to the gene pool of Easter Island might have been more than just trivial. In any case, the results of our more recent investigations support our findings in the 1971 samples.

**Figure 3.** The frequency of the HLA allele B*1507 in various populations (Solberg et al. 2008). The allele frequencies are given in different colours to the left.
No Traces of Amerindians by Studying mtDNA and Y Chromosome Markers

An early Amerindian contribution to the gene pool on Easter Island was only revealed by the genomic HLA investigations. No genetic traces of Amerindians were detected by typing for mtDNA and Y chromosome markers. One explanation for these contrasting findings is that the Amerindian HLA alleles may have been subject to different selective forces than Amerindian mtDNA and Y chromosome markers. The HLA alleles typed for encode molecules which are of great importance for immune responses, where different HLA molecules present different peptide-fragments of antigen to T lymphocytes. Some Amerindian HLA alleles may have been selected which encode HLA molecules of importance for immune responses against given pathogens on the island, while there was no similar selection of Amerindian mtDNA and Y chromosome markers.

There is, however, also another, not mutually exclusive explanation. At the end of the 1800s approximately 100 individuals only were left on the island. Many had disappeared because of the Peruvian slave raids, others had died because of epidemics. This may cause a more random transmission of genes from one generation to the next; i.e genetic drift, leading to random genetic changes in the population including loss of given gene variants. Uniparental genetic markers such as mtDNA and Y chromosome markers are more sensitive to genetic drift than genes which are inherited from both parents, such as the HLA genes. This also illustrates the usefulness of genomic HLA typing to complement mtDNA and Y chromosome analyses in anthropological investigations.

How Did the Early Amerindians Reach Easter Island?

If Amerindians reached Easter Island in prehistoric time, as our investigations suggest, how did they arrive? The answer to this question cannot of course be answered by our investigations. However, there are at least two possible, not mutually exclusive, explanations.

One possibility is of course that some native Americans arrived at Easter Island on balsa rafts, possibly via other Polynesian islands, by following westbound ocean currents from the northern parts of South America. By his Kon-Tiki expedition in 1947 Heyerdahl showed that it was possible to reach Polynesia on a balsa raft from Peru.

Another possibility is that some Polynesians sailed further east in their canoes and reached South America (Martinsson-Wallin and Crockford 2002). If they followed a more southern route in the Pacific they would be helped by more eastbound ocean currents and westerly winds. After we had finished our molecular genetic studies of the 1971 serum samples, Storey and co-workers analysed the remains of some chickens found in El Arenal in the southern part of Chile. Most interestingly, by mtDNA analysis they found that the chickens were of Polynesian type, while radiocarbon investigations showed that the remains dated back to 13-1400 (Storey et al. 2007, Storey et al. 2008). Furthermore, suggestive evidence of skeletal remains of pre-Columbian Polynesian ancestry at the Mocha Island, Chile was also recently reported (Matisoo-Smith and Ramirez 2010). Thus there is strong evidence that Polynesians have been in South America early; i.e. in pre-Columbian time (see also Lawler 2010). After having arrived in South America some of them may have returned to Polynesia, including Easter Island, taking with them some native Americans as well as the sweet potato and bottle gourd etc.

Conclusions

The results of our molecular genetic studies of some highly selected of Easter Islanders are compatible with the notion that the first inhabitants of the island were Polynesians. Our investigations of HLA alleles in the studied population, however, also demonstrate for the first time early genetic traces of some Amerindians on the island. We cannot by our investigations establish when the first Amerindians reached Easter Island. The combined results suggest, however, that they came in prehistoric time, but probably after the island was inhabited by Polynesians.

Acknowledgements

I thank the inhabitants of Easter Island for their participation in these studies. The investigations summarized in this article are the result of an extensive collaboration by many, to which I owe sincere thanks. Their names appear from the list of authors of and acknowledgements in Thorsby et al. 1973, Lie et al. 2007 and Thorsby et al. 2009. To mention just a few, Jean Dausset (1916-2009, who received the Nobel Price in 1980 for the first
discovery of an HLA antigen), Hopital Saint-Louis, Paris, France, initiated these studies and helped, together with my wife Anne Thorsby and others, in selecting the individuals bled in 1971. The molecular genetic studies performed in 2005-6 on the serum samples collected in 1971 were led by Benedicte A. Lie at our institute, together with the other authors of Lie et al. 2007. The investigations in 2008 were organized by Sturla Ellingvåg, Explico, Norway and others, while the molecular genetic studies were performed by the staff of the Immunogenetics Research Group at our institute together with others, as will appear from the list of authors of Thorsby et al. 2009. I thank Erika Hagelberg, Dept. of Biology, University of Oslo, Norway; Marcelo Fernandez-Vina, Dept. of Laboratory Medicine, University of Texas, Houston, TX, USA and Alicia Sanchez-Mazas, Laboratory of Anthropology, Genetics and Peopling History, University of Geneva, Geneva, Switzerland for their continuous support and help throughout these studies. I also thank Antonio Arnaiz-Villena, Department of Immunology, University Complutense, Madrid, Spain for high resolution typing of some Aymara Amerindian haplotypes. Many thanks also to Benedicte A. Lie and Marte Viken at our institute and Paul Wallin, Dept. of Archaeology and Osteology, University of Gotland, Sweden, for critical reading of the manuscript. Major financial support was received from Oslo University Hospital, Rikshospitalet and Medinnova, Rikshospitalet.

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**References**


The Polynesia - Mapuche Transpacific Contact

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Abstract - For almost a century, transpacific contacts with various pre-Columbian American cultures has been proposed based on similarities on a long list of cultural traits. But until now, it has not been possible to differentiate in a conclusive way whether those similarities are cultural borrowings derived from some kind of contact or constitute, simply, parallel developments. However, confronted with the weakness of empirical data and with traditional theoretical-methodological arguments, genetic evidence appears to be inarguable. The discovery in Arauco of chicken remains in a pre-Hispanic context, with Polynesian DNA, obligates the re-evaluation of those Polynesian traits described in Mapuche culture and the subsequent proposal of new lines of research within the framework of a renovated paradigm.

Resumen - Desde hace casi un siglo se han propuesto contactos transpacíficos con distintas culturas de la América precolombina, basadas en similitudes en una larga lista de rasgos culturales, pero hasta ahora no había sido posible discriminar de manera concluyente si esas similitudes corresponden a préstamos derivados de alguna clase de contacto o constituyen, “simplemente”, desarrollos paralelos. Sin embargo, frente a la debilidad de la data empírica y de los argumentos teórico-metodológicos tradicionales, la evidencia genética parece incontestable. El hallazgo en Arauco de restas de gallina en un contexto prehispánico, con ADN polinésico, obliga a re-evaluar los rasgos “polinésicos” descritos en la cultura Mapuche y proponer nuevas líneas de investigación en el marco de un renovado paradigma.

Introducción

El tema de los contactos transpacíficos es un tema muy antiguo y de amplia repercusión en la prehistoria de América, lamentablemente despreciado por una serie de buenas y malas razones.

Respecto de Polinesia y Chile, ya en 1835, a partir de sus vínculos comerciales entre Tahiti y Valparaíso, Jacques Moerenhout fue el primero en observar algunos paralelos etnográficos, como el poncho y la “dalca” de Chiloe (sewn plank canoe), aunque no cree que estas pudiesen viajar tan largas distancias (citado por Pereira Salas 1951). En 1924, MacMillan-Brown identificaba nuevos elementos polinesios, entre los cuales menciona el quipu, el curanto y el toki, que habrían llegado desde Nueva Zelanda o las Marquesas hasta el sur de Chile, y desde allí hasta Perú. Entre los más influyentes defensores de la presencia cultural melanésica y polinésica en América, se contaba Paul Rivet (1943). Desde Chile, Latcham (1927) fue el primero en observar algunas de esas similitudes. Sorenson y Raish (1990) recogieron 5.613 referencias sobre contactos transpacíficos desde distintas culturas en toda América. Sin embargo, muchos de ellos no resistiría la crítica especializada, mientras hasta la fecha no se ha podido validar la influencia de culturas de Asia en alguna de las culturas precolombinas de Mesoamérica.

De hecho, hasta ahora los contactos transpacíficos no se han podido validar como problema serio en el mundo académico, debido en primer lugar a la difusión masiva de hipótesis absurdas o sin reales fundamentos, pero también a que el material empírico por sí mismo no permite probar que las similitudes observadas correspondan a desarrollos independientes, adaptaciones convergentes, o a préstamos derivados de algún tipo de contacto. La lingüística, en cambio, goza de un mayor status explicativo.

Por otro lado, tampoco ayudan los prejuicios etnocéntricos respecto de la autonomía de las culturas americanas ni los modelos teóricos reduccionistas. Dejando a un lado una discusión teórica sobre la evolución y los contactos culturales que no cabe en estas páginas (cf. Ramírez 1992:44-46), podríamos agregar que los límites del poblamiento del Pacífico, para los mayores navegantes de la prehistoria, no podían ser sino los bordes continentales de la cuenca del Pacífico. Dado el extremo aislamiento geográfico de Rapa Nui, resulta mucho más excepcional que haya sido encontrada por exploradores polinesios en sus viajes hacia el este. En cambio, bajo ciertas condiciones y dentro de los márgenes de su capacidad de carga, no podían esquivar las costas de América.

Desde luego, vale la pena recordar que la costa no es simplemente el límite entre dos compartimentos estancos, sino una franja permeable. Sabemos que esos supuestos límites terrestres fueron traspasados por los antiguos navegantes de la América precolombina, cuya movilidad a lo largo de las costas está bien documentada (Lothrop
Gotland University Press 11

1932), pero hasta ahora no se ha encontrado evidencia cierta de una posible proyección miles de kilómetros mar adentro, que pudiera haber dejado huella en culturas polinésicas. El detalle es que el tránsito por mar no deja huellas, al mismo tiempo que resulta mucho más eficiente para recorrer grandes distancias, hasta la próxima tierra firme. El tránsito por mar provoca menos roce, es más económico en términos del gasto de energía y es más rápido que el medio terrestre, en donde hay que atravesar selvas, montañas, desiertos y grandes ríos, sin medios de locomoción tan eficientes como una canoa polinésica.

A pesar del propio Heyerdahl (1952, 1968) y de la oscura leyenda de Tupac Yupanqui (Kauffmann Doig 2000; Del Busto 2006), los americanos precolombinos no fueron navegantes de alta mar. Hasta la fecha no se ha encontrado evidencia cierta de culturas precolombinas en las Galápagos, a 965 km de distancia, ni en Rapa Nui, a 4000 km de distancia. Hasta ahora, la explicación más razonable para la dispersión en Polinesia de cultígenos americanos como el camote y la calabaza, es que fueron navegantes polinesios quienes llegaron a América y se desvieron a casa con ellos, desde Rapa Nui hasta Nueva Zelanda (Buck 1938; Finney 1994a; Green 1998, 2001, 2005; Clarke et al. 2006).

En cambio, recientemente el “establishment” científico acogió, aunque tibiamente, la propuesta de una conexión prehistórica entre Hawaii y el sur de California, a partir de dos elementos que serían inequívocamente polinesios: la canoa de tablas cosidas, cuyo nombre en Chumash pudo derivar de un término polinésico, y los anzuelos compuestos (Jones & Klar 2005).

Es un hecho muy importante a considerar que, a pesar del grado de interconexión cultural, a lo largo de la extensa costa de América central y sur no se encuentran canoas de tablas cosidas prehistóricas sino hasta Chiloé, y hasta el extremo sur de los canales patagónicos (referencia pendiente). No hay argumentos suficientes para sostener una explicación inequívoca, pero la posibilidad de un contacto polinésico paralelo, entre Hawai y California, y entre el Centro sur de Polinesia y el territorio Mapuche, es bastante más que factible.

Hacia el este viene la corriente


Un fenómeno natural que habría sido fundamental en este proceso es el Fenómeno de El Niño, que habría traído una embarcación polinésica directamente al territorio Mapuche (Finney 1985; Caviedes y Waylen 1993).

La ruta lógica hacia Sudamérica implica separarse del eje de la circulación de corrientes y vientos, que deja a Rapa Nui en el centro, bajar hasta la faja de vientos occidentales al sur del paralelo 35, para luego girar directamente hacia el este, justamente en dirección del área mapuche (Finney 1994b, Irwin 2006). Una ruta más directa pero más extrema fue la que aprovecharon los últimos prisioneros que lograron escapar de la prisión inglesa de Sarah Island, en Tasmania, en Febrero de 1834. Sin ser navegantes experimentados, lograron atravesar todo el Pacífico sobre las furiosas corrientes de los 40º de latitud sur, para llegar a las costas de Chiloé en 43 días, y desde allí hasta Valdivia (Brand 1995). El fracasado intento de Eric de Bisschop en la balasa Tahiti Nui (1959) de navegar hacia el este, no ayudó a sostener la hipótesis. Una posible ruta directa hacia el este, a través de una estrecha contra-corriente ecuatorial, ha quedado olvidada como una curiosidad de la literatura (Malkus 1937).

La evidencia empírica mapuche

Los Mapuche, en tiempos prehispánicos, ocuparon el extenso territorio del centro sur de Chile, entre los 33 y 43 grados de latitud sur, desde las costas del Pacífico hasta el borde oriental de la Cordillera de los Andes. En general, los distintos elementos supuestamente polinésicos entre los Mapuche (Menghin 1960), se han descrito para el territorio comprendido entre Concepción y Chiloé (37 a 43º S). La Primera referencia que pudimos observar en directo fue una mandíbula humana con un rasgo polinésico (“rocker jaw”) procedente de la isla Mocha, pero sin un contexto controlado (cf. Ramírez 1992: 63-65). Los materiales
Entre los artefactos Mapuche más llamativos, se cuentan algunas insignias de piedra pulida (clavas) de gran similitud formal con las “wahaika” maorí (Imbelloni 1928a; 1929; 1953; Menghin 1960; Schobinger 1956, 1956/57).

Los paralelos lingüísticos incluyen una cantidad de términos (Englert 1934), entre los que destaca “toki” como posible préstamo polinésico (Imbelloni 1928b). El artefacto mismo es una herramienta universal de corte, ya sea como hacha o como azuela, pero tanto el nombre como las funciones y elementos asociados que se escapan de lo tecnológico pueden reflejar fenómenos mucho más complejos.

Dos de las categorías analizadas previamente fueron descartadas como curiosidades llegadas al continente a comienzos del siglo XX: las puntas de proyectil de obsidiana (mataa), características del período tardío en Rapa Nui, y unas esculturas antropomorfas de piedra (cf. Ramírez 1992: 59-63).

En el extremo meridional del territorio Mapuche, los antiguos habitantes de la Isla Grande de Chiloé (llamados “Veliche” en tiempos históricos) desarrollaron una cultura de características muy especiales, que incluye rasgos descritos como “polinésicos” (Oyarzún 1934, Cárdenas et al. 1993). Algunos de esos rasgos podrían ser catalogados como desarrollos paralelos o adaptaciones convergentes, tales como el trabajo comunitario, llamado minga en Mapudungun, derivado del quechua minka, y umanga en Rapa Nui; el horno subterráneo (curanto), fechado en al menos seis mil años en el sitio Puente Quilo (Rivas y Ocampo 2005), los corrales de pescía y las canoas de tablas cosidas, pero tampoco es posible comprobar si hubo algún tipo de intercambio en uno u otro sentido.

Un nuevo elemento a considerar en la lista de similitudes es el “palín”, juego Mapuche que tendría un paralelo en las islas Australes. En el Museo de Otago se exhibe un palo curvo que servía para un juego “similar al hockey”, y existe una antigua referencia a un artefacto similar recuperado en una cueva de refugio en Rurutu (Emory 1927).

La gallina de los huevos de oro (azules)

Hace tiempo se postuló un origen polinesio para la llamada gallina araucana (Carter 1971), pero no se había podido comprobar hasta la fecha. En un sitio de Arauco (El Arenal 1) se han encontrado por primera vez restos arqueológicos de gallina, en un contexto fechado (TL) hacia el 1350 dC, (Contreras et al. 2005). Recientemente se publicaron los resultados del análisis de ADN sobre esos huesos (Storey et al. 2007), los que permitieron confirmar un origen polinesio. Además, una fecha AMS calibrada en esos huesos permitió confirmar la data prehispánica para la presencia de gallina en el sur de Chile, con un rango entre 1304 y 1424 dC. Finalmente, la genética pudo aportar la prueba del contacto. En consecuencia, se requiere de una re-evaluación de los elementos involucrados en ese contacto, en el marco de un nuevo paradigma.

Re evaluación de la data empírica: un par de ejemplos.

Clavas

En Chile, se denomina "clavas" a una serie de artefactos líticos provenientes del área Mapuche, sin contextos arqueológicos precisos, que se suponen insignias de mando de los antiguos jefes. Se trata de hojas líticas provistas de un mango, a veces con un orificio para ser llevadas amarradas a la muñeca. Se distingue una variedad de formas dentro de dos grupos mayores: las zoomorfas, que incluye la amplia serie de las ornitomorfas y algunos escasos modelados con felinos y, por otro lado, las llamadas “espatuliformes” (hoja simétrica) o "falciformes" (hoja asimétrica).

Respecto de este segundo grupo, ha sido postulado como evidencia de un contacto cultural polinésico con el sur de Chile, debido a su similitud formal con las mazas de guerra maorí conocidas como o "patu" de cuerpo simétrico ("onewa", de piedra; "raakau", de madera y "paraoa", de hueso) y con las de hoja plana asimétrica, de hueso o madera, denominadas "wahaika" (cf. Imbelloni 1928a; 1929; 1953; Looser 1931;Schobinger 1956/57; Menghin 1960).

Tanto en Polinesia como en el sur Mapuche se observa una gran variabilidad de formas, pero la falta de
contextos no permite ordenar los tipos en una secuencia evolutiva. En nuestro análisis de un total de 104 clavas del centro sur de Chile (cf. Ramírez 1992: 47-55) pudimos discriminar ocho categorías formales, algunas de las cuales presentaban una distribución espacial discreta. En particular, las clavas del tipo “falciforme” (wahaika) se concentran en el valle central y precordiller a al sur de Los Angeles, en la Región de Los Lagos (12 piezas). Un único representante del tipo “espatuliforme” (“patu”) descrito en la literatura para Villavicencio (Imbelloni 1928 a), en Mendoza, parece ser más bien un souvenir histórico. Un dato fundamental es que las “wahaika” mapuches fueron confeccionados con una materia prima local: la pizarra de la formación Panguipulli (Mario Pino, com. pers.). Las clavas zoomorfas del tipo “felino modelado” (10 piezas) tienen una distribución similar, aunque más acotada hacia el norte y más proyectada hacia la vertiente oriental de la cordillera. Por su parte, las clavas “ornitomorfas discoidales” (14 piezas) se agrupan significativamente en la zona central de Chile. El tipo ornitomorfo semilunar (57 piezas), que constituye más del 50 % de la muestra, presenta una distribución mucho más amplia que el resto.

Las clavas polinésicas (cf. Skinner 1974) también presentan una importante variabilidad estilística, que incluye formas complejas como el “kotiate” y las “wahaika” de madera y hueso con elaborados diseños tallados en el borde, y también una interesante variedad funcional con respaldo etnográfico, que no existe en Chile: “mere pounamu” (clava de jade), y los “patu muka” (machacadores de piedra para la fibra “muka”); “patu aute” (machacadores de madera para la fibra aute, o mahute); “patu aruhe” (machacadores de raíces); “patu tuna” (machacadores para anguilas).

Entre los artefactos maori se observa una secuencia evolutiva, a partir de un modelo similar a la pala de un remo, mientras que en la isla Chatham se encuentran los tipos arcaicos, que resultan ser muy cercanos a nuestro tipo ornitomorfo semilunar. En la isla Chatham, al este de Nueva Zelanda, la cultura moriori quedó suspendida en un estadio primigenio y luego desaparece, mientras la cultura maori siguió evolucionando en Nueva Zelanda (Keyes 1967). El tipo ornitomorfo semilunar de Chatham es notablemente similar, si no idéntico, a uno de los tipos Mapuche, lo que se podría interpretar como uno de los modelos ancestrales que pudieron compartir los navegantes polinésicos con los habitantes del sur de Chile. Con el tiempo, en ambos extremos esas formas pudieron seguir caminos separados, evolucionar en Chile centro sur hacia las ornitomorfas que pudieron tener un significado distinto (el loro, símbolo de quien habla por la comunidad ?), o provenir de una línea independiente en base a una tradición andino-amazónica (el felino). En nuestro caso, aunque no se haya comprobado un contacto polinésico, el modelo “wahaika” pudo ser tanto una expresión local derivada de un modelo ancestral polinésico como un desarrollo independiente, pero la primera alternativa parece más factible ahora. La falta de contextos arqueológicos sigue siendo una dificultad, pero futuras investigaciones y nuevos enfoques teórico metodológicos podrán ayudar a la comprensión del proceso.

**Toki**

Aparte de la notable coincidencia en el nombre, las hachas de piedra pulida son artefactos de desarrollo universal, desde el Neolítico europeo hasta Polinesia y el sur de Chile.

Desde un punto de vista formal, los toki en Polinesia presentan un cuerpo alto y un bisel de filo recto, para una función predominante como formones (chisels) o azuelas (adzes) enmangadas. En cambio, los toki mapuches son básicamente hachas (axes) de sección biplana a biconvexa. Un notable paralelo maori son los llamados “toki kura”, de forma trapezoidal o subrectangular, biplanas y con un orificio en el extremo para llevar colgando del cuello, de uso ceremonial o signo de prestigio. Los toki del tipo “maichihue kura”, se habrían usado como azuelas enmangadas, y usados en la fabricación de canoas, al igual que en Polinesia (cf. Ramírez, 1992: 56-58). Por otro lado, se observan interesantes paralelismos más allá del funcional, en la leyenda maori de Rata y el corte de un árbol con un toki mágico mapuche (Imbelloni 1931).

**Lingüística**

Los paralelos lingüísticos se han utilizado como la evidencia más sólida para probar contactos culturales. En la lengua Mapuche aparece una docena de palabras como posibles cognados, entre las cuales destaca la palabra “toki” (cf. Englert 1934; Ramírez 1992: 58-59, Schuhmacher 1992). Entre esos paralelos se cuentan las palabras para designar el color negro (Rap. uri uri y Map. kuri), chico (Rap. iti iti, Map piti), etc. A pesar de que no se ha realizado un análisis lingüístico profundo, hemos podido identificar dos nuevos paralelos: “kaipulli”, y “kumaka”. En Chiloe, kaipulli era un tipo de horno en tierra (curanto) para cocer algas. En Polinesia, la palabra se podría descomponer en kai (comer) y pupuri (recipiente).
Según Ruperto Vargas (com. pers.), uno de los antiguos tipos de papa chilota habría sido la “kumanka” actualmente extinta. Se ha postulado (cf. Green 2005) que la papa dulce que fue introducida en Polinesia proviene de las costas del norte de Perú o Ecuador, desde donde habría llegado con su nombre “kumara”. También el nombre pudo llegar con la expansión Inca hasta mucho más allá de los límites del Imperio, hasta Chiloé, para ser aplicado a alguna de las cientos de variedades de papas que se desarrollaron en esa isla (Cañas-Pinochet 1901). Una explicación alternativa es que una variedad de papa de Chiloé, dulce como el camote, fuera bautizada como kumara por eventuales visitantes polinesios que ya la hubieran recibido desde el trópico sudamericano con anterioridad. Chiloé se encuentra en la misma latitud de Christchurch en Nueva Zelanda, en un clima que no permitió la adaptación de papa dulce. En consecuencia, resulta poco probable que el camote y/o su nombre hayan sido introducidos en Chiloé desde el norte, por vía terrestre. En cambio, los colonizadores polinesios transportaron camotes hasta Rapanui, donde se conocen como “kuma”. Eventualmente, el camote y el nombre kumaka pudieron sobrevivir por algún tiempo en Chiloé, reintroducido en América por exploradores polinesios.

Conclusiones

El descubrimiento de gallinas de origen polinésico en un contexto prehispánico en las costas de Arauco ha permitido comprobar la antigua hipótesis del contacto transpacifico con los antiguos Mapuche. La presencia de elementos culturales que parecen ser préstamos en el ámbito conceptual, tanto palabras como artefactos de carácter simbólico, hablan más de una estadía relativamente prolongada que de un contacto efímero, de lo cual derivan una serie de preguntas para futuras investigaciones. Hasta ahora no se han encontrado evidencias de la presencia polinésica más al norte, pero una alternativa cierta fue el territorio Mapuche, hasta tan al sur como Chiloé. Eventualmente, esos mismos exploradores o sus descendientes pudieron seguir navegando hacia el norte hasta tierras tropicales, apoyados en la Corriente de Humboldt, donde habrían encontrado la papa dulce, y llevarla en su viaje de regreso a casa.

Las gallinas, así como los ratones del Pacífico, fueron trasladados intencionalmente por los polinesios en sus viajes. Si llegaron gallinas, con mayor razón podrían encontrarse restos de Rattus exulans en contextos arqueológicos del centro-sur de Chile. Se requiere evaluar el significado ecológico y cultural de la introducción de ambas especies.

Desde el punto de vista de materiales tales como las clavas y los toki, se requiere un renovado enfoque teórico metodológico, con el objeto de precisar con mayor rigurosidad las similitudes y diferencias, las particularidades locales y los detalles idiosincrásicos en ambos lados del Pacífico. Así como el ADN en material biológico, el análisis de la geoquímica de la piedra podría definir si se trata de materiales importados o producidos localmente, pero este segundo caso no descarta la posibilidad de que se haya logrado transmitir el modelo polinésico y no dejar el artefacto mismo, que era considerado un objeto sagrado que se transmitía de generación en generación. Si efectivamente los polinesios llegaron al sur de Chile, como parece comprobado, al parecer no se quedaron mucho tiempo. Volver a casa era parte de su estrategia de exploración y colonización, lo que obliga a buscar en Polinesia aquellos elementos culturales que pudieron llevarse desde el sur de Chile, así como se postula para el camote y su nombre en quechua, respeto del norte de Perú - Ecuador. Desde luego, habrá que discriminar qué navegantes polinesios pudieron estar involucrados en la aventura de llegar al sur de Chile, en un abanico de miles de kilómetros entre Nueva Zelanda y Rapa Nui.

Desde el punto de vista lingüístico, se requiere un análisis más detallado de una mayor cantidad de elementos. El análisis de los datos etnográficos y de las leyendas de la navegación es un tema que para los propios polinesios no reviste misterio, donde se recuerda al gran navegante Anua Matua, quien habría llegado mucho más al sur de América que Chiloé, desde su tierra madre en Mangareva.

Más allá de reconsiderar la leyenda como dato histórico, y del análisis refinado de la evidencia empírica, se requiere desarrollar un nuevo enfoque teórico metodológico que permita un mejor acercamiento a los cambios culturales en pequeña escala a través de algunos elementos propios de la cultura donante y receptora, tratar de reconocer las circunstancias del contacto y los cambios producidos a lo largo del tiempo. El primer paso es reconocer que la movilidad por vía marítima es mucho más eficiente de lo que se piensa habitualmente, y que las barreras son más bien mentales. En este sentido es que habrá que reconocer los esfuerzos de Thor Heyerdahl, aunque haya equivocado el rumbo.
Agradecimientos

Los primeros avances en la evaluación de esta hipótesis se realizaron con el apoyo de un proyecto Fondecyt (Ramírez 1990-91; 1992; 1994). Una segunda etapa de la investigación, orientada específicamente el problema de la gallina araucana, fue financiada por la Dirección de Investigación de la Universidad de Valparaíso (proyecto DIPUV 26-2005). Gracias a este proyecto, los huesos de gallina de El Arenal encontraron su camino al laboratorio de Lisa Matiess-Smith en la Universidad de Auckland, hasta las hábiles manos de Alice Storey, quien casualmente estaba trabajando en el ADN de gallinas en el Pacífico. Un especial agradecimiento a ellas, y al colega Daniel Quiroz, quien generosamente facilitó las muestras. Luego, mi reconocimiento a Gonzalo Figueroa García-Huidobro, Ruperto Vargas, Andrea Seelenfreund y Fernanda Falabella, y a mis generosos contactos transpacíficos: Ben Finney (Hawaii), Manahi Pakarati (ex consul de Chile en Nueva Zelanda), Roger Green y Geoffrey Irwin (University of Auckland), Roger Neich (Museum of Auckland), Rhys Richards (Wellington), Grace Hutton (curadora de las colecciones del Pacífico del Museo Te Papa Tongarewa de Wellington), y a la amistad de Hilary Scothorn y Filipe Tohi, de Auckland.

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Referencias


Cañas Pinochet, Alejandro 1901. Actas de la Sociedad Científica de Chile XI: 159-197.


Latcham, R. E. 1927. Las Relaciones Prehistóricas entre América y la Oceanía. La Información, Año 16 (122): 545 ss.


Schobinger, J. 1956/7. Sobre los antecedentes morfológicos de las clavas semilunares oceánico-americanas.
Runa VIII: 270-276.


Polynesians in the New World: The Chumash Connection and Beyond

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Abstract - Similarities in material culture, including sewn plank boat construction, compound bone fishhooks, and carved wooden bowls, compliment linguistic findings indicating at least one contact event between the Chumash and Gabrielino of southern California and Polynesian voyageurs. Oral traditions from Hawaii include an account of a voyage to America, while stories associated with the invention of sewn plank canoes among the Chumash allude to an intrusion from outsiders. Earlier estimates for the timing of this event between ca. cal AD 400 and 800 based on insecure proxy evidence are revised to cal AD 600-800 for a voyage that originated in Hawaii, although the possibility of an eastern Polynesian starting point cannot be ruled out. Strong similarities in the material culture of southern South America and the southern California coast, including compound bone fishhooks, barbed harpoons, and sewn plank boats compliment new linguistic findings that suggest yet another Polynesia-New World nexus.

Introduction

Two years ago Kathryn Klar and I presented linguistic (Klar and Jones 2005) and material (Jones and Klar 2005) evidence for a prehistoric contact event between Polynesian seafarers and Native societies of southern California (Chumash and Gabrielino). The possibility of such contact was actually raised at least as early as 1877 (Lang 1877) and was considered repeatedly by western North American anthropologists during the first half of the 20th century (see Kroeber 1939:44-45; Olson 1930:321; Walker 1951:61). By the end of the 20th century, however, the possibility of prehistoric Polynesian landfall in the New World had been largely deleted from the collective memory of American archaeology due to a rejection of diffusionary models in general (see Childe 1962) and trans-oceanic diffusion in particular (see Davies 1979). Also contributing to the dismissal of Polynesian diffusion as a possible influence on prehistoric American culture were declarations from certain highly influential American archaeologists that items of material culture that seemed to show Polynesian influence were simply products of independent invention and/or historical accidents that did not involve actual cultural contact (Heizer 1938, 1940, 1941a, 1944; Heizer and Massey 1953). About the same time, Thor Heyerdahl (1950, 1952) put forth his own case for Polynesian contacts with the New World. Heyerdahl was tremendously perceptive in recognizing possible signs of contact between Polynesians and North and South Americans, but his idea that contacts occurred as a result of Native Americans voyaging west from the New World was very poorly conceived; it was based partially on misinterpretation of archeological findings from Easter Island (see Suggs 1960), and he also ignored the Pacific linguistic record that clearly indicates an Old World origin for Polynesian languages. Because of these scholarly errors and because he generally sidestepped academia and brought his case directly to the public and mainstream media, Heyerdahl unintentionally contributed to the dismissal by academic archaeologists of Polynesian contact as a possible event in American prehistory. European scholars, however, always remained more positive about Heyerdahl’s hypothesis.

In 2005 when we brought the case for Polynesian contact with North America forward again, arguing for west-to-east voyaging, the idea had not been considered in any serious way by academics for many decades, and few American archaeologists seemed aware that this possibility had ever been considered before. Perhaps not surprisingly, we had an extraordinarily difficult time getting the piece published (see Davidson 2005) as the topic had become firmly established as taboo among North American scholars by this time (Kehoe 2003). The earlier cases for Polynesian contact were based exclusively on similarities in material culture. While politics and prejudices contributed significantly to the disappearance of the idea after the middle of the 20th century, it was also clear that similarities in material culture alone were unlikely to ever be accepted as unequivocal evidence for Polynesian contact. We revived the hypothesis in 2005 only because Klar discovered previously unrecognized linguistic evidence that provides a much needed supplement to the material evidence. Perhaps not surprisingly, the linguistic data include three words from two different Native southern California languages, one of which, tomolo (the Chumash word for their sewn plank boat) had been misinterpreted decades earlier by Heizer (1941b). While the corpus of material and linguistic data that suggests contact between Polynesians, the
Chumash, and Gabrielino remains modest, we feel that the newly available linguistic evidence complements the material similarities in such a way that it is hard to interpret the data sets in tandem as anything other than evidence for direct cultural contact. The alternatives to direct cultural contact are either:

1) independent invention and adaptive convergence (as suggested by Fagan [2003], Heizer and Massey [1953], and Gamble [2002]) or
2) a shared cultural tradition in southeast Asia at a significant time depth (perhaps ca. 20,000 years BP) from which the technologies and linguistic referents for them were carried independently by separate groups through Beringia into the New World, and to island southeast Asia, western Polynesia, and eventually, remote eastern Polynesia.

The linguistic component of our case is summarized by Kathryn Klar (this volume). The following is a summary of the material evidence for Polynesian contact including the original evidence discussed in 2005 and further findings made in subsequent years, particularly those that point to similar cultural contact and exchange of technologies in southernmost South America. The material evidence includes: the technique of sewn-plank boat manufacture, the hand-held adze used to make planks for these boats, details of the construction procedure, two-piece bone fishhooks, and composite harpoons. Variants of these technologies seem to have been exchanged between Polynesians and indigenous peoples of the New World both in North America (southern California), and southernmost South America (Chile). The chronologies of these contact events remain contentious (See Anderson 2006; Arnold 2007; Jones and Klar 2006), but we argue here that contact took place in North America sometime between cal. AD 400 and 800, and later in South America (after cal AD 1200). The South American case is taken up in more detail by José Miguel Ramirez in this volume.

**Sewn Plank Boat Construction: The Chumashan Tomolo and Gabrielino Tiat**

The item of technology that lies at the heart of the case for Polynesian contact in southern California is the sewn-plank canoe, referred to by Chumash speakers as the *tomolo* and by their neighbors to the south, the Gabrielino, as the *tiat*. The plank canoe was used by both groups for commerce between the Channel Islands and the mainland of southern California (Figure 1), and it has long been recognized as a uniquely sophisticated craft for prehistoric North America. The distinguishing feature of these boats was their woodwork which included hand-hewn planks, sewn together with cordage, and caulked with asphaltum sealer (Figure 2). Virtually every major European expedition to the Santa Barbara Channel produced a description of the Chumash plank canoe, beginning with Cabrillo in 1542 (Hudson and Blackburn 1979:341). The ethnographic record of the construction, use, maintenance, and the culture associated with the plank canoe is profuse due largely to the efforts of John Peabody Harrington, who collected information between 1913 and 1957 (Hudson et al. 1978:12-13). The information in Harrington’s unpublished notes on the canoe (nearly 3000 pages), later translated and synthesized by Hudson et al. (1978), and Hudson and Blackburn (1979:341-365), have rendered the plank canoe the most well-documented item of Chumash material culture. According to these notes, canoes were up to 25 feet long and could carry as many as a dozen people. They were used to fish, trade with the islands, carry passengers, and travel along the shore (Hudson et al. 1978:125). Within the Chumash cultural context, the *tomolo* represents the apex of technological sophistication, something which marks the Chumash people as distinct from other indigenous groups in California.

The Chumash and Gabrielino sewn-plank canoe is the only plank-built boat in Native North America. As noted most recently by Gamble 2002:303-304) and earlier by Heizer (1938, 1940, 1966) and Heizer and Massey (1953), all other indigenous North American watercraft were dug-outs, balsa/log rafts, or skin/bark canoes. Indeed, the only other example of a sewn-plank craft in the entire New World is the *dalca* (Figure 2) of the Gulf of Coronado in central Chile (Edwards 1962; Gamble 2002:302; Heizer 1938), which has long been considered a possible product of Polynesian contact (Steward and Faron 1959:277). Even the sophisticated maritime societies of northwestern North America sustained their sea-based economies with dug-out canoes (Jobson and Hildebrandt 1980; Olson 1927; Suttles 1990:8-9; Pilling 1978:152). When strakes or gunwales were added to the sides of these craft to increase freeboard, they were generally attached by mortising, not by sewing (de Laguna 1990:208). Based on detailed consideration of construction techniques, and dismissing the *dalca* as an inferior craft, one scholar (Cunningham 1989:1) argued that the Chumash *tomolo* was the only example of a true sewn-plank canoe in the entire Western Hemisphere.
While sewn-plank boat technology was extremely limited in the New World, it was employed throughout the Pacific including Polynesia, Micronesia, and Melanesia where it was associated with a wide range of craft - from large double-hulled sailing vessels to single-hulled fishing canoes (Haddon and Hornell 1975). The degree to which plank sewing was used varied according to the size of boats and the availability of trees (Johnstone

Figure 1. Location of Chumashan and Gabrielino language groups on the southern California coast.
Full plank construction was common on atolls and smaller islands where large trees were scarce, and canoe builders were frugal in their use of wood - they carefully split trees into planks that were sewn together rather than wastefully carving out the interior of an entire tree. Plank construction was well-documented in such wood-poor locations as Easter Island, Rapa, the Tuamotu archipelago, the Society, Caroline, and Gilbert Islands, and others. On islands with more luxuriant forests (e.g., Hawaii), the keels of boats were carved from solid logs and the sides were built up with planks added as gunwales and/or wash strakes. On the other hand, extreme conservation of wood in places like the Gilbert Islands resulted in maximal use of the plank-sewing technique creating the craft of “patches of wood,” rather than planks (Haddon and Hornell 1975:345). Despite its occurrence at only one location in Native North America, plank sewing was used throughout Oceania and clearly was a fundamental technological component of boat construction in all areas settled by Polynesians. Similarities between the Chumashan *tomolo* and the plank sewn watercraft of Polynesia have been previously acknowledged and summarily rejected (see Heizer 1938, 1940, 1941a) as an indication of cultural contact. Heizer argued that the use of cordage to bundle tules in the construction of balsa rafts could have readily led to the development of plank drilling and sewing. He also argued that there were enough differences between Polynesian, Chumashan, and Chilean plank sewn boats to suggest multiple independent inventions. Heizer and Massey (1953) associated the Chumashan plank canoe with a well-developed woodworking complex and argued that the sheltered waters of the Santa Barbara Channel “favored its development.” Outside of archaeology circles, Durham (1960:92-93) suggested an extra-North American origin for the plank canoe, probably in Micronesia or Polynesia, arguing that a wholly plank-built hull is a complex concept and technically difficult to construct. He also correctly noted that Chumashan canoes were "radically different from any neighboring American vessels" (Durham 1960:93). Another watercraft scholar, Cunningham (1989:75) noted that the Chumash *tomolo* was nearly identical to the outrigged hull of the Marshall Islands. Fagan (2004:114-119; 2004) has recently portrayed the plank canoe in nearly opposite terms, suggesting, like Heizer, that it was simply a logical progression from earlier boat and woodworking technologies. All of these arguments for indigenous development of plank-sewing in southern California were developed without linguistic evidence. As Klar summarizes (in this volume), there are three words used by the Gabrieleno and Chumash to refer to these boats in southern California that appear to derive from proto-Polynesian words for sewing, woodworking, and wood.

**Similarities in Construction Details and Tools**

Many details related to the process of constructing sewn plank boats and the tools used to build them show similarity between Polynesia and southern California (Haddon and Hornell 1975; Hudson and Blackburn 1982). Among the Chumash, logs were split into planks using bone wedges, and a hand-held adze which consisted of a wooden handle with an attached shell blade. Planks were also worked with shell or flake chisels, the edges of abalone shells, and sharkskin sandpaper. To effect the curving needed for some boards, steam was generated by excavating a pit, lining it with clay, starting a fire in the pit, adding water, and then the planks. Once they had soaked in hot water for a long time they were bent and shaped as needed. The sides of the craft were initially built up by gluing planks together (working from the bottom up) using a bonding material made of tar (asphaltum) and pine pitch. Once the lowermost planks were attached, they would sit for three days until the tar hardened. Because the hardening tar could not be exposed to direct sunlight, tule mats were placed on a wooden frame over the incipient craft while the seams dried. When the tar was set, holes would be drilled into the edges of planks using a stone trifacial drill (see Gamble 2002:309) and bone punch (Hudson et al. 1978:42). The boards were then sewn together using string made from a vegetable fiber and tar was applied with wooden caulking tools over the drill holes and to the seams as a final seal. This process was repeated for succeeding planks, slowly building up the sides of the craft, culminating with the placement of gunwale rounds.

Tools and techniques used in the construction of Polynesian sewn-plank boats are remarkably similar to those associated with the Chumashan *tomolo*. Foremost among these were hand-held adzes of nearly identical design (a short handle to which was lashed a blade) (Buck 1957:255) used as the primary tool to work planks. While adze
blades were commonly made of stone in most of Polynesia, in the Tuamotu group, they were made with pieces of giant clam shells which is very similar to the large Pismo clam (*Tivela stultorum*) shells used among the Chumash. Drilling of planks was done with bone drills in Polynesia and stone drills and bone punches among the Chumash. The Chumash had a well-developed biface technology and a long tradition of stone drilling, and it seems reasonable that they would have immediately adapted their superior technology to this aspect of
construction. In Polynesia, wood was finished with sandpaper derived from a plant source, while the Chumash used sharkskin for the same purpose. As among the Chumash, caulking in Polynesia was done with wooden caulking tools, although those of Hawaii were of a more complex design. Plank canoe construction in much of Polynesia was undertaken within a specially constructed canoe shed (Haddon and Hornell 1975:328) that protected the craft from the elements during its construction. This is very similar to a structure of mats and poles used by Chumash canoe builders for the same purpose and seem particularly striking as an unlikely case of independent invention.

Two-Piece Bone Fishhooks

The other item of material culture that we identified as similar in both style and function between southern California and Polynesia is a two-piece bone fishhook (Jones and Klar 2005). In both areas these hooks were used to troll for large pelagic species from the back of boats (Anell 1955:152; Reinman 1967:135; Salls 1988:134; Tartaglia 1976:99). Compound bone hooks of a relatively simple, non-Polynesian style were used off the southern California coast at least as early as 6000-5000 cal B.C. (King 1981), and were among the earliest fishing implements used in the northeastern Pacific. These early compound hooks were made from straight, slender, cylindrical, bi-pointed bone pieces that were attached to one another with asphaltum wrapped with cordage.

![Figure 3. Two-piece bone fishhook parts from the Pacific: a, b: archaeological specimens from the Chumashan area (King 1981:356); c, d: archaeological specimens from Hawaii (Emory et al. 1968: Plate 2); e: complete specimen collected by the George Vancouver expedition, now in the British Museum. Redrawn from Hudson and Blackburn (1979:181).](image-url)
The appearance of this Polynesian composite hook type sometime between AD 300 and 900 is nearly contemporaneous with archaeological evidence for the first use of sewn-plank canoes in the Santa Barbara Channel. Like the *tomolo*, this type of compound hook is absent from culture areas immediately north (Greenwood 1972; Jones and Ferneau 2002; Jones 2003) and south (Gallegos 2002) of the Chumash/Gabrielino region.

### The South American Connection: Plank Sewing, Two-Piece Fishhooks, and Composite Harpoons

As discussed by José Miguel Ramirez (in this volume and earlier Ramirez 1990), arguments for Polynesian contact in southernmost South America have an even longer history, owing largely to an even more abundant and compelling material record. Among the traits that were argued in the 19th century to represent Polynesian contact on the coast of Chile were circular shell fishhooks and plank-sewing (the Chilean *dalca*). These early arguments (e.g., Lang 1877) suggested that the presence of these items in pre-contact contexts both South America and southern California represented prehistoric diffusion from Polynesia. Here we resurrect that hypothesis, but focus on plank-sewing, two-piece bone fishhooks, and the composite harpoon. We do not mean to imply that there was direct cultural contact between Chile and southern California, but rather that two-piece hooks and sewn-plank boat construction may have diffused from a Polynesian complex to the New World via different routes at different times.

Of course, the case for contact in South America has also long included the distribution of the sweet potato (Yen 1974) and the occurrence of chickens in apparent pre-contact context on the coast of Chile (Carter 1971). Findings from the analysis of the DNA of the Chilean chickens reported by Storey *et al.* (2007) demonstrate almost unequivocally that Polynesians made landfall in southernmost South America. This new evidence makes it considerably more likely that the similarities in material culture also reflect cultural contact with Polynesia.

One of the most obvious but previously overlooked similarities between the material culture of Polynesia and coastal Chile is the same two-piece bone fishhook that occurs in southern California and Hawaii. Bennett and Bird (1949) illustrate clear examples of composite bone hooks from the north coast of Chile that are nearly identical to specimens from Hawaii. Their chronology and function, however, were not defined in this early publication, and we hope to investigate these implements and their dating more thoroughly in the future.

The Chilean *dalca*, the only South American watercraft constructed by plank-sewing, has also long been considered a possible artifact of Polynesian contact. The pre-contact *dalcas* were made from only three planks, and differ considerably from the *tomolo* and Polynesian sailing vessels. On its own, the *dalca* does not provide compelling evidence for contact, but its co-occurrence in the same general vicinity with two-piece bone hooks and chickens makes this possibility much more likely.

The final item of material culture that deserves some attention is the Chilean composite harpoon. The similarities between the Chilean and southern California composite harpoons are striking (Figure 4), particularly in the shape of their barbs- which are very similar to the complex pieces in Polynesian-style two-piece fishhooks. Composite harpoons are not uncommon along the shoreline of western Pacific, particularly on the Northwest coast of North America. It is possible that the technology arrived in Chile as a result of southern diffusion along the Pacific coast of the New World, but this would imply a relatively deep time depth for these implements in California. They appear in the southern California sequence, however, only during the Middle Period, sometime between cal AD 500 and 1000 (King 1981; Munns and Arnold 2002:131) along with the earliest canoe drills, and Polynesian-style two-piece hooks, although the chronology of the latter is less clear. The sequence suggests that a complex of maritime technologies including a new style of two-piece hook, the composite harpoon, and sewn-plank boats arrived together in southern California sometime between cal AD 500 and AD1000. The composite harpoon, however, does not occur in Hawaii which suggests that if this complex originated in Polynesia, it was from some other island group. Composite harpoons are known from the Marquesas (Roger Green, personal communication 2007) which might have been the ultimate point of origin for Polynesian-style material culture on the Chilean mainland. The items that make up this complex merit further systematic study.
Chronological Issues

Anderson (2006) and Arnold (2007) have challenged the case for Polynesian diffusion on the basis of chronology which has become a complicated issue in Polynesia due to new, and somewhat controversial, revised cultural chronologies (e.g., Hunt and Lipo 2006). With respect to possible contact with California, Kirch’s (2007) revision of the date for the initial settlement of Hawaii from cal AD 500 to “about” 800, based on evidence for fire in sediment cores, makes a difference for the diffusionary model. If California was reached from Hawaii, settlement of Hawaii must predate the appearance of Polynesian-style technologies and linguistic referents to those items in California. Arnold (2007) argues that the new Hawaiian chronology refutes the case for Polynesian contact in southern California stating that the *tomolo* appeared at cal AD 500. In point of fact, the chronological sequences that define the timing of these events are neither perfect nor universally agreed upon. For California, we (Jones and Klar 2005) relied on King’s cultural sequence for the Santa Barbara Channel which was originally completed in 1982, and was later revised and published (King 1990). However, the King sequence is not securely anchored in absolute time. King had few radiocarbon dates at his disposal in the late 1970s, many were not directly associated with graves, and the procedures employed to compensate for isotope fractionation and calibration of shell dates have never been clear. Some of these issues were resolved in the 1990 publication, but the age ranges of most phases and diagnostic artifacts must be considered approximations with ± factors of at least 100-200 years.

The best piece of evidence for the timing of the appearance of the *tomolo* in southern California is a dated canoe plank with a two sigma range between cal AD 600 and 700 (Gamble 2002). Among artifacts associated with canoe manufacture and use, there is questionable evidence for the occurrence of canoe drills as early as cal AD 400 but they are only confirmed after cal AD 700 (King 1981:357; Munns and Arnold 2002: 131) (Figure 5). Asphaltum plugs used to seal canoes date no earlier than cal AD 700 and Polynesian style two-piece bone hooks date to cal AD 900 but possibly as early as cal AD 700. Given the uncertainties in all of these dates, the contact event can be ascribed to a window between cal AD 400 and 800.

In South America, the revised chronology for Easter Island (Hunt and Lipo 2006), while controversial, is consistent with radiocarbon dating of chicken remains from the coast of Chile in suggesting relatively late appearance of Polynesians on the Island (c. cal AD 1200) and slightly later contact on the mainland of South America (c. cal AD 1300-1400). For now, it is reasonable to assume that the other material items were conveyed at the same time.
Discussion

The distances involved in Polynesian exploration and settlement of the Pacific (Table 1) indicate that they were more than capable of covering the expanses of open ocean that separate eastern Polynesia from the shores of the New World. Recent chemical analyses of the composition of stone adzes (Collerson and Weisler 2007) suggest that distant voyages may have been continued after initial colonization of islands. More importantly, chicken DNA findings from the coast of Chile (Storey et al. 2007) suggest almost unequivocally that Polynesians made landfall in southernmost South America. In light of this important empirical evidence, similarities in material culture that have in some cases been argued for more than a century to represent Polynesian contact need to be more seriously considered. Similarities in maritime technologies (sewn-plank boat construction, two-piece bone fishhooks) in particular between southern California and Chile, seem to reflect a complex that originated in central Polynesia and diffused to the New World via different routes at slightly different times (cal AD 400-800 to California and post cal AD 1200 to southernmost South America).

Table 1. Distances involved in Polynesian Voyaging.

<table>
<thead>
<tr>
<th>Passage</th>
<th>Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marquesas-Hawaii</td>
<td>3200</td>
</tr>
<tr>
<td>Marquesas—Easter Island</td>
<td>4040</td>
</tr>
<tr>
<td>Marquesas-Hawaii and Return</td>
<td>6400</td>
</tr>
<tr>
<td>Hawaii—Santa Barbara Channel</td>
<td>3360</td>
</tr>
<tr>
<td>Easter Island—South America</td>
<td>3160</td>
</tr>
</tbody>
</table>

Note

1For a more detailed consideration of the history of this hypothesis see paper by José Miguel Ramirez, this volume.
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References


Lang, J. D. 1877. Origin and Migrations of the Polynesian Nation. George Robertson, Sydney, Australia.


Linguistic Evidence for Prehistoric Polynesian-American Contact

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Abstract - A small but steadily increasing number of carefully-scrutinized lexical items suggests the occurrence of at least a few prehistoric contact events between Polynesian mariners and Native peoples of the west coasts of North and South America. In North America, the Southern California Chumashan *tomolo/o 'sewn-plank canoe' and the Gabrielino ti'at 'sewn-plank canoe' and tarayna 'boat' are best understood as being derived by borrowing from Central Eastern Polynesian sailing vocabulary. In Polynesia, kumara (and variants) 'sweet potato' is believed to have been borrowed from a coastal South American language, and toki 'basalt adze' may have been borrowed from Polynesia into South America. In this paper, I present two additional forms which support the contact hypothesis. From the Kawésqar (Alacaluf) group, who built sewn-plank canoes, Captain Robert Fitzroy (of Beagle fame) collected a form kiālu 'West Patagonian canoe;' this could plausibly derive from a Polynesian form ancestral to the modern Hawaiian compound kialoa 'long, swift, light canoe.' In addition, a possible shared word for 'harpoon' or 'spear' or 'ironwood' (the material from which the weapons were made) exists in Chumashan wïlï 'harpoon; ironwood'; Alacaluf (collected by Hyades) ou-léé 'spear, harpoon'; and Hawaiian wēlau, ēlau, 'spear point; tip, top, extremity' (Pukui and Elbert); Maori tavero 'lance longue' (Jaussen) and Tuamotuan vero 'to throw/hurl a spear/dart' (Stimson). Taken together with the archaeological evidence, these forms offer compelling support for prehistoric Polynesian-American contact.

Part I

North America

In two papers published in 2005 (Jones and Klar 2005, Klar and Jones 2005), my colleague Terry Jones and I presented linguistic and archaeological evidence which, when taken together, suggest strongly that there was at least one prehistoric contact event between Polynesian voyagers and Native Californians of two tribes, the Chumash (a linguistic isolate) and the Gabrielino (part of the Takic subgroup of the Uto-Aztecan). All of the assertions in Part I of this paper are thoroughly explicated in those two papers, especially Klar and Jones 2005, and readers are strongly urged to consult the technical papers if they have questions about any of the conclusions presented below.

Our linguistic evidence consisted of three lexical items related to boats—two in Gabrielino and one in Chumashan—which we believe were borrowed from a Central Eastern Polynesian antecessor language. Our data may be summarized as follows.

Central Chumash

<table>
<thead>
<tr>
<th>Dialect</th>
<th>Form(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventureño</td>
<td>tomol</td>
</tr>
<tr>
<td>Barbareño</td>
<td>tom'ol</td>
</tr>
<tr>
<td>Ineseño</td>
<td>tomol</td>
</tr>
<tr>
<td>Purisimeño</td>
<td>tomoł , tomoł</td>
</tr>
</tbody>
</table>

Island Chumash

tmolo, tomoł

As five of the six attested Modern Chumashan languages (i.e. all the Southern Chumash dialects) had cognate forms for ‘sewn plank canoe,’ we can reconstruct a common form.

Proto-Southern Chumash

*/tomolo'/ > *[tomolo'o]

This form is monomorphic in Chumashan; it cannot be analyzed into smaller meaningful units. That alone, regardless of its meaning, makes it unusual in Chumashan; forms of this length are almost without exception
made up of two, three, or more morphemes. In addition, the CVCVCV² shape of the word is very un-Chumashan. In a language with more than three dozen consonants and only six vowels, words tend to have complex consonant clusters, not strings of CV syllables. These anomalies suggest that the attested forms are reflexes of a proto-form which was not native to Chumashan, but borrowed from another language.³

But which language? Assiduous searching through records of languages whose speakers were known to have been in contact with Chumashan dialects in history and prehistory, namely Salinan, Yokuts, Uto-Aztecan, and numerous European languages, revealed no possible candidates as a source of borrowing from any language to the north, south, or east of the Chumashan range. To the west, the nearest languages were those of the Central Eastern Polynesian (CEP) groups. Linguists don't generally consider bodies of water, small or large, as barriers to contact. Mountains are much more likely to isolate one group from another. A search of those languages spoken to the west of the Chumash revealed a widespread compound which was certainly a part of the CEP canoe-building lexicon (a very large set of terms), and for which we could reconstruct a proto-form.

Hawaiian  kumulaa'au 'tree'
Tahitian  tumu raa'au 'arbre'
Marquesan  tumu 'akau 'arbre'
Rarotongan  tumu raakau 'stump, trunk, taproot'

Central Eastern Polynesian  */tumu raa'au/

This compound is formed of two widespread Polynesian bases, in their proto-forms *TUMU 'origin, base, summit' and *RA'AKAU 'wood, tree.' We have proposed that the word in its broadest sense meant 'tree, wood used for making useful objects.'

A CEP form */tumu raa'au/ would be immediately nativized by Chumashan speakers as */tomolo'o/ > *[tomolo']. Over intervening centuries, this form would develop by regular and well-attested processes into the variety of reflexes founds in the modern languages.⁴ In time, forms of tomolo' wood used to make canoe planks' came to be used as the name for the boat made with the planks itself.⁵ Historically recorded Chumashan speakers had two other referents for specific types of boats, 'axipeneš 'dugout canoe' and tomol 'ištapan 'tule reed boat'. Unlike the tomolo forms, both of these are formed of known Chumashan morphemes and well-understood morphophonemic processes.

We considered the possibility that Hawaiian sailors working on fur trade (and other) ships in the 18-19th centuries on the California coast could have been the source of the form, but two fundamental linguistic facts virtually rule out that scenario. First, Chumashan languages have a phoneme (and phone) /k/, and Chumashan speakers would not have borrowed the /k/ in kumulaa'au as /t/. The source had to be a language in which the well-known standard Hawaiian shift */t/ > /k/ had not occurred. While /t/ is used in rare, archaic contexts in Hawaiian, it is unlikely that an ordinary sailor would have used such a highly marked form as tumulaa'au. The normal pronunciation is and would have been kumulaa'au, and the Chumash would have borrowed it as */komolo'o/. This, obviously, did not happen. Second, and more importantly, even if the form had been borrowed from an archaic Hawaiian pronunciation in recent centuries, there simply would not have been time for the dialect forms as recorded after contact (see above) to have diverged so widely, nor for the word to have completely replaced an older Chumashan word (*/swax/ ~ */šwax/) (see Heizer 1952: 45) as the preferred lexical referent for 'boat'.

But the Chumash were not the only southern California group to make sewn-plank boats. Their immediate neighbors to the southeast, the Gabriéline, had the technology too. It seems to have always been assumed by scholars (we have found no evidence to the contrary) that this Uto-Aztecan group learned how to build these boats from the Chumash. But a look at Gabriéline lexicon suggests otherwise. The Gabriéline were relatively late arrivals at the coast; their Uto-Aztecan relatives were mainly inland and desert peoples, with no highly developed maritime tradition. (See Bright 1976) But the Gabriéline have two words for boat.

\[\text{ti'aat} \text{'sewn-plank canoe'} \]
\[\text{tarayna, taraynxa} \text{ '(any) boat'}\]

Like tomolo in Chumashan, these forms are anomalous in Uto-Aztecan. Neither is known in any form in any other Uto-Aztecan language, and both are unusual phonologically. However, they too can be easily derived from
two widespread Polynesian bases, *TIA ‘weave, sew; stake, post’ and *TALAI ‘hew, carve.’ The latter is the most widespread base found in Polynesian woodworking vocabulary, and reflexes of both *TIA and *TALAI are even more widespread in Polynesian than are those of *TUMU and *RA'AKAU. As the Chumash had done, the Gabrielino nativized their newly-acquired words in a series of well-understood processes internal to the language. The general word for ‘boat’ means ‘hewn or carved object’; a ‘plank canoe’ specifically is a ‘sewn object.’

The ultimate conclusions to be drawn from all this is that the plank-sewing technique came to the Chumash at a time when Northern and Southern Chumash had already separated from one another. Southern Chumash may already have gone some way toward diverging into Island and Central Chumash, but they were more like each other than they were at the time of European contact. (1000 to 1200 years is time enough to allow for the kind of dialect differentiation we observe in the Chumashan forms. The time depth between the English of Beowulf and the English of Jane Austen is approximately the same.) The Gabrielino learned plank-sewing directly from Polynesian mariners, at the same time as the Chumash. This implies that they were already living on the coast at the time of the contact event(s), though it is possible they had been there only a few generations and had not borrowed any boat or woodworking technology or accompanying lexicon from the Chumash. While the Chumash added one new item to their already rich native maritime lexicon, the Gabrielino acquired both of their attested forms from Polynesians along with the technology. There can be no doubt that this had profound implications for the subsequent cultural development and territorial spread of both groups.

Part II

South America

A linguistic case for pre-European contact, though not without controversy, has existed for decades. As Adelaar and Muyksen (2004) summarize it,

"[T]he search for such connections "has shown at the least two lexical items shared by Polynesian languages and languages in South America. One of them is the name of a plant domesticated in the New World, the sweet potato (Ipomoea batatas), Easter Island kumara, Hawaiian 'uala, which is found as k'umar or k'umara in Quechua and Aymara. The second word is toki, Easter Island 'stone axe', Mapuche 'stone axe', 'military chief (the holder of the axe)'; compare also Yurumangui totoki 'axe' (Jijón y Caamaño 1945). Although the former case constitutes near proof of incidental contact between inhabitants of the Andean region and the South Pacific, the latter is not nearly as convincing but certainly deserves attention. Apparently, there were sporadic contacts that led to an occasional interchange of words, not to migrations of entire populations that could have brought along their languages." (Adelaar and Muyksen 2004: 41).

More recently Scaglion has presented linguistic evidence suggesting that the contact involved in the sweet potato borrowing could have occurred in coastal Ecuador, among the Cañari people, east of the Gulf of Guayaquil, rather than in the Andean highlands (Scaglion 2005).

In addition to the sweet potato and stone club/axe, the sewn-plank canoe of southern coastal Chile, from approximately Chiloé Island to Tierra del Fuego, has long been noted for the similarity of its construction technique to both Polynesian boats and to the sewn-plank canoe of the Gabrielino and Chumash in Southern California. Known by the Mapudungun (Mapuche) word dalca (pronounced [θalka]), it has been described in the archaeological and ethnographic literature of South America since at least 1877 (Lang 1877). Latcham (1930) gives a detailed description of the construction techniques (planking and sewing) of the dalca. In a 1966 article, Robert Heizer summed up virtually everything that was known about American sewn-plank boats at that time.

The complexity and distribution of language families in Tierra del Fuego rivals that of California. Representatives of no fewer than four distinct linguistic stocks, Chon (= Chonan; includes Selk'nam, Haush, and Ona), Yahgan (= Yámana), Alacaluf (= Kawésqar), and Chono (= Aksanás) are spoken in the most southerly region of South America. The genetic linguistic relationship(s) between these groups, if there are any at recoverable time depths, are by no means settled, but are certainly ancient (Adelaar and Muyksen 2004: 550-55). The first three groups were identified by early observers as "canoe Indians;" i.e. they built boats and spent as much time on the water as on the land. The Chonan groups, on the other hand, were "land Indians," who did not
construct watercraft. Linguistic records are limited in each group's case, but are particularly sparse for the Alacaluf and almost non-existent for the Chono. (The latter, whose territory was immediately north of the Alacaluf, seemed to have used the Mapudungun (Mapuche) word *dalca for their canoe in modern times.)

However, on the Swedish Magellanic Expedition of 1908, Carl Skottsberg recorded a form (most probably Alacaluf, perhaps Chono) *kiālu for the 'West Patagonian canoe' (Cooper 1917:18). This is uncannily similar to the Hawaiian *kiāloa 'long, light, and swift canoe' (Pukui and Elbert:146). This Hawaiian form is composed of the same Polynesian base *TIΑ that we saw above in Gabrieliño ti’aat, and another common base *LOA 'long'. This resemblance of *kiālu and *kiāloa cannot be dismissed lightly; an explanation beyond mere coincidence of form must be sought. As in the Chumash/Gabrieliño situation, we have here in adjoining traditional territories separate linguistic groups constructing boats using the distinctive plank-sewing technique, and at least one of them has a lexical referent of possible Polynesian origin.

There is one further set of forms which may tie together all three areas—Eastern Polynesia, the Chilean coast and western Tierra del Fuego, and southern California. The Proto-Polynesian base *WELO 'thrust, as in spearing' turns up in widespread Polynesian languages, including Maori *wero 'stab, spear'; Tahitian *vero 'throw a spear, launch a canoe'; Marquesan *ve'o 'spear'; Tuamotuan *velo 'thrust, as in spearing'; Easter Island *bero 'throw, stab.' Hawaiian *elau, *welau 'short spear' (Pukui and Elbert) may belong to this group as well. Ventureño Chumash *wilē means 'ironwood; harpoon' (i.e. both the material object and the wood it is made of; compare *tomolo usage). In Mapudungun, Nguelehue (to be normalized as *ngwelewele) is *harpón' (Eriże), and an early attestation of Alacaluf gives ouē-lēē (normalized /welē/) 'spear, harpoon.' (Cooper 18). The relationship, if any, between these terms is not clear (though it is clearly not genetic), and the process leading to the historical distribution of the terms is no doubt complex, but the widespread occurrence of similar lexical items for a basic tool of maritime subsistence (spear, harpoon) is highly suggestive. Further investigation is in order.

Part III
General Conclusions

We believe that this assemblage of linguistic evidence, when taken alongside the archaeological evidence, provides a sufficiently compelling case to encourage further investigation into the hypothesis that ancient Polynesians and ancient Americans, north and south, made contact with each other, shared knowledge and technology, and left tangible traces of those meetings in their respective languages. In North America, Chumashan languages are well-attested almost from first European contact by numerous observers over more than 400 years (from Fages in 1769 to Beeler's field work with the last Barbareño Chumash speaker in the 1960s), and Chumashan grammar has received enough attention (though there is much more to do) to understand the language processes involved in the borrowing of lexical items from other sources. Gabrieliño, though less well-attested in the historical record, has the advantage of being a member of a large, well-studied family (Uto-Aztecan), so that we can explain the borrowing with a high degree of certainty. The languages of the canoe Indians of western Tierra del Fuego are, by comparison, poorly attested and little studied. Of Chono, we have almost nothing, and little hope of ever knowing more, barring the discovery of manuscript evidence in European or American archives. For Alacaluf, which the modern people call Kawesqar, our historical record is sparse, and there are few remaining native speakers. Our knowledge of the lexicon of archaic cultural items and practices will have to come solely from what the journals and observations of early European explorers preserve. Further north, along the Chilean coast, Mapudungun (Mapuche) is a promising area in which to look for solid linguistic evidence of prehistoric Polynesian-American contact. To date, no plausible Polynesian source form has been located for the term *dalca; it must continue to be regarded as an indigenous appellation, though from which language it originally came (Mapudungun? Chono? Alacaluf?) is unknown.

Notes

1 Readers who wish to consult the complete versions of these two lengthy papers will find links to them at the following website: http://www.cla.calpoly.edu/~tljones/. Unless otherwise noted, all Chumashan and Gabrieliño forms in this paper are taken from the field notes of John P. Harrington. Citations of reconstructed Polynesian bases are from POLLEX (see under Biggs and Clark 1994). Dictionary sources for all other Polynesian and American language citations are included in the References.

2 No form is recorded for Northern Chumash (Obispeño); however, as there is no evidence of sewn-plank canoes having existed north of Point Conception, this should not be surprising. The time depth of the split between
Northern and Southern Chumash is quite deep, and almost certainly predates the innovation of plank-sewing among Chumashan people.

3The case is a bit more nuanced than this implies. The reconstruction justified by the Chumashan forms as attested, */tomolo'/ > *[tomolo"], is slightly different than the first stage of nativization of a CEP form */tumu raa'au/ > proto-Chumash */tomolo'o/ > *[tomolo"]. As Chumash does not allow a string CVCVC(V), the last syllable would be pronounced as glottal stop plus echo vowel (normal in Chumashan). The echo vowel is non-distinctive, and speakers would certainly not have known whether it meant anything specific in Central Eastern Polynesian. In any case, the end product is the same, *[tomolo"], which form went on to develop into the modern reflexes. That this process had gone as far as it had (i.e. that the forms were so variable) implies a fair amount of time depth. The form was not borrowed in post-European times.

4One way to understand this is to think of an English word recently borrowed from another language, e.g. croissant. Native English speakers immediately nativize it by, among other things, replacing the French "uvular r" with a typical English "retroflex r" and pronouncing the final consonant cluster (-nt) rather than simply nasalizing the vowel in the final syllable. Even after this, the form, with its word-final stress accent, does not sound very "English," and speakers tend to move the stress onto the first syllable (a much more suitable location for stress in a Germanic language). Still, the word has a foreign feel to it, and cannot be analyzed by a linguistically naïve speaker of English into anything more than the referent for a type of particularly flaky and buttery pastry (where do you even put a syllable division? croiss-ant? croi-ssant? crois-sant?), though in French it clearly contains two morphemes. *tomolo'o would have sounded equally foreign to a Chumashan speaker's ear, and even after nativization, the long string of CVCVCV syllables and completely harmonized vowels (indicating no morpheme boundaries in Chumashan, despite its easy analyzability in Polynesian) would still sound "marked."

5This type of metonymy is common worldwide. Consider, for example, some of the many ways the word iron is used in English: An object made of iron used to smooth wrinkles out of cloth; a type of golf club whose head is made of iron; an object made of iron used to brand cattle; or fetters made of iron; a tablet containing iron used as a mineral supplement; even more abstractly, a stubborn—or determined—person has an iron will, literally a will made of iron. Mutatis mutandis, a tomolo is a canoe made of tomolo.

6The linguistic material in this part of the paper is new; this is the first time it has appeared in print

7The Chono lived on Chiloé Island, or at least the southern part of the island, on the west coast of Chile. They are not to be confused with the Chon (= Chonoan) groups. The latter occupied a large portion of eastern Tierra del Fuego. The two stocks are not generally thought to be related, but so little is known of Chono (of Chiloé) that a definitive statement is not possible. Mapudungun (Mapuche) is now spoken on Chiloé.

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References


Latcham, R. E. 1930. La dalca de Chiloé y los canales patagónicos. *Boletín del Museo Nacional* 13:63-72


Chapter 5

Western Pacific Archaeology and Anthropology
Archaeological Investigations of a Stone Platform at the Malaefono Plantation, ’Upolu, Samoa

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Abstract - During field work in 2005 our attention was drawn to an interesting prehistoric remain at the Malaefono organic plantation close to Salei’moa village on ’Upolu. Several stone platforms/stone heaps and remains have been reported removed due to farming activities during the last century, which indicated that the plantation area previously housed habitations. During 2006 we carried out archaeological investigations on a remaining stone platform in the area. This “star/cog” shaped platform, with eight protrusions was mapped and test excavated. The investigations showed its internal structure and its relation to other features and the surrounding landscape. The excavation also gave indications of settlement activities prior to the construction of the platform at this site. This paper presents the results of the investigation and discusses the star mound concept in general.

Introduction

Due to previous archaeological research of mounds in Samoa (Martinsson-Wallin 2007) and in connection to an educational exchange established in 2005 between the National University of Samoa (NUS) and Gotland University (HGo) in Sweden, our attention was drawn to an interesting prehistoric remain at the Malaefono organic plantation close to Salei’moa village on ’Upolu (Figure 1).

Figure 1. Map of Samoa with location of Malaefono plantation.
According to the land owners Richard and Suela Cook, the plantation area had previously housed habitation and several stone platforms / stone heaps and remains were reported removed due to farming activities during the last century. Adzes of various types have occasionally been found by the landowners. One of the adzes resembled a type V adze (Green and Davidson 1969), associated with the Lapita group’s tool kit. This adze could indicate an early settlement in the area. The plantation served as a copra plantation during the German era and it is now one of few free hold land areas in Samoa. In 2006 the first course in archaeology (HAR 100) was introduced by Dr. Helene Martinsson-Wallin at NUS in collaboration with Professor Asofou So’o at the Centre for Samoan Studies. As part of a field course, mapping and minor test-excavation was carried out at the stone platform at the Malaefono plantation. Mapping employed the use of digital techniques and GIS methods. This “star/cog” shaped platform, with eight protrusions was investigated to find out more about its temporal status, structural features, and relation to other features and the surrounding landscape. Another issue was to find out more about the function of star/cog mounds and discuss the classification of these types of structures. This paper presents the result of the investigation and discusses the star mound concept. The investigations were carried out during March 6th-17th. Field assistants were Fil. Mag. Ilse Vuisters and BA Joakim Wehlin from Gotland University, and a GIS-team from Easter Island (CONADI) carried out the mapping under the leadership of archaeologist Sonia Haoa Cardinale assisted by Petero Hey Ika and Tandy Shephard-Toomey. Students from within the HAR 100 course were Iosefa Percival, Momoe van Riche and Unasa Va’a.

**Star Mounds/Platforms**

At inland locations often distant from the present settlement areas, one of Samoa’s most discussed prehistoric remains are found; the star/cog mound or platform. These types of structures have been classified by archaeologist as “specialised sites” but it is not clear in what way they were specialised (Davidson 1974:228). The term star mound can be related to the large structure at Manono, which is known as the “star house” (Ibid). These types of structures have been indicated to be tied to the Samoan ritual sport known as pigeon-snaring (Herdrich 1991:381, 391). William B. Churchward (1971:139-141), British Consul to Samoa, made the following account in 1887:

"Pigeon catching is the oldest and most cherished sport in all Samoa, and until lately, partook much more of the nature of a fixed ceremony than a mere amusement. It was made the occasion for feasting and junketing in a high degree, and whilst it lasted all sorts of irregularities could be indulged in without comment."

The use and purpose of star mounds as burial mounds, residential structures, inland fortifications, territorial markers and sites for ritual divination are additional suggestions proposed by Herdrich (1991). One star mound was excavated at Luatuanu’u in ‘Upolu in 1967, which showed it to be a late feature built over an earlier habitation site, but not in it self associated to any settlement or burial (Peters 1969:216). Subsequent research (Holmer 1976; Frost 1978; Hewitt 1980:32, 41; Best et al. 1989; Kikuchi 1963) also refutes these type of structures as remains of habitation or burial sites. A recent investigation of a star mound in Tutuila, using ground penetration radar, suggests two building phases of this structure (Welch 2005).

Herdrich describes the star/cog mounds in the following way:

"to designate any mound that is composed of rock or earthen fill and which usually has a stone facing of anywhere from one to about 14 courses high. In addition, these mounds or ‘tia’ have projecting arms or rays that average about 3 m long and 3-4 m wide. “


Herdrich and Clark have subsequently made an additional definition; “any rock or earthen mound (tia) with one to 11 ray-like projections (‘ave)” (1993:53). Structural analyses by Herdrich have shown that they vary in shape but have similar location in the landscape. He has interpreted them in a symbolic way and suggests that their location, on ridges or mountain tops and in the inland bush, show a close proximity with the supernatural (1991:405). Herdrich further suggests that the variety in shape is due to the mythological god to, which the structure is tied (1991:409).

According to Davidson (1974:227) there were 27 star mounds reported on ‘Upolu but subsequent surveys have located over 50 such sites (Clark 1996:453). Eight star mounds are reported on Savai’i, three on Ta’u and one on Manono. The star mound on Manono with its large dimensions (30.5x30 m) and twelve arms has been referred to as the “star house” (Davidson 1974:228). Around 80 star mounds (tia ‘ave) have been reported from Tutuila.
(Clark 1996:453). Excavations in Samoa by teams of both Green and Jenning indicated this type of feature to be dated to the last 300 years and sometimes built on older habitation sites (Peters 1969:221; Holmer 1976:25; Hewitt 1980:41). In Tutuila and Ta’u they are also interpreted as late features (Herdrich 1991:390; Clark 1996:453).

Mound building is suggested to have been introduced in Samoa from c. AD 1100 (Martinsson-Wallin 2007, Clark and Martinsson-Wallin 2007; Davidson 1974), but the star or cog mound/platforms seems to be tied to the last 300 years. The prehistoric settlement pattern visible on the landscape at inland locations, as the settlements in the Palauli district in Savai’i and in the Falefa Valley in ‘Upolu, includes remains from a more than 1000 year old tradition. This settlement pattern changed during the contact period when settlements were all moved to the coast (Davidson 1979, Jennings et al. 1982), but the appearance of star or cog mounds/platforms might indicate a change in the settlement pattern and utilisation of the landscape just prior to the contact period.

The Malaefono Platform

On the NW part of ‘Upolu close to the village of Sale’imoa an organic plantation and modern quarry site is situated (Figure 1). The plantation is located c. 1 km inland and stretches a couple of km’s uphill in a moderate elevated terrain. At the south, upper part of the plantation a basalt quarry is situated. Just N of the entrance to the plantation large river boulders with grinding grooves (foaga and ma’a tui ‘ava) are found close to a water reservoir and river (Figure 2).

On the far S end of the plantation site, close to the currently operated quarry site a star/cog shaped platform is situated (Figure 3). The platform measures c. 26 x 22 m and has eight protrusions/”arms” (Figure 4). It is located on a gentle slope and since the top is levelled the height differs from 50 cm on the W side to 130 cm on the E side. A steeper slope is situated c.10-15 m to the E of the mound. Here the landscape indicated that a stream was flowing in the past. Since the structure is on elevated grounds it is very likely that prior to the plantation era there was clear view down to the ocean.
Figure 3. Overview of Malaefono platform.

Figure 4. Plan view of Malaefono platform, with trenches 1-3 indicated.
The outer visible wall is made up of volcanic vesicular basalt stones (15-50 cm in diameter). The stones in the protrusions are generally of smaller size. The eight protrusions and notches have slightly different shape Notch A (NNW) and E (SSE) are probably two entrance ways to the platform (Figure 4). In the cleared area on the W side of the mound, a few stone lines and heaps of stones were visible. We were also told that many stone platforms had been taken away during cultivation of the plantation and we were also shown a number of adzes that had been found on various occasions. It is obvious that the area once had a prehistoric settlement, but today most of the sites are destroyed due to subsequent development of the land.

**The Excavation**

Three test trenches were excavated, two next to the outer perimeter of the platform and one in the top of the platform (Figure 4). The two former were excavated to investigate the foundation and entrance way of the structure as well as to understand the stratigraphy below the platform. The latter investigated the composition of the platform and possible cultural remains below the platform. Trench 1 was outlined in notch A, which could be an entrance way with a small step similar to notch E on the opposite side of the structure (Figure 5). At a depth of 10 cm in trench 1 scattered stones, 5-10 cm in diameter and four larger stones (largest 30x20cm in size) placed in a row in line with the outer boarder of the protrusions, were found (Figure 6). This was interpreted as an entrance way/walkway similar to the one visible in notch E but partly disrupted by the roots of a palm tree.

Trench 2, was outlined next to the platform wall on the W side of the mound. The platform foundation stones were found c. 20-25 cm under the ground surface. A feature which contained dark brown soil, charcoal and red sandy soil was detected below the foundation at a depth of 55 cm from the ground surface (Figure 7). This feature can be clearly seen in the section of the trench and situated below the platform (Figure 8). Only a small part of the feature was excavated since it continued to the E under the platform and its original size and shape could only be estimated to be a rounded feature c. 120 cm at the top and the 60 cm at the bottom. The feature was c. 70 cm deep and the bowl shaped bottom was found at a depth of 125 cm from the ground surface of the feature. At 20 cm depth it contained charcoal, very red and sandy soil and stones 10-20 cm in diameter, which is clearly visible in the section. At the bottom of the feature burnt stones, 5-7 cm in diameter, were found. Charcoal samples were collected from the feature which yielded a date of 410±41 BP (Wk-20154), and calibrated using OxCal v. 3.10 to AD 1420-1640 (Cal. at 2 sigma).
Figure 6. Trench 1 with row of stones.

Figure 7. Trench 2 with feature.
Trench 3 was outlined on the top of the platform just west of the mid line (Figures 4 & 9). The platform was shown to be constructed in the following way: a pavement of smaller stones c. 10 cm was placed on the top and below this was c. 5 cm layer of soil; below the soil was a c. 65 cm layer of larger stones of vesicular basalt that rested on a 20 cm thick layer of sandy soil. Below this was a c. 20 cm layer of brown soil which rested on top of bedrock. Charcoal was found in the brown soil under the platform and a sample yielded a date of 436±41 BP (Wk-20155), which was calibrated using OxCal v. 3.10, to AD 1410-1630 (Cal. at 2 sigma).

The layers found in trench 3 are shown in table 1. The excavation indicated that the platform was constructed on top of an area previously used as a habitation area or indicated other human activities. A few adzes were collected in the vicinity when the platform was cleared.

Table 1. The stratigraphy of Trench 3.

<table>
<thead>
<tr>
<th>Depth (cm b.s)</th>
<th>Layer description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>Small stones ((1-20 cm) and some of the larger stones below were visible</td>
</tr>
<tr>
<td>11-15</td>
<td>Sandy Soil</td>
</tr>
<tr>
<td>16-80</td>
<td>Stone construction containing massive vesicular stones</td>
</tr>
<tr>
<td>81-100</td>
<td>Sandy Soil</td>
</tr>
<tr>
<td>101-125</td>
<td>Brown soil</td>
</tr>
<tr>
<td>126-150</td>
<td>Sandy Soil</td>
</tr>
<tr>
<td>151-</td>
<td>Bedrock</td>
</tr>
</tbody>
</table>

Figure 8. Drawing of East and South section of feature in Trench 2.
Interpretation and Comparative Analysis

The platform at Malaefono plantation could be tied to the star mound concept (tia seu lupe), but the name Malaefono could also indicate this as a council platform for the chiefs. However, the origin of the name is not known. Issues about relationship between the natural environment, settlement pattern, cultural symbolism, and mindscape are to be considered, when analysing and discussing the star/cog mound concept found in the Samoan landscape. Hunt and Kirch (1988:179) suggest that these star mounds were “monumental symbols… associated with powerful political groups”. These structures are mainly found in independent Samoa and Tonga but are apparently absent in the American Samoan Manu’a Islands, which have bearing on the late socio-political system on these islands. If these structures have been of socio-political importance it is also interesting to investigate their context and consider the stone paving and heaps to the east of the platform at Malaefono. It is likely that the platform once formed part of a complex with a paved walk way running to it. In a structural sense it resembles the (cog) star mound and surrounding complex at Mount Olo (Hewitt 1980:40). At this site, settlement activities were also found below the mound but dated to c. AD 1100 (Ibid).

The two dated charcoal samples found below Malaefono platform were judged to derive from one and the same cultural activity. Even if the charcoal samples do not derive from the same feature as such, according to rigid chronometric hygiene, should be refuted, we accept them due to their stratigraphic context. The dated samples show contemporaneity and this cultural activity was taken place prior to the building of the platform. The Malaefono platform was probably built after the 16th century. This date fits well the previous research and dating of star/cog mounds or platforms (Davidson 1974, Hewitt 1980, Herdrich and Clark 1993, Clark 1996). The function of these types of platforms or mounds is not totally clear. According to Herdrich and Clark (1993:56) it is likely that they had a ritual function including pigeon-snaring.

Ethno-historic accounts indicate pigeon snaring/hunting as a popular ”sport” which, according to Scott (1969), had ritual or ceremonial significance. Pritchard (1866), Buck (1930) Krämer (1995), also mentions tia as mound or cleared area and tia seu lupe as pigeon catching mound. The pigeon snaring seems to have been of great

Figure 9. Trench 3 indicating the fill of the platform.
importance in Samoa at least during the contact time. According to Krämer (1995:385-388) there were several kinds of pigeon hunting. The hunting ground was walled *tia*, which was a cleared wooded area surrounded by the various leaf huts (*faleseu*) (Ibid:386). There are no direct written accounts of built up mounds in regard to the pigeon hunting, but it is mentioned that the *ofo* was the elevated part of the hunting ground *tia* (Ibid:386). Even though previous researchers refer to local workers telling stories of pigeon snaring on the site, only one star-like mound is ethno-historically linked with that activity, according to Davidson (1974:205). Buck (1930), states that the *tia* were permanent structures, but pigeon hunting have been reported as a seasonal activity (Krämer 1995, Turner 1884:127). Events like this called upon full resources of the village and the whole population moved into the bush for a long time, maybe months. If a whole community moved in to the forest and close by the star mound it should apparently show some evidence in the archaeological record. The surrounding features including walkways and pavements could indicate the area had been used for longer visits of larger group. The inland as a ritual/religious area has recently been discussed by Wallin and Martinsson-Wallin (2007) and Wehlin (2006) based on research of the Letolo settlement (Pulemelei site) in Savai‘i.

Traditional history, ethno-historical accounts and similarities in material culture show a cultural and historical link between islands in the Samoan and Tongan archipelagos. Comparative analyses of pigeon catching and mound structures show that pigeon catching mounds are a quite common in Tonga, but not in form of a star. Apart from obvious morphological differences, pigeon snaring/hunting structures have been built in both areas. One feature, access ways, found at the Malaefono platform have also been found at star mounds on Tutuala (Herdrich and Clark 1993:53). Structures excavated in Tonga have access ramps located in the NW and SE corners (Burley 1996:427). This pattern conforms, according to Burley (1996:432), to the expected flight path of a migration flock of pigeons.

When studying the star mounds/platforms the traditional and ethno-historical accounts indicated that the landscape as a ritual place is important to consider (Olsen 1997; Wallin and Martinsson-Wallin 2007). The forest and inland area could have been seen as a domain for the supernatural or for ritual purposes. According to Herdrich (1991) Samoan mythology clearly supports the association of *aitu* (ghost or spirit) with the pigeon-catching mounds and the location place them in context with the supernatural. The most common star mound seems to have eight protrusions or rays, an important number in Polynesian cosmology in general. The god *Sa Tangaloa* is sometimes described as having eight livers and it is easy to refer to the well known traditional octopus (*fe‘e*) with eight arms in the Samoan culture. The tale of the octopus who was the war god of A’ana ‘Upolu and built the house of the octopus (*O le fale-o-le-fe‘e*), could be a deity who assisted the hunters in their attempts to catch the pigeons (Herdrich 1991:410-414). The investigated structure at Sale’imoa with its eight protrusions indicates a star/cog mound, but the level top and the name Malaefono indicate that the structure could be a council platform.

### Summary

A platform c. 26x22 m in size and c. 65 cm high platform with eight protrusions was excavated at the Malaefono plantation at Sali’emoa on ‘Upolu. The investigation was carried out as field school for the HAR 100 class at NUS 2006. The purpose of the excavation was to investigate its morphology, age and possible function. The investigation showed that there were two entrance/access ways to the structure. It also showed that the top was paved with smaller stones and that the platform was made up of larger stones of vesicular basalt, which rested on a layer of sandy soil. Below this was a horizon which showed remains of human activities in the form of a dug down feature and remains of charcoal. These activities were dated within a range c. AD 1410-1640 and were obviously remains from activities prior to the building of the platform. Comparative analyses indicated structural similarities with a star/cog mound at Mt. Olo on ‘Upolu. The star/cog mound or platforms have been associated with pigeon caching, which is indicated to have had ritual connotations. Structures tied to pigeon snaring, however with morphological differences, are found both in the Samoan and Tongan archipelagos. Excavations of such structures indicate them generally to be prevailing during the last 300 years. As such they seem to be an addition to a settlement pattern prevailing for c. 1000 years and probably indicate changes in the settlement pattern just prior to the contact period.
Acknowledgements

Many thanks to the owner of the Malaefono plantation Richard and Suela Cook and their workers with foreman Frank in particular. The Rapanui GIS team Petero Hey Ika and Tandy Shephard-Toomey led by Sonia Haoa Cardinale. Special thanks also to assistant in field MA Ilse Vuijsters.

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References


The Tell-Tale Adze: Connecting Samoan Basalt Adzes to the Investigation of Political Complexity

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Abstract - Stone adzes are integral to investigating cultural changes within Polynesian societies due to their archaeological durability and the vital roles they held in subsistence practices. This paper delves into how adze studies can offer insights into larger socio-political changes by examining adze production and distribution during the Traditional Period in prehistoric Samoa. During this period, there was a marked increase in the quantity of adze production recorded on Tutuila Island, and a geographic expansion in the distribution of these adzes into the larger Fiji-West Polynesian region. As these transformations manifested themselves together in a certain period of time, crucial questions need to be raised; 1) how do we quantify these increases, and 2) what mechanisms, cultural or otherwise, were responsible. I propose that these increases are interrelated and a result of coeval expansion in political control exercised over production labor for wealth accumulation at the expense of kin relationships.

Introduction

This paper focuses on documenting the organization of Samoan adze production and its relationship to the archipelago’s emergent political complexity during the Traditional Samoan Period, dating from 1700 to 300 years ago. Prior archaeological research has documented the presence of adze specialists in ancient Samoa (Ayres and Eisler 1987; Green 1974; Leach and Witter 1987, 1990) however, this work has left unaddressed the questions of which type of specialists was present as well as what their impact was on prehistoric Samoa society. In evaluating these questions, I utilize data I collected at numerous adze manufacturing loci from around Tutuila Island, American Samoa (Figure 1).

Figure 1. A map of Tutuila showing locations mentioned in text.
As a research locale, Tutuila was chosen for three primary reasons. Within Fiji-West Polynesia, tool-quality basalt was unevenly distributed due to the islands’ unique volcanic histories; and as a result, Tutuila is one of a few locales with large quantities of high-quality basalt (Best et al. 1992; Clark et al. 1997; Di Piazza and Pearthree 2001; Johnson et al. 2007; Winterhoff et al. 2007). Although little evidence of production has been recorded elsewhere in the Samoan Archipelago (Green 1974:266), archaeologists have documented close to a dozen production loci all around the island, some of which are quite expansive, just like Tataga Matau (Winterhoff 2007). Tutuilan adzes have been recovered from surrounding island groups such as the southern Cooks, Fiji, Tonga, Tokelau, Phoenix and Santa Cruz, which emphasizes the importance of Tutuilan adze production to understanding larger regional exchange networks.

Craft specialization is well known for historic Samoa. Ample evidence documents the important position held by guilds and craftsmen in Samoa’s political structure (Goldman 1970). Defined as an arena of heterogeneous and hierarchical status by Tcherkezoff (2000), Samoa’s traditional leadership system also included the position, tufuga, a specialist who could exact payment for their services. Documenting the presence of stone tool specialists in Samoa started early on with the observations of an early missionary, John Stair, in 1897. Part of his documentation on Samoan lifeways included a list of tufuga, in which he noted “maker of stone hatchets”. Regrettably, his list is the only direct historical documentation linking adze manufacture with specialists, because later materially-oriented ethnographers, Krämer (1902) and Buck (1930), failed to corroborate his observations. This could reflect that Reverend Stair had made a recording mistake or he had inadvertently witnessed the tail end of a rapid technical shift towards more efficient metal tools and Western traders.

Over the last three decades, archaeologists have weighed in on whether adze specialists had been present in prehistoric Samoa. Based on the ethnographic work on various tufuga guilds, Roger Green took the stance that specialists were present for manufacturing high-quality adzes used by master carpenters based on his review of assemblages recovered from habitation sites in Western Samoa and museum collections (Green 1974). Helen Leach and Dan Witter argued for the presence of specialists based on their systematic research of the famous Tataga Matau quarry (1987, 1990). At the quarry, they documented large quantities of debris, finely-made adze preforms, and defensive features. Ultimately, they championed the site’s uniqueness as the only Samoan export locale for basalt adzes and the only location where specialists were present (1990). However with further survey, William Ayres, Jeffery Clark and David Herdrich contradicted the uniqueness of Tataga Matau’s position by providing additional evidence of specialized stone tool manufacture occurring elsewhere on Tutuila by citing extensive debitage assemblages at sites in Alega, Maloata, Fagasa, Tula and Le’aeno Valleys (Ayres and Eisler 1987; Clark 1993; Clark et al. 1997). However astute, this prior research was mainly concerned with only a yes or no answer, and has not addressed the vacuum in our understanding of the organization of adze manufacture and its relationship to larger socio-political processes.

**Adze Production Organization on Tutuila Island**

To properly investigate the organization of craft specialization, it is necessary to first define the form or forms of specialization present. To accomplish this, I draw upon the insightful research of Cathy Costin (1986, 1991), Robin Torrence (1986) and Timothy Earle (1989, 1996, 1997) and their work on documenting variation in craft production and address the Tutuilan situation by utilizing a set of four parameters; (1) who controls production, (2) the density of production loci, (3) the amount of a producer’s work-load, and (4) the facilities where production occurred (Figure 2).

The first parameter, control, relates to the nature of who benefits from a producer’s labor, the producer or the community’s leader and what was the motivation for the production increases recorded in the Traditional Period. If a community leader was in control over adze production then attached specialists would have manufactured products for the purposes of wealth accumulation. In response to that control, attached specialists would work close to restrictive features such as administrative or defensible positions; while manufacturing sites themselves would be larger, so leaders could benefit by merging their controlled labor into one easily restrictive locale. If the individual producers were in control, then adze production was performed to supplement their horticultural income. These independent producers would have not spent the same amount of energies a leader would have, so they could focus on maximizing their own production. In their efficiency, an independent producer would have mainly utilized small and interspersed manufacturing sites close to the available resources.
Based on examination of 16 different production loci around Tutuila, both forms, attached and independent, seem to be present during the Traditional Period, as witnessed in the comparison of settlement patterns in the Malaeola Valley and the Fagamalo Valley (Figure 3). The loci that have dispersed household units without any restrictive features present are found in Afao, Fatu ma Futi (Addison et al. 2006) and ‘Aoa (Clark and Michlovic 1996). These valleys have small ‘independent’ manufacturing households located within the valley floor. Examples of attached workshops located in either peripheral locations or near defensive features are Tataga-Matau, Le’aeno, Malaeola, Fagasa and Tula.

The second parameter, density, consists of the relative concentration of craft production occurring in a particular society. Relating to control and resource availability, production can either be nucleated within a specific locale or dispersed over an entire region. The loci density of adze manufacturing shows dispersed production occurring throughout Tutuila in the Traditional Period. But, if you expand the lens to the societal level, then there is a marked concentration in only Tutuila – with only three additional production loci recorded elsewhere in the archipelago: Mt Vaea in Upolu and two in Manu’a (Best et al. 1992:58; Weisler 1993). Although researchers have not examined the two large western islands of the Archipelago specifically for adze manufacturing, a number of multi-year field projects in the 1960s and 70s failed to encounter any significant amount of flaking debris (Green and Davidson 1969, 1974; Jennings and Homer 1980). I propose that this lack of evidence is not a product of sampling, but in fact, an issue of resource availability. The wide prehistoric distribution of adzes from Tutuila also attests to the quality of its basalt and desirability of these products (Best et al. 1992). Based on this data, Samoan adze production was nucleated.

The third parameter, work-load, describes the amount of energy expended by a producer on their craft: part-time or full-time. Ultimately this parameter is the most difficult to quantify, because a producer’s intensity can be

![Figure 2. Diagrams of the four organizational parameters in production labor.](image-url)
low but sustained over a long period of time or high for a short period, and the resultant assemblage would look relatively the same. Thus, this problem of quantification requires a contextually-based approach. In an effort to create a quantifiable measure for Tutuila production, intensity is examined according to the “density of manufacture”. This was accomplished by dividing the total weight of debitage recovered by the cubic meter of culturally positive soil that was removed to uncover it (Figure 4).

Differing densities show that there is marked variation among production loci, such as between sites in ‘Aoa and Malaeloa. There are issues with sampling, such as at Tataga-Matau where only a portion of the lithic debris was analyzed; nevertheless, a strong pattern still emerges. In addition, there are related data to take into account to determine the work-load of Samoan adze specialists, such as skill levels, scheduling, and risk (Costin 1991). First, the flaking skills recorded in adze manufacture during the Traditional period are the same as earlier periods, and do not change except for the magnitude. Next, Samoan subsistence practices provided ample sustenance with a low demand of labor compared to other Polynesian societies (Goldman 1970:246). Based on the summation of early missionaries and ethnographers, “[Samoa’s] rich soil is so easily cultivated that the small amount of labor usually bestowed upon it, simply scratching the surface, is quickly rewarded…” (Stair 1897:53). With these low demands for subsistence, individuals could have easily supplemented their livelihood with adze production. The risk a specialist accrues when relying on adze manufacture as their sole form of livelihood is connected to the consumption rates of their commodities. Even though households required these tools for a range of activities, adzes were wood-working tools required for home and canoe construction as well as land clearance. But, what frequency would individuals have needed them for daily or even seasonal activities?

Figure 4. The production density of Tutuila’s lithic assemblages calculated per valley.
Coming to a concrete answer is beyond the scope of this present study, but I suggest that adze consumption would have been low locally, except for wood-working craftsmen. Thus, the shallow pool of repeat consumers as well as limited skill level would have made this activity a particularly risky full-time venture.

The last parameter, facility, looks at the type of production units located in a particular community. This parameter measures production organization at the local level. By determining if production units were associated with households or workshops, conclusions can be drawn based on a units’ internal composition, its overall size and the amount of debris being produced. On Tutuila, both forms are present during the Traditional Period (Figure 5). In the Afa Valley, an example of household production is recorded at the Afa Terrace, where two prehistoric house structures and light lithic scatters are recorded on the same terrace construction. I recorded a total of 63 kg of debris composed mainly of small tertiary flakes. Based on the amount and type of debitage recovered, the manufacturing activities were small scale, probably consisting of either tool rejuvenation or final flaking of a few pre-forms. In the Malaeloa Valley, I located numerous workshops during survey. These specially-created terraces contained dense flake scatters and few or no residential features. For example, the Frog Terraces contained 49.5 kg of lithic debris composed of a variety of flake sizes and stages representing substantial preform production. In looking at the rest of the sites across Tutuila, there are other communities with lithic workshops present. These are located throughout Tutuila at Tataga Matau, at sites in the Tula, Vaipito, Fagasa valleys (Williams 1993) and at Pavaiai. Although not surveyed for this project, two other communities, based on their locations and proposed production frequencies, also contain adze workshops; Le’aeno (Clark et al. 1997) and Alega (Clark 1993) in Eastern Tutuila.

Compiling the results together, I assert that during the Traditional Period, there are two forms of specialization occurring simultaneously on Tutuila Island. This variation could muddle interpretations, unless one remembers what Roger Green said over thirty years ago - basically all adzes were not created equally (1974:254-255). In Samoa, adzes were employed as both utilitarian items for subsistence and wealth generating goods by craftsman guilds (Earle 1997). For utilitarian adzes, individual production was conducted by part-time independent producers at dispersed households for intra-valley distribution. Examples of this situation are recorded at Auto, Tula, Alega, Fagamalo, Pavaiai, Afao, Asili, Vaipito and Fatu ma Futi. For guild adzes, nucleated workshops were organized by master craftsmen or elites for wider distribution for the purposes of wealth accumulation. Attached specialists worked part-time at centralized workshops, similar in structure to historic accounts of tufuga guilds. Examples include Le’aeno, Fagasa, Malaeloa and Maloata. As I have discussed evidence for elite control over labor in Samoan adze production, the next question I ask is if the influence of leaders ended at only labor or were there other strategies employed to gain additional surplus for prestige competition.

**Discussion and Conclusions**

Identifying the type of production organization in Samoa was the first step; the second is investigating the relationship of adze production to the prehistoric political system. I propose that the presence of specialized workshops or guilds derived from the expanding political control exercised by leaders over specialized labor, where the control resulted in the accumulation of personal prestige at the expense of kin relationships. As social
power in a system draws upon the amounts of resources at a leader’s disposal, leaders could draw upon a number of different avenues of power relating to adze specialists. First, basalt adzes were manufactured from geological sources unevenly dispersed across communities where, particular leaders could have benefited by restricting access to said resources. Second, basalt adzes were distributed outside of Samoa, where trading for prestige items would have placed beneficiaries in a higher standing due to their control over land or labor. Third, secondary connections to chiefly power can be found in the specialized basalt adzes and chisels that were utilized by other specialists for the production of high status items like guesthouses, sculpture, and canoes.

A view of basalt adzes as a legitimate commodity for prestige competitions calls into question an intriguing ethnohistoric observation that Tutuila was the least politically important island in the Samoan archipelago. Although Tutuila was able to create substantial surplus in respect to adze production, the island did not hold sizable political status at Western contact. In fact, Krämer in 1902 stated that the island held no great titles and was ultimately subservient to chiefs on ‘Upolu. Originally, I assumed that this may have been a recent situation exasperated by European and American powers, but from numerous conversations with local chiefs from around Tutuila, I have found this view to be corroborated by their oral traditions. I propose a diachronic and economic explanation centered on chiefly strategies to explain the ethnohistoric situation by outlining the prehistoric connection to adze production and social status over time (Figure 6).

![Figure 6](image)

Figure 6. A graphic illustration relating adze production to the emergence of elites on Tutuila.

Beginning in the Polynesian Plainware period, 2500 to 1700 years ago, and lasting through a portion of the Traditional Period, the island of Tutuila was a production locale for mainly local, but also limited archipelago-wide distribution. Prior to 1000 years ago, I propose that Tutuilan chiefs transported finished adzes to relatives located on other islands in a manner similar to general reciprocity, or allowing visiting relatives to have direct access to the raw material. Then afterwards, the social realm began to change in Samoa, high levels of prestige competition and their material manifestations started to occur (Davidson 1979). In response to the increasing political demands, kin obligations lessened within the archipelago as Tutuila’s elites started to accumulate material wealth. Residing in a geologically rich island, Tutuilan chiefs began to restrict access and demand payment for their products witnessed by the dramatic increases in production and resource control at communities around Tutuila, like Tataga Matau, Malaeloa, Le’aeno and Lau’agae. During this time, Tutuila became famous by being able to monopolize high quality wood working tools used as status items; however, this relationship dramatically changed at Western contact, when European traders and goods entered into these exchanges (Green 1974:254). Although, Samoa was sighted early in the exploration of the Pacific, a more intensive interaction was delayed by the local massacre of a French crew (Dunmore 1994). As a result, Samoa, most particularly Tutuila, stagnated in a growing regional exchange of western trade goods for roughly 100 years. Regional exchange continued during this period, but instead of acquiring Tutuila’s high quality basalt through trade, past consumers acquired the newer and better metal tools, changing old trade relationships. Then Tutuilan leaders, without much else to contribute, fell in political standings as chiefs from the more highly populated ‘Upolu began to politically incorporate them.
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References


The Tutuila Basalt Export Industry and the 5600 km Distribution of Samoan Adzes at ~700-600 BP

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Abstract - This paper reviews the evidence for large-scale basalt tool manufacturing on Tutuila and the geographical and temporal spread of those tools in the southwest Pacific. Since the first anthropological work in Samoa in the 1920s, Tutuila has been known as a center of basalt tool manufacture. The last decade has seen a doubling of the number of documented lithic manufacture and quarry sites, with several now securely dated to ~700-600 cal BP. A later period of 500-300 cal BP may also be indicated. Regional distribution is greatest in the earlier period, but some evidence suggests movement of Tutuila basalt tools in the later period, at least to nearby archipelagoes. Tutuila adzes are documented over a 5600 km distribution from Pohnpei in the northwest to Ma’uke in the southeast. Tutuila has been long recognized as a major production and distribution center for high-quality basalt tools in the southwest Pacific (e.g., Best et al. 1992, Clark 2002, Clark 1993, Clark et al. 1997, Di Piazza and Peartree 2001, Leach and Witter 1990, Weisler and Kirch 1996, Winterhoff 2003). This has elsewhere been termed the Tutuila Basalt Export Industry (Addison and Asaua 2006). This paper first reviews the evidence for tool production on Tutuila, then examines where Tutuila products have been found.

Tutuila Lithic Manufacture Sites

Tutuila sits in the middle of the Samoa Archipelago roughly halfway between the temporal power center of Savai’i and ‘Upolu to the west and the seat of the sacred Tui Manu’a title at Ta’u in the east (Figure 1). Tutuila was built in two distinct volcanic phases. The newest phase, the Leone Volcanic Series, was actively erupting as recently as 1400 years ago (Addison and Asaua 2006, Addison et al. 2006). However, the main part of the island is Pliocene in age – some 1.0-1.5 million years old (McDougall 1985) – and divided into three major volcanic provinces. It is from these older volcanics that the high-quality Tutuila basalt comes. For reasons that are unclear, unusually hard, dense, fine-grained basalt was laid down among softer volcanic rock. During the intervening million years, the softer rock decomposed to a clay or lateritic matrix surrounding chunks or layers of the high-quality basalt. Ancient Samoans either found the high-quality basalt where it was exposed at the surface, or dug into the surrounding matrix to find it.

The first written record of basalt tools (Figure 2) being manufactured on Tutuila is from a palagi resident of Manono who wrote in 1840: “At Tutuila, however, is found the hard stone (Trap.) of which the Polynesian adzes and other tools were made previously to the introduction of iron” (Heath 1840). More than a half century later, Te Rangi Hiroa Sir Peter Buck recorded the name of the Tataga Matau basalt quarry when doing field research for his monograph on Samoan material culture (Buck 1930:330). Tataga Matau is located on the ridges behind Leone Village and is the largest documented basalt quarry site on Tutuila. A team of archaeologists from New Zealand investigated Tataga Matau in the late 1980s (Best et al. 1989, Leach and Witter 1987, Leach and Witter 1990). The etymology of this quarry’s name seems straightforward: tataga refers to the striking action that flakes pieces from rocks in the process of shaping them into tools, and matau is an archaic word referring to a stone adze that is fully shaped but not yet ground, polished and sharpened. Shawn Barnes (pers. comm. 2006) has suggested that the name may be more descriptive than specific, and that many villages may have referred to their own quarries as “tataga matau.”

To date, 50 lithic sites have been found in 28 different villages or locations on Tutuila (Table 1). This number can be taken as a mere indication of the number of the sites that actually exist, as only a relatively small area of Tutuila has been systematically searched (e.g., Clark 1989; Clark and Herdrich 1988). To date, archaeologists have used the term “quarry” with variable meaning in reference to Tutuila lithic sites. Ideally, sites where basalt
Figure 1. Distribution of lithic sites on Tutuila. Multiple sites at one location are represented by a single dot. White dots = extraction sites; black dots = flaking sites; black squares = major grinding sites; inset not to scale.

Figure 2. Examples of basalt tools from Tutuila. The three objects at the extreme right are interpreted as scrapers or graters. The others are adzes or pieces of adzes.
raw-material was removed from the ground or exposed outcrops (properly “quarries”) would be clearly
distinguished from sites where tool manufacture took place (as indicated by large amounts of flakes). Although
this may seem an irrelevant distinction, it has important implications for how the production of basalt tools was
done, who did it, who controlled it, and how the tools moved off-island (e.g., Winterhoff et al. 2007).

Table 1. Known lithic sites on Tutuila (n.d. = no date; ? = date unclear).

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Name or location</th>
<th>Visibility</th>
<th>Activity</th>
<th>Size</th>
<th>Date (cal)</th>
<th>References</th>
</tr>
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<tr>
<td>AS-34-1</td>
<td>Fagamalo</td>
<td>Buried</td>
<td>Flaking</td>
<td>Small</td>
<td>post-1200 BP²</td>
<td>(Addison and Asaua 2006)</td>
</tr>
<tr>
<td>AS-34-34</td>
<td>Maloata</td>
<td>Surface</td>
<td>Flaking</td>
<td>Large</td>
<td>?</td>
<td>(Ayres and Eisler 1987)</td>
</tr>
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<td>AS-34-16</td>
<td>Afao/Atauloma</td>
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<td>Grinding</td>
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<td>n.d.</td>
<td>(Addison 2004)</td>
</tr>
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<td>~600BP?</td>
<td>(Best et al. 1989, Leach and Witter 1987, Leach and Witter 1990)</td>
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<td>n.d.</td>
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</tr>
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<td>n.d.</td>
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<td>Grinding</td>
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<td>n.d.</td>
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<td>n.d.</td>
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</tr>
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<td>(Ayres et al. 2001)</td>
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<td>Flaking</td>
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<td>n.d.</td>
<td>(Ishimura and Addison 2005, Ishimura and Addison 2007)</td>
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<td>Surface</td>
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<tr>
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<td>Airport Foaga</td>
<td>Beds/Tafuna</td>
<td>Surface</td>
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<td>n.d.</td>
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<td>Fatu-ma-Futi</td>
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<td>Flaking</td>
<td>Small</td>
<td>post-700 BP</td>
<td>(Walter and Addison 2005)</td>
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<td>Vai’s Quarry/Pago Pago</td>
<td>Surface</td>
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<td>(Currey et al. 2004)</td>
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<td>Flaking</td>
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<td>post-700 BP</td>
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<td>Small</td>
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<td>Extraction</td>
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<td>Flaking</td>
<td>Large?</td>
<td>post-700 BP?</td>
<td>(Brophy 1986, Frost 1978)</td>
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<td>Flaking</td>
<td>Large</td>
<td>n.d.</td>
<td>Site recently found by ASPA; no written documentation available</td>
</tr>
<tr>
<td>Not yet assigned</td>
<td>Alao 1</td>
<td>Surface</td>
<td>Extraction</td>
<td>Small</td>
<td>n.d.</td>
<td>(Addison 2007d)</td>
</tr>
<tr>
<td>Not yet assigned</td>
<td>Alao 2</td>
<td>Surface</td>
<td>Flaking</td>
<td>Large</td>
<td>n.d.</td>
<td>(Addison 2007d)</td>
</tr>
<tr>
<td>Not yet assigned</td>
<td>Alao 2</td>
<td>Surface</td>
<td>Flaking</td>
<td>Large</td>
<td>n.d.</td>
<td>(Addison 2007d)</td>
</tr>
</tbody>
</table>

Investigation of the Tutuila Basalt Export Industry is only in its beginning stages, but several things can be said at this point. For areal coverage, only a small portion of Tutuila has been systematically searched for lithic sites. The majority of currently known sites on Tutuila are visible on the surface. Only six of the known sites are not visible on the surface. This is not coincidental. Archaeological surface survey will only find sites visible on the surface. Each of the buried sites was found during archaeological monitoring of construction activity. This
highlights the importance of careful attention to this activity. This is especially true if we want greater understanding of the timing of the development of the Tutuila Basalt Export Industry. Table 1 indicates that our understanding of lithic chronology on Tutuila comes largely from these subsurface sites found during construction monitoring.

The currently available evidence suggests that there was major basalt tool manufacturing on Tutuila in the post-700 cal BP period. It should be emphasized that this is only the very beginning of a chronological understanding of tool manufacture on the island. It remains unknown if there was major production before this period, if there were cycles of decline and resurgence in tool production, or if there was a steady increase through time. The Puapua and Malaeloa AS-32-13b sites document a later period of tool manufacture after ~500 cal BP.

The occurrence of a variety of sizes of lithic sites all over the island suggests that the tool manufacture on Tutuila was complex and widespread. This is not a situation with one quarry exploited during a discrete period and under one kind of production management. The fact that there are flaking areas at some distance from possible quarry sources raises questions about access to and control of quarries, intra-island exchange relationships, and the social, economic and political aspects of basalt tool production on the island. That finished tools were used, reworked, and reused repeatedly – often down to a mere stub of stone – suggests that high quality basalt was not universally available, or at minimum, had significant costs associated with its acquisition (Ishimura and Addison 2005, Ishimura and Addison 2007). The Airport Foaga Beds indicate large-scale adze finish-grinding at a location at least 5 km from any possible quarry source and some 15 km from any known quarry. This situation begs questions about how and why large numbers of tools were being finished so far from quarries. Geochemical sourcing offers a technique for generating data to begin addressing such questions.

Johnson (Johnson et al. 2007) has succeeded in geochemically distinguishing quarry material from the three major Pliocene volcanic provinces on Tutuila, laying the groundwork for future studies to assign artifacts from archaeological sites on Tutuila and beyond to particular quarries. Recent geochemical work by Winterhoff (Winterhoff 2003, Winterhoff et al. 2007) has succeeded in distinguishing different basalt source material from three different valleys (Tataga Matau, Maloata, and Malaeloa) within a single volcanic province. The Malaeloa sources can further be divided into three distinct groups. Winterhoff documents intra-island movement of source material between the source areas as well as to areas with no known quarries (e.g., Afao workshop sites obtained rock from sources in both Tataga Matau and Malaeloa). These initial studies suggest the rich possibilities for improving the understanding of the social, political, and economic aspects of the Tutuila Basalt Export Industry on Tutuila itself.

**Regional Distribution of Tutuila Basalt Tools**

The previous section has demonstrated the scale of basalt tool manufacture on Tutuila. But where were the tools used? Evidence from the region suggests widespread distribution of these Tutuila products (Table 2).

<table>
<thead>
<tr>
<th>Location where lithics were found</th>
<th>Distance from Tutuila (km)</th>
<th>Quarry source</th>
<th>Date of context where found</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Upolu</td>
<td>70</td>
<td>Tataga Matau, Malaeloa, Maloata, Eastern Tutuila, and Tutuila unknown</td>
<td>~1800 cal BP?</td>
<td>(Best et al. 1992, Winterhoff et al. 2007)</td>
</tr>
<tr>
<td>Manu’a, Ta’u</td>
<td>120</td>
<td>Tataga Matau</td>
<td>~2000 cal BP</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Savai’i</td>
<td>160</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td></td>
</tr>
<tr>
<td>'Uvea</td>
<td>500</td>
<td>Samoan looking</td>
<td>Surface</td>
<td>(Sand 2006, Sand and Llau 2000)</td>
</tr>
<tr>
<td>Tokelau (general)</td>
<td>~600</td>
<td>Tataga Matau, Maloata, Malaeloa</td>
<td></td>
<td>(Winterhoff et al. 2007)</td>
</tr>
<tr>
<td>Tokelau, Fakaofo</td>
<td>560</td>
<td>Eastern Tutuila and Tutuila unknown</td>
<td>Pre-600 cal BP?</td>
<td>(Best et al. 1992)</td>
</tr>
</tbody>
</table>

Table 2. Inter-island exchange of Tutuila basalt tools, arranged by distance from Tutuila (includes data from tables in (Clark 2002) and (Di Piazza and Peartree 2001).
<table>
<thead>
<tr>
<th>Location where lithics were found</th>
<th>Distance from Tutuila (km)</th>
<th>Quarry source</th>
<th>Date of context where found</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokelau, Nukunonu</td>
<td>590</td>
<td>Tataga Matau</td>
<td>Pre-600 cal BP?</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Cook Islands, Pukapuka</td>
<td>630</td>
<td>Tataga Matau</td>
<td>Pre-600 cal BP?</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Futuna</td>
<td>645</td>
<td>Samoan looking</td>
<td>Surface</td>
<td>(Sand 2006)</td>
</tr>
<tr>
<td>Tokelau, Atafu</td>
<td>670</td>
<td>Tataga Matau and Eastern Tutuila</td>
<td>post-1000 cal BP</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Tongatapu</td>
<td>910</td>
<td>Tataga Matau</td>
<td>“late” (post 300 cal BP)</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Fiji (general)</td>
<td>~1000</td>
<td>Maloata, Malaeloa</td>
<td>Surface</td>
<td>(Winterhoff et al. 2007)</td>
</tr>
<tr>
<td>Fiji, Vanuabalavu (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>790-480 cal BP</td>
<td>(Best et al. 1992, Clark 2002)</td>
</tr>
<tr>
<td>Fiji, Yacata (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Clark and Hope 2001)</td>
</tr>
<tr>
<td>Fiji, Lakeba (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>900 BP?, 700-200 cal BP</td>
<td>(Best et al. 1992, Clark 2002)</td>
</tr>
<tr>
<td>Fiji, Moce (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Fiji, Namuka (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Fiji, Komo (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Best 1984)</td>
</tr>
<tr>
<td>Fiji, Ogea (Lau)</td>
<td>~1000</td>
<td>Petrology suggests Samoa</td>
<td>Surface</td>
<td>(Best 1984)</td>
</tr>
<tr>
<td>Fiji, Karaba (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Fiji, Fulaga (Lau)</td>
<td>~1000</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Fiji, Vatoa (Lau)</td>
<td>~1000</td>
<td>Morphology suggests Samoa</td>
<td>Surface</td>
<td>(Thompson 1938)</td>
</tr>
<tr>
<td>Fiji, Totoya (Lau)</td>
<td>~1000</td>
<td>Tutuila</td>
<td>Surface</td>
<td>(Clark and Cole 1987)</td>
</tr>
<tr>
<td>Fiji, Gau</td>
<td>~1200</td>
<td>Morphology suggests Samoa</td>
<td>Surface</td>
<td>(Clark 2002, Moce 1972)</td>
</tr>
<tr>
<td>Phoenix Islands, Manra</td>
<td>1070</td>
<td>Tataga Matau</td>
<td>550-750 cal BP</td>
<td>(Di Piazza and Pearthree 2001)</td>
</tr>
<tr>
<td>Tuvalu</td>
<td>1300</td>
<td>Eastern Tutuila and Tutuila unknown</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Cook Islands, Aitutaki</td>
<td>1300</td>
<td>Tataga Matau, Eastern Tutuila, and Tutuila unknown</td>
<td>600-800 cal BP</td>
<td>(Allen and Johnson 1997)</td>
</tr>
<tr>
<td>Cook Islands, Rarotonga</td>
<td>1450</td>
<td>Tataga Matau, Tutuila unknown</td>
<td>500-700 cal BP</td>
<td>(Sheppard et al. 1997)</td>
</tr>
<tr>
<td>Cook Islands, Ma’uke</td>
<td>1630</td>
<td>Tataga Matau, Asiapa</td>
<td>600-700 cal BP</td>
<td>(Best et al. 1992, Sheppard et al. 1997)</td>
</tr>
<tr>
<td>Reef/Santa Cruz Islands, Taumako</td>
<td>2300</td>
<td>Tataga Matau and Eastern Tutuila</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Reef/Santa Cruz Islands, Nupani</td>
<td>2300</td>
<td>Asiapa</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Reef/Santa Cruz Islands, Tikopia</td>
<td>2300</td>
<td>“Samoan looking”</td>
<td>post-750 cal BP</td>
<td>(Kirch and Yen 1982)</td>
</tr>
<tr>
<td>Solomon Islands, San Cristobal</td>
<td>2800</td>
<td>Tataga Matau</td>
<td>Surface</td>
<td>(Best et al. 1992)</td>
</tr>
<tr>
<td>Pohnpei</td>
<td>~4000</td>
<td>Tutuila</td>
<td>Surface</td>
<td>(Ayres and Mauricio 1987)</td>
</tr>
</tbody>
</table>
More than a decade ago, Best and colleagues (Best et al. 1992) conceptualized the temporal distribution of Tutuila tools in the region as concentric rings emanating from Tutuila. According to this scenario, in the earliest period Tutuila tools are found on the other islands in Samoa, with later distribution to Fiji and around the region (Best et al. 1992:68-69).

In the intervening 15 years, only the southern Cook Islands (Allen and Johnson 1997, Sheppard et al. 1997) and the Phoenix Islands (Di Piazza and Pearthree 2001) have been added. Allen and Johnson found that two adze fragments found on Aitutaki came from Tutuila, and other specimens are likely from eastern Tutuila or unknown Tutuila quarries (Allen and Johnson 1997:126). Two adze fragments from Manra in the Phoenix Islands closely match samples from the Tataga Matau quarry on Tutuila (Di Piazza and Pearthree 2001:147).

The Tutuila Basalt Export Industry - Summary

Tutuila was a major source of stone tools in the southwest Pacific. The fifty known quarry and tool manufacturing sites on Tutuila are only a small sample of such sites that are likely to exist on the island. Not only is the geography of lithic sites on Tutuila incomplete, there are major gaps in our understanding of most aspects of tool manufacture. Questions remain about: where tools were produced; the management of their production; the possibility of craft specialization and the timing of its emergence; the social, political, and economic relationships between communities where quarries were located and the (sometimes) distant communities where tools were produced. Finally, questions remain unanswered about how all of these changed throughout the more than two millennia of Tutuila’s history.

Current evidence on the regional distribution of Tutuila basalt tools is fragmentary and has been largely dependent on the initiative of individual archaeologists to do geochemical analyses on lithics they have found on islands outside Tutuila. Even this partial evidence suggests how widespread Tutuila basalt was in ancient times. Surely there are many more islands within a 2000 km radius of Tutuila where such evidence remains hidden in the ground.

The timing of the manufacture and off-island distribution of Tutuila basalt tools remains to be well defined. Evidence from Tutuila is ambiguous, but there are growing indications of large-scale production at ~600-700 cal BP (Table 1). Sites with components earlier than this period are poorly dated and/or the association between dates and lithics is problematic. The late-prehistory extent of large-scale manufacture is also poorly dated, but two sites postdate ~500 cal BP. Interestingly, one of these may have specialized in tools interpreted as coconut graters (Addison 2007b).

Evidence from off-island shows Tutuila basalt spread throughout the Samoan Archipelago in the early periods of settlement (Table 2). It is unknown how extensive tool manufacture was on Tutuila at this time. Recently excavated sites at Aganoa’, and Ulu Tree II (Addison and Winterhoff in prep) date to this period. Although lithic manufacture was not a significant component of either site, sourcing of the few lithics at these sites may provide information on which quarries were used in this earliest period of Tutuila history.

Outside of Samoa, the evidence mostly corresponds with the ~600-700 cal BP dates for large-scale tool manufacture from Tutuila sites (Table 2). Best initially dated Samoan adzes in Fiji to ~900 cal BP (Best 1984, Best et al. 1992). In an extensive review of the evidence for Samoan lithics in Fiji, Geoff Clark suggests that 650-450 cal BP is more likely (Clark 2002). More lithic samples from well dated stratigraphic contexts are needed. Currently all samples but two are from the Lau Group; wider geographic sampling in Fiji would be helpful. With 22 Samoan tools or flakes, Fiji currently has most of any archipelago with known Samoan stone imports.

Tutuila tools in Tokelau and Tonga are unexpectedly late given the proximity of these islands to Tutuila, but sites with lithics clearly dating to earlier periods remain to be found. Proximity and oral history suggest strong links between Samoa and Futuna/Uvea (Sand 2006). Geochemical characterization needs to be done on the “Samoan-looking” tools that have been found on these islands. Nearby Niuatoputapu and Niuafou’ou are also likely candidates for having Samoan adzes (Figure 3). Regional weather patterns and parameters surrounding traditional voyaging technology suggest that Tutuila was ideally located for contact with a variety of islands in the region and this needs to be accounted for in discussions of tool distribution (e.g., Di Piazza and Pearthree 2001).
At 5600 km (from Pohnpei to Ma’uke), the geographic spread of Tutuila basalt is the largest known distribution of any material in Oceania. It surpasses the Oceanic spread of Bismarck Archipelago obsidian, although including the Indonesian spread of the latter makes its distribution some 6000 km (Summerhayes 2000). The recently published evidence for Hawai’i basalt in the Tuamotu Islands also involves a shorter distance (Collerson and Weisler 2007).

So far, lithics from the region geochemically sourced to Tutuila have been adzes or waste flakes. Bifacially modified flake tools interpreted as coconut graters (tuai) or vegetable peelers (asi) show a high degree of uniformity and occur in sites all over Tutuila. A recently discovered site in Puapua (Leone Village) may have specialized in these tools (Addison 2007b). Another site in the lagoon in front of ‘Auma (Leone Village) has a high number of these tools (Suafou’a-Taua’i pers. comm.) and may have also been a specialized manufacture site. These tools may have also been distributed in the region.

Much research awaits both in Samoa and in the region to develop a deeper and more comprehensive understanding of the Tutuila Basalt Export Industry.

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Thanks to Christophe Sand for inviting me to present in the session “Past Interactions within the Western Pacific: the Archaeological Evidence”, for comments on this paper, and for years of friendship and collegiality. Travel to Gotland would not have been possible without the generous assistance of the Easter Island Foundation, Mary Dell Lucas and Far Horizons Archaeological and Cultural Trips, Michael Coe, Jerome Glick, Ron Guttman, Pam Halfmann, Faith Hentschel, Wythe Holt, Sibyl Masquelier, Shawn McLaughlin, Joy Mundy, Jorge Navarette, Gary Rollefson, Jean Rusk, and Susan Silver.

**Notes**

1 Although geologists make finer distinctions, I use basalt to refer to the range of basaltic rock found on Tutuila.
Strata with abundant lithic-manufacture debris at Fagamalo were not directly dated, but are stratigraphically above a date of 1218±40 BP (WK11507).

Clark apparently mistook this site for part of Tataga Matau, but Best et al. consider it a separate site.

Winterhoff et al. (in press) indicate that “much of the [Malaeloa] valley and its hillsides were places of tool production.”

Excavated by Frederic Pearl and Suzanne Eckert in 2006.

This site is exposed at low tide. I interpret it as having been deflated.

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**References**


Heath, T., 1840. The Navigator's or Samoa Islands. Their Manners, Customs, and Superstitions. Honolulu.


The Lapita Settlement of Samoa: Is a Continuous Occupation Model Appropriate?

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Abstract - The spread of people using Lapita pottery throughout a region from the Bismarck Archipelago to Samoa is one of the major events in Pacific prehistory and represents the beginning of humanity’s colonization of the last major unpopulated area of the earth – Remote Oceania. In the conventional model, occupation of Samoa is seen as continuous and Lapita as directly ancestral to the current populations and their cultures (e.g., Clark 1996, Green 2002, Kirch and Hunt 1993b). A similar scenario is widely accepted for all of West Polynesia (except Niue, Tokelau, Tuvalu whose initial colonization was clearly later) and is closely linked to the constructions of Ancestral Polynesian Society (Kirch and Green 2001 and sources therein). Critiques of this scenario have been few (but see Smith 1995, Smith 2002). This paper discusses the early settlement of Samoa and the possibility of an initial Lapita colonization followed by later recolonization by a non-Lapita group.

Samoan Archaeology – the Last 50 Years

At the 10th Pacific Science Congress held in Hawai‘i in 1961, Jack Golson presented results of his 1957 investigations on 'Upolu Island in Samoa (Figure 1). Golson’s work represented the first modern archaeology in Samoa and gave an initial indication of the richness of the archipelago’s record (Golson 1959, Golson 1969). The subsequent half century has seen a great increase in understanding of Samoan prehistory, although large gaps remain (Addison and Asaua 2006b, Burley and Clark 2003, Clark 1996).

Green and Davidson – Settlement Pattern and the Discovery of Samoan Lapita

In response to the planning for a coordinated Polynesian Culture History program at the 10th Pacific Science Congress, Green and Davidson began a multiyear research project on the islands of ‘Upolu and Savai‘i, building on Golson’s initial investigations. Their work and that of their colleagues (Green and Davidson 1969, 1974a) laid the foundations of subsequent discussions of Samoan prehistory.

The discovery of Lapita pottery at Mulifanua on ‘Upolu (Jennings 1974) suggested the antiquity of Samoan prehistory. Based on the style of the ceramics, Green and Davidson inferred the Mulifanua deposits to date to “around or before 800 B.C.” (Green and Davidson 1974b:224). Subsequent radiocarbon dates of ~2880-2750 cal BP confirmed their initial estimate (Petchey 2001). Green and Davidson noted that the first 600-800 years of Samoan prehistory were represented only by the Mulifanua deposits, with “securely dated habitation layers…not known until the first century A.D.” (Green and Davidson 1974b:224).

The fact that the Mulifanua site was located under some meters of ocean and reef deposits was used to argue that there had been widespread submergence of ‘Upolu and Savai‘i. The 600-800 years missing from the archaeological record was thought to be inaccessible and submerged (see also Dickinson and Green 1998, Green 2002). Logically required by this model is that it took 600-800 years for Samoans to begin using inland sites. Otherwise, evidence of earlier sites would be found in the interior. Presumably, before this, sites were confined to the low-elevation nearshore and were submerged by island subsidence and unavailable for archaeological investigation.2

The ~2000 cal BP sites were characterized by Polynesian Plain Ware pottery. Green noted that the “continuity between Lapita and the Plain Ware assemblages” was based on “general technological resemblances” and the evidence was “not very impressive” (Green 1974b:249). Yet, at the time, it was the best “case in Western
Polynesia for continuity between the ancestral Lapita horizon and the Polynesian cultural complex which developed from it in the course of the next 2000 years” (Green and Davidson 1974b:224). Clearly, more data were needed:

“Finally, it is important at this stage in West Polynesian prehistory to assess the degree of continuity in sequences from each island group, especially those of Tonga, Samoa and Fiji. For it is not until we can assess the degree of continuity, change and cultural replacement on the basis of a full range of portable and structural artifacts, and not simply on adzes or pottery, that the issues of Polynesian cultural origins and subsequent inter-island relationships can be satisfactorily stated and debated” (Green and Davidson 1974b:213)

**Kirch and Hunt – To’aga Progradation and Colluvial Deposits**

The fortuitous discovery of ceramics at the To’aga Landfill on Ofu Island (Figure 1) in 1986 (Hunt and Kirch 1987) offered the opportunity to find the missing 600-800 years of Samoan prehistory. Because of Ofu’s different geologic and tectonic history, archaeologists had the possibility of excavating the kind of sites that were thought to be submerged on ‘Upolu and Savai’i, thus providing the link between Lapita and Polynesian Plain Ware. And because the calcareous sand matrix at To’aga preserved bone and shell, the “full range” of portable artifacts missing from Green and Davidson’s (1974b:213) work could be excavated and analyzed.

This would be an important step in assessing “the degree of continuity, change and cultural replacement” in the Samoan and West Polynesian sequences as called for a dozen years earlier (Green and Davidson 1974b:213). Kirch and Hunt saw their work as representing “a modest contribution toward the ultimate goal of tracing the development of an Ancestral Polynesian Culture out of its Lapita roots” (Kirch and Hunt 1993a:2)

Kirch, Hunt and colleagues (Kirch and Hunt 1993c, Kirch et al. 1990) spent three field seasons at To’aga excavating deeply stratified cultural deposits overlaying a beach dated by non-cultural shell to 3900-3300 cal BP.
(calibration after Rieth et al in review, Table 1). These deposits would be interpreted to “span virtually the entire three-millennium-long sequence of Samoa” (Kirch and Hunt 1993a:2). The interpretive paradox at To’aga was that, although the dates indicated occupation contemporaneous with the Mulifanua Lapita site (or even predating it), no dentate-stamped pottery or vessel shapes characteristic of known Lapita assemblages were found at To’aga. Still they felt “certain that the island of Ofu, and the To’aga site, were settled by the end of the second millennium B.C. as part of the process of discovery and colonization of the Fiji-Western Polynesia region by Lapita populations” and that an in situ Lapita occupation was “situated on a beach ridge inland” of their excavations “and now buried under several meters of talus and colluvium” (Kirch 1993a:91). They argued that the full range of artifacts at To’aga indicated continuity of settlement from Lapita times onward (Kirch and Hunt 1993b).

The geomorphological transformations modeled for To’aga (Kirch 1993b) indicated that the earliest deposits were inaccessible to archaeologists. A Lapita-aged narrow coastal strip was covered by millennia of colluvial deposition and coastal progradation. This model was seen as having “implications for other coastal sites throughout the archipelago” (Kirch and Hunt 1993b:229).

Now, archaeologists had two geomorphological reasons for not finding Lapita sites in Samoa – rapid subsidence in the west and coastal progradation with massive colluvial deposits in the east. Tutuila, centrally located in the archipelago would offer another geomorphological scenario.

J. Clark – ‘Aoa and Infilled Bays

At the same time that Hunt and Kirch made the initial discovery of ceramics at the To’aga Landfill, Jeff Clark was beginning three seasons of fieldwork on Tutuila (Clark 1989, Clark 1992, Clark 1993a, Clark 1993b, Clark and Herdrich 1988, Clark and Herdrich 1993). Two of the research goals of the Eastern Tutuila Archaeological Project were finding Lapita sites on Tutuila and understanding the relationship of geomorphological processes to site visibility on the island (Clark and Herdrich 1988:9-10). At ‘Aoa, Clark found ceramic deposits with dates he interpreted as “contemporaneous with the Lapita site of Mulifanua, starting at ca. 3000 BP” (Clark 1993b:325) and comparable to the earliest dates at To’aga. However, as at To’aga, the hallmarks of Lapita ceramics – dentate stamping and complex vessel forms – were absent.

On western Tutuila, Clark was unable to find sites comparable in age to ‘Aoa (Clark 1993b). To account for this distribution, Clark suggested the possibility that Tutuila was tilting, with the western end of the island subsiding and the eastern end uplifting (Clark and Herdrich 1988:10). We now know that early sites on the western end of Tutuila are likely covered in meters of ash from the Leone Volcanic Series which was actively erupting as recently as 1400 years ago (Addison and Asaua 2006a, Addison et al. 2006). Other evidence suggests that Tutuila has been tectonically fairly stable with neither subsidence nor uplift as major factors (Dickinson 1997).

‘Aoa showed that subsidence was not hiding early sites on eastern Tutuila as at Mulifanua, neither were they buried under meters of colluvium as at To’aga. In Clark’s model, major change in eastern Tutuila shorelines was due to regional patterns of sea-level change. The earliest sites should be located on gentle slopes near former embayments or wetlands associated with the mid-Holocene high sea stand.

Clark offered two possibilities for the near absence of diagnostic Lapita pottery in Samoa:

“Lapita occupation in the Samoan archipelago, as identified by the presence of the distinctive dentate-stamped and incised pottery, was quite limited. Given the number of archaeological investigations that have now been carried out in the archipelago, several with the intent of finding Lapita sites, the absence of such sites beyond Mulifanua is striking and probably meaningful. Of the possible explanations for this situation, only two will be mentioned here.

First, this easternmost extension of Lapita may be represented by ceramic assemblages in which the distinctive decorations were rarely applied, and were abandoned soon after island settlement in favor of a derived Samoan Plain Ware. Decorated sherds at Lapita sites elsewhere typically compose only a small percentage of the total assemblage, often under 10%. Therefore, a complete abandonment of decorations would not be a decidedly dramatic change. Some time ago, Green (1974b) proposed such a shift from decorated Lapita to Samoan Plain Ware, but the data discussed here suggest that the shift was sooner than previously suspected.
Second, it may be that the Mulifanua site was not occupied by "Lapita people," and the small percentage of decorated Lapita ceramics at the site represent trade ware from outside the archipelago (see Terrell 1989). This would suggest a contemporaneous non-Lapita occupation of Samoa, perhaps reflecting a widespread Plain Ware tradition and associated culture(s). Plain Ware sites have been reported from throughout the central Pacific, although the precise relation of Plain Ware to the Lapita tradition has not been firmly established." (Clark 1993b:325-26)

Now, in addition to geomorphological explanations for why Lapita sites couldn’t be found beyond Mulifanua, Samoan archaeology had an alternative explanation – a non-Lapita source for Polynesian Plain Ware. Before exploring this idea, we review the current archaeological understanding of Eastern Lapita and the Ancestral Polynesian interaction sphere.

![Image](http://www.evs-islands.blogspot.com)

**Figure 2.** The Fiji/West-Polynesia region. Base map courtesy of Peter Minton (http://www.evs-islands.blogspot.com).

**Regional Perspective – Eastern Lapita**

An Eastern Lapita Province encompassing the Fiji/West-Polynesia region was originally proposed by Green based on “differences in vessel shape and by the style and frequency of decoration” (Green 1974a, Green 1978:7). Eastern Lapita is divided into late and early based on aspects of dentate stamping such as the number of design fields used, the density of the stamping, and its complexity (e.g., Best 1984; Clark and Anderson 2001:78; Green 1974a; Green 1976; Green 1978; Mead et al. 1975). As is typical in the early stages of the study of complex phenomena, the generation of additional data has raised more questions rather than clarifying the situation. It now seems more complex than ever (Clark and Anderson 2001:82, and recent discussions at the Archaeology of the Polynesian Homeland Conference held in 2006).
Recent work in Tonga and Fiji has illustrated some of the areas of clarity and ambiguity. For Tonga, Burley and colleagues (Burley et al. 2001:101) distinguish Eastern Lapita from stylistic provinces farther west by the absence of “highly decorated cylinder stands, stylized anthropomorphic faces, or densely applied dentate stamped motifs” but with “vessel form, decorative application, and the structural basis of the design system clearly illustrating a “simplified” subset of Lapita (sensu Green 1979:54).” Burley also notes the similarity of collections from Tonga, Fiji and Samoa that, “represent an Eastern Lapita ceramic style that more broadly defines the Eastern Lapita province” (Burley et al. 2001:101). Moreover, Burley and colleagues conclude “that the distinguishing decorative motifs of the Eastern Lapita ceramic suite were imported to Tonga, not developed in situ” (Burley et al. 2001:101).

Analysis of ceramics from four “relatively undisturbed” sites in Fiji indicates that “simple dentate stamping was not contemporaneous with stylistic features designated early Lapita” (Clark and Anderson 2001:79). This is a situation in which we do not have a broad-range of decoration that includes simple dentate stamping and where the complex and dense dentate stamping is discontinued. The situation Clark and Anderson describe is a change in decoration. The question remains: is this due to an autochthonous change in an in situ population or is this an indication of population replacement?

Vessel form also changes over time, but in a different way. Here, there is not a change in form, but rather, some forms disappear and others remain. Vessel form is largely homogenous throughout early to late Eastern Lapita “except in relative quantity”, at least for Fiji (Clark and Anderson 2001:82). But then, at the Late-Eastern-Lapita/Polynesian-Plain-Ware divide in Fiji, there is a sudden and radical reduction from a range of complex vessel forms to simple bowls and cups.

Burley and colleagues note a similar disjuncture in Tonga (Burley et al. 2001:101) where the “ceramic transition from Lapita to Plainware is stratigraphically and compositionally distinct in most of the excavated Tongan sites” and with vessel forms radically reduced and dentate stamping absent. They further note that change from Lapita to Plain Ware occurred abruptly throughout Tonga (Burley et al. 2001:102).

**Dating Eastern Lapita**

Eastern Lapita sites date to roughly 2800 BP (Anderson and Clark 1999, Burley et al. 1999), but Eastern Lapita is of such short duration that radiocarbon determinations can only give a general idea of the time period involved. This dating method lacks the precision to date internal dynamics of the earliest human populations within the Fiji/West-Polynesia region.

This poses a major difficulty in assessing different ideas about the Lapita expansion because the whole Lapita occupation in the Eastern Lapita province has overlapping dates. Ceramic analysis has been used for distinguishing finer chronology within this time period. For example, intra-Fiji variation can’t be determined by radiocarbon dates (Clark and Anderson 2001:82). Clark and Anderson (2001:78) use stylistic features of ceramics to divide early and late Lapita in Fiji because “[radiocarbon determinations provide an approximate span for the Lapita Phase but the majority of sites are undated and, leaving aside issues of sample type and provenance, at two standard deviations those that have calibrated age ranges encompassing almost the entire Fijian Lapita sequence as it is now conceived (Anderson and Clark 1999).” Likewise, Burley and Dickinson (2001:11829) use pottery styles to bolster their radiocarbon dates, because the dates themselves do not offer enough precision to distinguish Nukuleka (Tonga) as a “colonization period” site.

The chronology of the Lapita-to-Plainware transition in West Polynesia also remains poorly defined (Rieth et al. in review, Rieth 2007, Smith 2002), but appears to have happened in Tonga ~2700-2400 cal BP (Burley 1998, Burley and Connaughton 2007) and in Samoa ~2500 cal BP (Rieth et al. in review). With current radiocarbon technology and calibration methodology, it is unlikely that we will get much better definition of the absolute chronology. This is a question that will require careful excavation of stratified sites with minimal mixing of strata – to say the least, a rare kind of site in the region.

**Eastern Lapita Economy and Settlement Pattern**

Discussions of Lapita settlement pattern and subsistence are closely linked because of the longstanding debate on what Lapita people ate. The settlement pattern question is perhaps more tractable and seems moving towards resolution. In the Lapita homeland of the Bismarck Archipelago there is a shift from early sites located only on
small offshore islands to later settlement on main islands and inland (Glenn Summerhayes, pers. comm.). In the Fiji/West-Polynesia area Lapita sites are found in both coastal and offshore locations (Burley et al. 2001; Clark and Anderson 2001) and tend to be small (Burley 1998:Table 1; Clark and Anderson 2001:82).

The nature of the colonization-period Lapita economy has long been debated. Groube (1971) initially argued for a “strandloper” subsistence system in which Lapita colonists skimmed the best wild foods and moved on once an area had been depleted. Kirch (summarized in Kirch 1997) countered that Lapita colonists were adept horticulturalists that transported a cultigen inventory and agricultural system with them. Both may be right, in that there may not have been only one colonization-period subsistence system across the whole 3000-km range of Lapita. Groube’s data from Tonga is near the eastern edge of the Lapita expansion – an area with substantially different environmental variables than the Bismarck Archipelago sites for which the strongest agricultural arguments are made.

For Fiji, Clark and Anderson suggest that there is little evidence for Lapita agriculture and argue that its presence should not be assumed:

“While recognising the difficulty of identifying evidence of agriculture, especially of plant remains, in Fijian Lapita sites, we nevertheless believe that the default option should be ‘absent until demonstrated’ rather than ‘present’ (e.g. Kirch 1997:195, 203–212) on the grounds of Western Lapita data, debatable domestic bone occurrences in Eastern Lapita and historical linguistics. It would then follow that agricultural production was not necessarily a factor in population dispersal processes either in Eastern Lapita generally or within the Tonga settlement pattern (cf. Spriggs 1997:85–86, Kirch 1997:203–212). Turning to other evidence of subsistence, quantitative analysis of shellfish remains from east (Votua) by Szabo (pers. comm.) shows greater specialization on colonial species of intertidal reef taxa in the latter site, but possibly because the Natunuku material is stratigraphically mixed and includes a significant quantity of later-collected shell from the local lagoon…. These various data document a common foraging subsistence mode throughout Fiji in Lapita times. It was focused everywhere primarily on marine resources but included less abundant terrestrial wild foods. If agriculture existed it was not well-developed and there is nothing to suggest any intra-archipelagic variation in its deployment.” (Clark and Anderson 2001:84)

Anderson has elsewhere proposed that initial Lapita populations were highly mobile and were focused on “skimming” the best faunal resources (Anderson 2001, see also Best 1984:650-653). Burley and colleagues (Burley et al. 2001:102) write that the “settlement strategy in Ha’apai is concordant with a mobile, maritime adaptation”. They also note the high reliance of Lapita populations in Tonga on non-agricultural food:

“…the nature of the Lapita faunal record, settlement pattern, and other factors continue to imply an early subsistence economy heavily influenced by considerations other than starch production. Spennemann (1989) has used the term ‘optimal foragers’ and we concur. That the Lapita people did not fully move on when depletions occurred is amply documented in the Plainware component at each of the sites…” (Burley et al. 2001:102).

We question their inference of continuity between the Lapita and Plain Ware components of sites. In Tonga, Lapita and Plain Ware deposits are quite different, with Lapita deposits occurring as middens on beach sands “while Plainware strata indicate a period where transported sediments, shell fish, organic remains, and dense concentrations of pottery have led to intensive and quite thick matrix buildup” (Burley et al. 2001:101-102). This latter kind of deposit is normally associated with sedentary and agricultural populations in Polynesia (as Burley et al. imply), but because the Plain Ware deposits are fundamentally different from the earlier Lapita deposits in aspects of cultural material, subsistence remains, and depositional matrix, we see room to question whether there was continuity of population, and begin to consider whether there wasn’t population replacement.

Evidence from both Fiji and Tonga appears to support a neo-strandlooper model. Anderson (2003) has recently suggested that agricultural elements slowly diffused into Remote Oceania. We argue that limited agriculture could easily be added to this neo-strandlooper economy. A commonly occurring element at early sites in the region is the presence of nearby wetlands (at least their existence is plausible based on geomorphological reconstruction). It is possible that early Lapita colonists slightly modified these wetlands and planted Colocasia...
taro, with perhaps banana or other cultigens at the margins. After initial weeding and mulching while the area’s faunal resources were being exploited, the plantings could be left until harvest at later visits. This would have been the most energy-efficient way of assuring the carbohydrates needed to avoid potentially fatal azotemia (Addison 2008 for a discussion of the advantages of Colocasia taro, and Davidson and Leach 2001 discuss the azotemia threat to Lapita colonizers). It would have also preserved any planting stock brought by the colonists, without necessitating a sedentary settlement pattern. In fact, such a scenario would have required only the transportation of one cultigen – Colocasia taro, arguably the easiest of the Oceanic cultigens to transport by canoe (Addison 2008). Other cultigens could have been introduced later, at a time that was convenient to the colonists. Swine could have been an initial introduction. This species could easy forage for itself on the reef and in the forest. These “wild” swine could then have been more intensively husbanded at any point in the future. Such an initial strategy would account well for the temporal distribution of pig remains in Lapita sites.

Matisoo-Smith concludes that evidence “from a range of fields now suggests that the elements formerly associated strictly with a Lapita intrusion are present in Near Oceania prior to the appearance of full-blown Lapita — including arboriculture, agriculture, pottery and even the mitochondrial DNA marker, the ‘Polynesian motif’.” So, were these elements incorporated wholesale into a package that accompanied the initial Lapita colonists in Fiji/West-Polynesia? Or were various elements introduced to Fiji/West-Polynesia at different times?

**Characteristics of the Lapita Expansion in the Fiji/West-Polynesia Region**

Until more datasets are produced, answers to questions about what Lapita colonists brought with them (in addition to their pottery) will rely on how we model their expansion. Clark and Anderson (2001:77) summarize the ideas about the Lapita expansion as follows:

“Kirch (1997:62) and Anderson and Clark (1999:37) suggest that Lapita settlement was restricted to the Bismarcks for 200–300 years before an explosive phase of eastward expansion which occurred so rapidly that no chronological gradient can be discerned in the radiocarbon record. In contrast, a staged clinal advance for Lapita expansion has been proposed by Burley et al. (1999). They compared age estimates from Tonga to those from New Caledonia (Sand 1997) and the Bismarcks (Specht and Gosden 1997), and concluded that Lapita movement was incremental, occurring as a series of colonisation fronts (see also Green and Kirch 1997:30; Sand 1999:307)” (Clark and Anderson 2001:77).

The most complex modeling of the Lapita expansion in the Fiji/West-Polynesia region has been done by Clark and Anderson (Clark and Anderson 2001). They used variability in ceramic assemblages to evaluate three models of movement within Fiji. The three models are:

1. that sites [within Fiji] were not distinguished by the west-east geographic divide, changing only chronologically (but synchronously in west and east).

2. that [within Fiji] there was a west to east progression in the dispersal of Lapita settlement, i.e. the variation is patterned both chronologically and geographically.

3. that [within Fiji] there is neither geographical nor chronological pattern, perhaps because of multiple origins and local isolation. (Clark and Anderson 2001:77-78)

They conclude that:

“…the Lapita colonisation of Fiji appears far more complicated than any of the three simple models proposed and only model 1 is doubtful on the data reviewed here…..Whether this reflects the limitations of the archaeological sample and the methodologies employed to interpret it must be resolved by future work of the type undertaken by Best (1984). However, both ‘explosive’ and ‘incremental’ interpretations of Lapita dispersal developed from radiocarbon chronologies are likely to underestimate the real complexity of the colonisation process since they are primarily concerned with dating the leading edge of a population dispersal. In this regard it is essential to further refine the stylistic analyses of Lapita material culture and to compare sites on the basis of a wide range of variables to better understand, not only how quickly Lapita people crossed the sea gaps isolating island groups, but how they set
about occupying the archipelago landscapes that were the ultimate colonisation objective.”
(Clark and Anderson 2001:87)

Addressing the earliest Lapita expansion into the region Clark and Anderson (2001:84-85) suggest the possibility of an early Lapita expansion that reached no further than Fiji due to “demographic exhaustion as colonising populations became too thinly spread to maintain eastward momentum.” Anderson has elsewhere (Anderson 2001:18) suggested that the “colonizing pulse was weakening” as Lapita moved eastward. Samoa lies at the very eastern edge of the Lapita expansion. Was Samoa an overextension of this pulse? We wonder if this expansion was also demographically unsustainable and resulted in the Lapita abandonment of Samoa after several decades or generations of occupation. Colonizing episodes have been known to expand beyond sustainable limits and then retract. The Viking expansion to North America and the East Polynesian “mystery islands” are examples of this kind of pattern (see Anderson 2001).

After 30 years of concerted effort, Lapita researchers are still grappling with questions about the nature of the initial Lapita expansion, its motivation(s), the amount of subsequent interaction, the temporal span of that interaction, and post-Lapita movement of people in the region. These are complex topics covering a huge geographic area and a temporal span of minimally a few hundred years and as much a millennium. Add to this the notion that migratory expansions are, by their very nature transformative, and it seems that answers will be complex and most likely there will be heterogeneous patterns both temporally and between the Lapita sub-regions. With such large questions being debated in the Lapita research community, we think that there is enough room for us to question some of the assumptions and interpretations about early Samoan prehistory.

**Lapita and Post-Lapita Regional Interaction**

Lapita-period interaction in the West Polynesia region – at least as manifested by exchange – appears to have been minimal (Summerhayes 2000). Burley summarized the evidence a few years ago:

> “Green (1996) provides an exhaustive review of evidence for exchange in Fiji/Western Polynesia. While he (1996, p. 126) is able to make the assertion that evidence for imported goods ‘is no longer uncommon’ in early Lapita sites, the data amassed for Tonga and Samoa are underwhelming at present. In fact, Davidson's (1978, p. 388) earlier statement that ‘there is little evidence for a Lapita trade network in the region’ remains generally correct for Western Polynesia” (Burley 1998:357).

In the Polynesian Plain Ware period we also see little evidence of exchange. Notably, there does not appear to have been much movement of stone resources from Niutoupoutapu and Tutuila. Perhaps corollary to this is the fact that the specific attributes of the plainwares differ in each place – e.g., simple bowls in Samoa compared to almost exclusively large jars in Tonga (Burley, pers. comm.). As discussed by participants at the Archaeology of the Polynesian Homeland Conference (Tutuila, Nov-Dec 2006) this appears to be a time of differentiation in the archaeological records of the various islands of the region. And yet, it has been argued that this was a long period of sustained interaction and of common development – the period of Ancestral Polynesian Society (Kirch and Green 2001).

An extensive and systematic analysis of the evidence for continuity in West Polynesia found little archaeological support for such continuity (Smith 2002). Although Smith’s research can be challenged on methodological or theoretical grounds, there has been no data-based substantive archaeological rebuttal of her conclusions.

The time has come to question the assumed cultural and biological continuity between the people responsible for Lapita-bearing deposits, Polynesian Plain Ware deposits, and aceramic deposits in West Polynesia. What if there were different “societies” in the region? What would the archaeological evidence look like if the islands of West Polynesia were not in close contact and there was not development of an Ancestral Polynesian Culture? Will archaeologists “see” or “find” such evidence without models or other conceptual frameworks specifying data requirements for different scenarios?
Mulifanua and the Assumption of Continuity Between Eastern Lapita and Samoan Plain Ware

As we noted earlier, the conventional model for Samoa holds that Mulifanua (and/or additional yet undiscovered Lapita sites in similar geomorphological settings) represents the founding human population of Samoa, that the archipelago was subsequently continuously occupied by their descendents, and that Samoan Plain Ware was a direct cultural descendent of Lapita ceramics as represented by the Mulifanua assemblage.

Petchey’s study of the Mulifanua assemblage (Petchey 1995) is the most comprehensive to date. Her research was specifically aimed at analyzing temper, clay, vessel form, and decoration of the Mulifanua sherds. Through her compositional analysis, Petchey found that only one sherd has temper exogenous to ‘Upolu (as well as having distinctive clay). The most likely source of this quartz-rich temper is Fiji, although Tonga and Tutuila are also possibilities (Petchey 1995:88-89).

Petchey uses problems with stratigraphy and dates at Mulifanua to argue that there is “no undisputed connection between the ceramics of the Mulifanua Lapita and later Samoan Plain Ware” (Petchey 1995:158). Furthermore, the relative lack of diversity in Samoan temper sand sources means that “broad similarities in the Samoan tempers cannot, therefore be used to represent continuity between the Mulifanua Lapita ceramics and Samoan Plain Ware” (Petchey 1995:159). Petchey notes the lack of analysis of the plain component of Eastern Lapita assemblages and summarizes that it is “thus surprising that the hypothesized transition between Lapita and Polynesian Plain Ware is based on resemblances of temper, notched decoration, ‘irregular striations on the vessel body’ and a decline in aesthetic quality of the pots (Green 1974a:249, 1974c:128), none of which are universally agreed upon” (Petchey 1995:160).

Petchey’s analysis of Mulifanua vessel form and decorative motifs in comparison with six other Eastern Lapita sites indicates that the Mulifanua assemblage is neither Late Eastern Lapita nor Early Eastern Lapita but “somewhere in the middle” (Petchey 1995:149, also 157). A possible scenario accounting for this is that people first reached Samoa in the middle part of the Eastern Lapita sequence; its wasn’t part of an initial push into the area, nor was it the last place settled. This is suggestive of the kind of “leapfrog” colonizing front proposed by Clark and Anderson (Clark and Anderson 2001). The settlement at Mulifanua may then have been abandoned before changes to late Eastern Lapita vessel form and decoration took place.

As mentioned earlier, to account for the lack of Lapita sherds at ‘Aoa and To’aga, Clark (Clark and Michlovic 1996) and Kirch and Hunt (Kirch and Hunt 1993b) have proposed that dentate stamping was almost immediately dropped in Samoa. This is hard to reconcile with Petchey’s stylistic assignment of the Mulifanua sherd to the middle of the Eastern Lapita sequence. Why would dentate stamping continue everywhere else in the Eastern Lapita Province into late Eastern Lapita forms, but not in Samoa? We suggest that this dilemma has been created by ambiguity in the dates for ‘Aoa and To’aga. By interpreting the initial deposits at these two sites to ~2400 cal BP this dilemma no longer exists.

Were Other Groups Moving Around?

Clearly, the “Lapita peoples” were comfortable with their maritime technology and were highly mobile. But were they the only ones moving around? Were other groups – perhaps related to Lapita peoples – moving around the ocean as well (as suggested above by Clark, 1993b:326)? If these groups were not making (and depositing) Lapita pottery they may be less archaeologically visible – their presence would have been swamped by the highly visible and distinctive Lapita archaeological signature.

Several lines of evidence suggest continued movements of people, or at least a later pulse of movement. Anderson has suggested an episodic model for Polynesian expansions with a major pulse at ~3300-2800 BP and another at ~2000 BP (Anderson 2000; Anderson 2001:21). Movement(s) of pottery-using people(s) from island Melanesia into Micronesia probably happened in this period as well.

Kennedy’s recent summary of banana origins and distribution in the Pacific suggests multiple introductions into Remote Oceania (Kennedy 2008). Animal husbandry seems to have changed through time. In a recent review of the evidence for animal translocations in the Pacific, Matisoo-Smith (in press) concludes that the “significance of early pig remains in Lapita sites should be put in a larger context. While pigs were apparently present from the earliest Lapita contexts, their economic significance or interpretation is not clear. Pigs are not present in large numbers until later in the archaeological sequence.” Dog may be a later introduction as the “archaeological
evidence for Lapita dog or for any dog prior to 2000 BP in the Pacific is weak to non-existent” (Matisoo-Smith 2007). Again, the idea of continued introduction of agricultural elements into Remote Oceania is indicated. DNA evidence indicates two separate introductions of dogs into Remote Oceania. Matisoo-Smith (in press) suggests the possibility “that at least one of these lineages was introduced later, around 1000-2000 BP, when there is an increase in the numbers of dogs in the archaeological record.” Matisoo-Smith further points out that the “use of the proto-Polynesian forms related to *kulii in most of the western Pacific is consistent with our findings that the Lapita-dog connection is questionable” (Matisoo-Smith 2007).

Remote Oceania there are two mtDNA lineages (haplogroups IIA and IIB) for the Polynesian rat – Rattus exulans – (Matisoo-Smith and Robins 2004). Haplogroup IIA is primarily associated with Lapita, while IIB is perhaps a later introduction, although if separate introductions, the time gap is currently unknown (Matisoo-Smith pers. comm.). Initial results on Gallus gallus (chicken) also show two “mitochondrial lineages in the Pacific indicating the possibility of two introductions of these domesticates to the region” (Storey et al. 2007:10338).

Studies of human genetics in Oceania suggest a complex history of interaction and gene flow. Studies of mtDNA from ancient bone (Hagelberg and Clegg 1993, Hagelberg et al. 1994) suggest the possibility that the original Lapita colonizers and later Polynesians did not share entirely the same origin. These results should be treated as tentative until the results have been duplicated by other labs (Matisoo-Smith in press).

In a recent review of the biological evidence associated with Lapita, Matisoo-Smith writes that one “clear conclusion is that the overall picture of the human settlement of the Pacific is not simple. We can no longer think of it in terms of any specific number of waves of migration, but rather in terms of a dynamic, on-going process.” (Matisoo-Smith in press). Given the evidence for the amount of interaction and the complexity of the dynamics in the area between Island Southeast Asia and Remote Oceania, we think the possibility should be entertained that more than a single population may have settled in Fiji/West-Polynesia. These populations may represent groups that were roughly contemporaneous with Lapita, perhaps were not biologically distinct from Lapita populations, but lack the signature dentate-stamped ceramic design.

**Chronometric Hygiene and Samoa Settlement Chronology – An Apparent Gap**

Rieth (Rieth 2007:8) has summarized the main points of the conventional model of the initial settlement of Samoa as:

1. The initial colonists of Samoa arrived between ~3000-2600 cal BP and produced dentate-stamped pottery;
2. There are likely multiple early settlements with dentate-stamped pottery, although their number and geographical extent is debated, and Mulifanua is the only known example;
3. Dentate-stamped decoration was quickly abandoned, likely within 100-200 years of initial settlement;
4. Early Lapita sites in the western half of the archipelago are probably submerged in the intertidal zone due to island subsidence;
5. In other parts of the archipelago, early pottery-bearing sites are also likely to be found deeply buried under terrigenous and/or biogenic sediments along ancient shorelines because of a variety of interconnected geomorphological factors, and;
6. Although identification of early sites in Sāmoa is more difficult than other parts of the Fiji/West Polynesia region, the cultural sequence and patterns are similar within the bounds of localized variation.

When archaeology started in Samoa, standard errors of more than ±100 years were common and many issues surrounding treatment of different sample types were either unknown or unresolved. Relationship between the sample event (an organism ceasing to fix carbon) and target event (a cultural deposit) and the contextual interpretation of dates has been a been a perennial problem. Chronometric hygiene approaches have sought to

Using chronometric hygiene protocols, Rieth and colleagues (Rieth et al. in review, Rieth 2007) demonstrate that the currently available suite of \(^{14}\)C determinations is inadequate to assess the ideas in the conventional model and may in fact show a hiatus between Mulifanua and Plain Ware sites. They conclude that the “initial Lapita settlement of Sāmoa is represented by a single deposit at Mulifanua dating to ~3000-2600 cal BP. Although it has been proposed that additional Lapita settlements may have been distributed along the coasts of much of the archipelago, investigations have not located these deposits nor reliably dated early Polynesian Plainware deposits older than ~2500 cal BP. It is only by ~2300-2000 cal BP that a number of settlements were occupied across the archipelago” (Rieth et al in review).

**An Alternative Model – Non-continuous Settlement**

There are enough questions about both the continuity of ceramics and the continuity of radiocarbon dates to suggest that other possibilities than the conventional model be explored. Are there other, equally plausible, ways of interpreting the evidence?

Here we propose an alternative model. The model has the following elements:

1) Lapita colonists arrived in Samoa toward the end of the Lapita expansion into Remote Oceania;
2) Samoa was beyond the sustainable limits of the Lapita expansion;
3) Lapita people left Samoa after a short time (perhaps within a generation);
4) Samoa was permanently settled only later and at a time when dentate stamping had been abandoned in Fiji/West-Polynesia;
5) Settlement was continuous thereafter.

**Expectations of the alternative model**

The alternative model would expect:

1) Minimal Lapita (dentate-stamped) presence in Samoa;
2) Many beach locations dating to ~2900-2700 cal BP with no Lapita (nor any cultural deposit);
3) Non-continuous occupation (although the deposits might directly superimposed, there should be a gap evident in the dates between ~2900-2700 cal BP and ~2400-2000 cal BP);
4) Continuous sequences from ~2400-2000 cal BP onward;
5) Evidence in the material culture of non-continuity, especially in aspects of ceramics such as technology, temper, decoration, surface treatment, vessel form, etc.
6) There may be isolated early dates throughout the archipelago associated with the initial Lapita exploration of the islands (a la Graves and Addison 1995).

Expectation 1 will be difficult to investigate. The conventional model supposed additional Lapita sites on ‘Upolu and Savai’i in similar geomorphological context to Mulifanua (i.e., submerged and possibly under cemented marine deposits). Even if funding were available, it is unlikely that environmental permits could be obtained to dredge through coral reefs around ‘Upolu and Savai’i. However, economic-development projects on these islands may in the future do just that. Would that archaeologists were included in such projects! The discovery of more Lapita sites like Mulifanua would falsify expectation 1.
Expectation 2 can be investigated through systematic subsurface investigations. As noted above, the submerged coastal sites of Savai‘i and ‘Upolu cannot be investigated, however, sites that are in areas with minimal subsidence or with uplift are amenable to standard techniques, such as those employed by Kirch and Hunt on Ofu. Elsewhere we have outlined a program for identifying likely target areas on Tutuila Island that can address this expectation (Rieth et al. in review). We and Rieth anticipate testing these areas beginning in 2009.

For Expectation 3 we recognize that the flattest portion of the Holocene radiocarbon calibration curve spans roughly the 2700-2400 BP section. This will make it particularly challenging to address this question, and only dates with minimal standard errors and on short-lived parts or species will pertain to it. It will also be necessary to have robust suites of dates from sites proposing to address this question so that anomalous dates can be more easily identified and removed from the analysis.

Evidence for Expectation 4 is accumulating from Tutuila (Addison and Asaua 2006a) and the record from To’aga suggests post-2400 cal BP continuity (Kirch and Hunt 1993c). Huge gaps remain in our understanding of ‘Upolu and Savai‘i.

Expectation 5 will require analysis of plain ware assemblages from around Samoa, with the specific research objective of identifying evidence for continuity or discontinuity. It will be important here to distinguish between temporal changes suggesting a new population from autochthonous evolution from the first Lapita settlers (supporting the continuous occupation model). Methods developed by Cochrane (2004) to examine similar questions in the Yasawa Islands of Fiji could be usefully applied here.

It is axiomatic that the earliest occupation of Oceanic islands will be difficult to study because of the relatively low number of initial inhabitants and the long period to which colonization period sites have been subject to disturbance (Anderson and Sinoto 2002, Graves and Addison 1995). The long-running debate on the timing the initial colonization of East Polynesia highlight this problem (e.g., Anderson et al. 1994; Graves and Addison 1995; Kirch 1986; Sinoto 1968; Sinoto 1970; Spriggs and Anderson 1993). A recent re-evaluation of the controversial early dates from the Marquesas Islands, (Anderson and Sinoto 2002) suggests that artifacts and faunal remains may be better indicators of the earliest sites because the radiocarbon dates do not give fine enough resolution and are subject to a host of interpretive problems. It is likely that a similar circumstance may obtain in Samoa where non-Lapita sites have radiocarbon dates contemporaneous with the one known Lapita site, or even predating it.

Conclusion - Resolving Alternative Scenarios

In discussing the early settlement history of Samoa, this paper has highlighted some of the incongruities in the regional datasets and their interpretation. We have proposed a discontinuous model for the settlement of Samoa, have laid out expectations of that model, and have proposed data that would falsify them.

Pacific archaeologists have, since at least the mid-20th century, rejected the diffusionist ideas of an earlier generation. Ideas of waves of migration into Polynesia have been replaced by ideas about autochthonous development. In these later formulations, an initial Lapita population(s) moves into the Fiji/West-Polynesia area ~3000 cal BP. Linguists argue that West Polynesia rapidly lost contact with Fiji but maintained internal contact between islands for many centuries, thereby differentiating Proto-Polynesian from languages to the west.

We wonder what archaeologists (and even linguists) would see in the data if we envisioned a situation in which there were multiple groups moving around the area between the Bismarck Archipelago and Samoa in the period ~3000-2000 cal BP? This could be seen as two way traffic, or as unidirectional movement from the west.

Would this perhaps account for the DNA evidence, which is getting increasingly hard to fit into the autochthonous development model? It is perhaps time for us to consider more complex models that allow for more movement of peoples, ideas, and genes. Without going back to some of the naïve or racist aspects of diffusionist thinking of the 19th and early 20th centuries, perhaps we can consider the possibility that some of the changes we see in the archaeology of West Polynesia may be due to new populations and new ideas moving in. How such peoples would have interacted with existing populations remains to be explored. As well as modeling past dynamics, generation of better datasets is crucial. Especially, this includes comparable analysis of Plain Ware assemblages from multiple islands and much finer-grained dating protocols. Much work awaits in the region.
Acknowledgements

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Notes

1 Although we acknowledge the ongoing discussion of whether there is a “Lapita cultural complex” and what constitutes it, we do not wish to engage in it here and hence adopt the conservative definition of “Lapita” as dentate-stamped pottery.

2 Jennings, Holmer, and colleagues’ work on ‘Upolu, Savai’i, and Manono has added much to understanding of later Samoan prehistory. Because of fundamental problems with site stratigraphy and pre-2000 BP chronology (see detailed treatment in Rieth 2007 and Rieth et al. in review), their work is not discussed here.

3 See Clark and Anderson (2001:79-81) on why mainland sites may be under-represented in Fiji.

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References


A GIS Based Model for Locating Lapita Aged Settlements in American Sāmoa

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Abstract - The lack of Lapita pottery recovered from archaeological deposits across the islands of Samoa has both fascinated and perplexed archaeologists for over 30 years. Despite several well funded and extensive research projects aimed at discovering early settlement locations, only one locale (Mulifanua) has yielded Lapita decorated pottery. Explanations for the absence of archaeological materials dating to this time period have often focused on geomorphological changes associated with tectonics and sea level. These arguments suggest that the deposits are likely present but extremely difficult to locate; being either submerged under water or deeply buried beneath colluvial runoff. Here we present a GIS model with two main goals: First, we model the environment of the American Sāmoan Islands circa 2800 BP. We assess land availability and environmental characteristics at this time. Using the spatial and temporal distribution of radiocarbon dates across the archipelago we evaluate the results our GIS modeling. Next we suggest a number of areas that are most likely to contain the earliest archaeological deposits in American Samoa. Our model has ramifications for reviewing a number of hypotheses regarding initial settlement of the Samoan archipelago as well as changes in human spatial organization.

Introduction

Review of the archaeological literature on Lapita settlement locations (e.g., Lepofsky 1988; Kirch 1997; Nunn 2005) provides a wealth of information on habitat preferences for early colonizing populations. Nevertheless, locating Lapita aged archaeological deposits in Sāmoa has proved challenging despite several research projects specifically with this goal in mind (e.g., Clark 1989, Clark and Herdrich 1988; Kirch and Hunt 1993). Settlement location is a solution to a set of problems concerning resource acquisition and time allocation. The structure and distribution of natural resources plays a fundamental role settlement choice since colonizers would have sought to optimize the allocation of a variety of survival necessities. Some of these requirements include access to wild sources of protein and available settlement space (Jochim 1976). While resource distributions are certainly important for predicting the location of early archaeological deposits, various natural variables can also make discovering these areas difficult (e.g., Schiffer 1987). For example, regional geologic processes, localized tectonic activity, and changes in climate, can all affect the configuration of prehistoric coastlines, altering the preservation and location of archaeological deposits in the process (e.g., Dickinson and Green 1998). Soil erosion due to a variety of natural and anthropogenic factors can also deeply bury old deposits complicating their discovery today (e.g., Kirch and Hunt 1993). As a result, models for locating Lapita aged deposits must take into consideration natural environmental variables, anthropogenic landscape alterations, and a number of living requirements, through appropriate modeling methodologies.

In the study presented here, a GIS model to locate Lapita aged archaeological deposits on the islands of American Sāmoa is presented (Figure 1). The model integrates data on distance to coastal access, slope, sea level, and settlement space to elucidate primary areas for early settlement. While archaeological field work is indeed necessary to test the predictions, the model results will facilitate future field project planning and aid in cultural resource management strategies.
Background

Lapita Settlement of the Sāmoan Islands

Current analyses of Lapita archaeological sites in the Fiji/West Polynesia region suggest that colonization occurred no earlier than ~2900 cal BP (Anderson and Clark 1999; Burley and Clark 2003; Burley et al. 1999). Material culture associated with initial settlements has been termed Eastern Lapita to distinguish the region from the Western Lapita distribution. Colonists produced pottery with highly recognizable dentate-stamped designs which has become the primary definitional characteristic of the cultural complex. Eastern Lapita decoration disappears less than two hundred years after initial settlement (Anderson and Clark 1999; Burley and Clark 2003; Burley et al. 1999; Green 2002). In general, the loss of ceramic decoration is coupled with decreased vessel variability (Burley 1998; Green 1974).
In Sāmoa, initial colonists who produced dentate-stamped pottery arrived between c. 3000-2600 cal BP. The submerged site, Mulifanua, located on the North coast of ‘Upolu Island, is the only known deposit yielding dentate-stamped Lapita pottery in the Sāmoan Islands. While it is certainly likely that other archaeological deposits containing pottery with dentate-stamping may exist across the archipelago, their location and distribution remain puzzling. When compared to the nearby islands of Fiji and Tonga, the lack of Lapita pottery in Sāmoa appears anomalous.

**Environmental Context**

The islands of the southwest Pacific are located in a complex and dynamic environmental region where substantial environmental processes have occurred since initial colonization. Field data and computer generated models suggest that relative sea level in the equatorial Pacific has decreased approximately 1-3 meters between c. 5000-1500 yr BP (Mitrovica and Peltier 1991; Nunn 1995; Pirazzoli and Montaggioni 1988; Fletcher and Jones 1996; Grossman et al. 1998). Change in relative sea level is affected by a number of complex geophysical processes, including equatorial oceanic siphoning (e.g., Mitrovica and Peltier 1991), regional hydro-isostasy (e.g., Dickinson 2001), and localized tectonic activity (e.g., Dickinson and Green 1998).

Conclusive evidence for localized island subsidence in Sāmoa comes from the Mulifanua site on northern ‘Upolu Island. A submerged midden deposit containing dentate stamped Lapita pot sherds was discovered underneath a layer of paleobeachrock during dredging for the construction of the ferry passage to Savai’i (Green 1974; Green 1979; Dickinson and Green 1998).

The submergence of Mulifanua is due to lithospheric downflexure of the mantle as a result of Savai’i volcanic activity. Radiocarbon ages from shells contained within the paleo-beachrock date the Mulifanua site to approximately 2750 BP (Petchey 1995, cited in Dickinson and Green 1998). Estimates taking into consideration a former high sea stand of .8-1.6 meters approximately 2.8 ka, suggest a range of 2.6-4.4 meters of subsidence for Mulifanua since Lapita colonization (Dickinson and Green 1998). Kirch and Hunt (1993) have also documented subsidence on Ofu Island, perhaps as a result of volcanic loading from the shield volcano of nearby Ta’ū (Kirch and Hunt 1993; Dickinson and Green 1998; Dickinson 2001).

In contrast to the highly dynamic tectonic activity of its neighbor islands, research on Tutuila and Aunu’u indicate that localized tectonic subsidence or uplift have not affected relative sea level position over the last 3000 years (Stearns 1944; Nunn 1998; Clark and Michlovic 1996; Dickinson and Green 1998). In general, emergent coastal features such as wave cut benches and platforms track the regional mid-Holocene sea level high stand (Dickinson and Green 1998).

While the multiple and complex processes affecting relative sea level position across the Sāmoan archipelago make the development of a GIS model that takes into consideration relative sea level position 3000 years ago complicated, the choice to model only the islands of American Sāmoa simplifies the pursuit. As subsidence does not appear to have been an important processes dictating sea level position on either Tutuila or Aunu’u, the model presented here assumes relative sea level was approximately 1-2 meters higher circa 3000 years ago (*sensus* Dickinson and Green 1998).

Localized subsidence may play a role in locating archaeological deposits on Ofu Island. Research by Kirch and Hunt (1993) suggests that Lapita aged deposits are deeply buried far inland along a previously prograding coastal plain. At the To’aga site, Lapita aged deposits have been recovered at depths roughly equal to the modern tidal height. Given, the regional evidence for a 1-2 meter higher than present sea level during this time period, subsidence seems a likely explanation for the depth of the deposit (Kirch and Hunt 1993; Hunt and Kirch 1997). However, the combination of beach progradation and subsidence does not appear to have led to submergence of archaeological deposits as is the case at ‘Upolu. No evidence for submerged coastal cultural deposits in American Sāmoa has been presented by researchers.

The environmental and archaeological evidence reviewed above suggests two fundamental themes for locating Lapita deposits in Sāmoa. First, despite several extensive archaeological research projects aimed specifically at discovering Lapita pottery in Sāmoa, deposits with dentate stamped ceramics remain elusive. The lack of documented Lapita sites in Sāmoan appears to be anomalous when compared to nearby Tonga and Fiji. Second, given the submerged location of the Mulifanua site and the complex environmental variables affecting relative sea level position across the archipelago, it is unclear if the deficiency in Lapita represents highly dynamic environment variables or perhaps a divergent pattern in colonization at the extent of the Lapita distribution. In
order to resolve the cause of the diminution of Lapita pottery in Sāmoa, it is necessary to first highlight locations that are primary candidates for early colonization.

Model Methodology

While GIS has recently been used to assess various colonization scenarios for South Asia (e.g., Field et al. 2007), until recently little research has been conducted on initial habitation of the Pacific Islands. In the model developed below, multiple environmental variables are analyzed using a combination of raster surfaces and satellite imagery. The final product is a series of hypotheses regarding landscapes in American Sāmoa that would have been highly attractive for initial settlement circa 3000 B.P. The GIS model was developed in ARC GIS 9.1. Model variables include coastal access, slope, sea level position, and area available for settlement.

Coastal access was considered an essential variable because the importance of marine resources to the Lapita diet has been well attested to archaeologically (Butler 1988; Kirch 1997). Moreover, research on the location of Lapita settlements suggests that colonizers preferred habitats with easy access to marine areas (Lepofsky 1988; Kirch 1997, Nunn 2005). Consequently, areas with easy coastal access were considered highly attractive (Figure 2). Coastal access layers were produced by identifying sandy beaches and easily accessible low shorelines from Quickbird and IKONOS Satellite images in combination with the Atlas of American Sāmoa (1981) (Figure 2). These polygons were then converted to rasters and a cost-distance analysis was conducted using the cost-distance tool in ARC GIS 9.1 (Figure 3). The result is a set of cells increasing in cost with distance from coastal access areas. These cells were then reclassified and assigned numbers based on optimality (higher numbers equal less optimal areas). The most attractive area corresponds to 500 meter catchments around coastal access areas.

Figure 2. Coastal access areas visible through satellite.

Slope is also a limiting factor for residential settlement. Optimal areas for settlement on Tutuila, Ofu, Olosegia, and Ta’u are considered to have slopes between 0-12 degrees (Figure 4). While landscape adjustments such as terracing could potentially solve some of the problems associated with slope steepness, steep slopes are often coupled with other less optimal environmental conditions, such as increased risk of mass wasting events. Moreover, return routes to residences that require traversing steep slopes expend more energy than trips across flat landscapes (see Field et al. 2007 for similar GIS modeling). The coastal access cost distance raster and slope zone raster were combined into one friction surface (Figure 5) and reclassified. These raster layers estimate landscapes in close proximity to easily accessible coastal areas that are relatively flat.
Figure 3. Areas on Tutuila Island within 500 m of easy coastal access.

Figure 4. Slope raster for Tutuila Island. Lowest value indicates slope class 0-12 degrees.
It is important to note that while the friction surface raster presented in Figure 5 approximates zones according to the environment today, sea level change has dropped in the equatorial Pacific 1.5-2.6 m since the mid-Holocene (approx. 4500-5000 B.P) (Mitrovica and Peltier 1991; Fletcher and Jones 1996; Dickinson and Green 1998; Grossman et al. 1998). As mentioned above, while localized tectonic processes led to subsidence of ‘Upolu and Ofu Islands, present evidence suggests that paleoshoreline features on both Tutuila and Aunu’u appear well correlate to the height of the mid-Holocene stand of the sea (Dickinson and Green 1998; Nunn 1998).

To address change in sea level position it was necessary to access the location of sea level at initial colonization. A 2 meter contour was placed on the Slope/Coastal friction surface. The raster was then adjusted according to available land above the 2 meter contour. The new raster layers highlight relatively flat areas with easy access to the coast above sea level 3000 years ago.

Land available for settlement was also modeled in the GIS. Analysis of land availability using only computerized GIS layers may confront a number of limitations. For example, because the development of digital representations of contour maps from paper United States Geological Service (USGS) maps requires digitization through computerized tracing, the results are only as accurate as the skills of the technician. Perhaps more importantly, USGS contour maps produced by standard photogrammetric methods may contain systematic error when compared to more precise mapping conducted with on-the-ground survey equipment such as transit or total stations (see, Burley et al. 2001). Moreover, the areas modeled are all located along the coast and it was therefore necessary to take into consideration tidal range.

Finally, settlement space must be substantial enough to allow the necessary requirements for residences and related gardening activity. Factoring all of these variables, the final model returned areas in American Sāmoa that meet the following requirements at ~3000 cal BP, (1) located within a 500 m catchment of coastal access areas; (2) have slopes 0-12 degrees; (3) elevated more than two meters above sea level, and; (4) provide at least 300 m squared of available settlement space (Figure 6 & 7).
Figure 6. Optimal settlement areas c. 3000 B.P. on Tutuila Island. Area has been adjusted to at least 300 m$^2$ and 2 masl.

Figure 7. Optimal settlement areas 3000 B.P. on Ofu, Olosega, and Taú islands. Area has been adjusted to at least 300 m$^2$ and 2 masl.
Results

Eastern Tutuila and Aunu’u

On Eastern Tutuila and Aunu’u, 2 areas meet the specified requirements discussed above: 1) ‘Aoa Valley and 2) Maliuga pt. to Matuli pt (Figure 8). A limited amount of archaeological research has been conducted along this portion of the eastern coastline. The presence of large beach flats with easy coastal access makes this area ideal for human settlement. Detailed work at ‘Aoa, by Clark and Michlovic (1996) recovered plain ware pottery deposits along a dynamic landscape. Recent re-analysis of over 200 radiocarbon dates for the Sāmoa Islands by Rieth and Hunt (in press) calls into question the integrity and age of the deposit at ‘Aoa and further archaeological research is necessary to resolve the chronology of the area.

Central Tutuila

Three areas along central Tutuila would have been attractive for Lapita settlement: 1) Pago Pago, 2) Utulei, 3) and Vatia (Figure 9). Both Pago Pago and Utulei present difficulties for assessing colonization events. Historic and modern development has incorporated large sections of 20th century fill creating a modern landscape perhaps quite different from the past. The GIS analysis presented here has not incorporated paleo-landscape data for the area. As a consequence the post-fill topographic information used here may not accurately reflect the size and shape of the shoreline 3000 years BP. Only Vatia is a promising area for investigating early settlement in central Tutuila.

Western/Central Tutuila

Model results from western Tutuila indicate two optimal settlement locales: 1) Leone and 2) Vaitogi (Figure 10). The geologic history of the Tafuna Plain which derives from the Leone Volcanic Series, suggest that both of these areas may not have existed during Lapita colonization or may have been dominated by perilous lava flows that occurred as recently as ~1500 cal BP (Addison and Asaua 2006). However, multiple pre-2000 BP archaeological deposits inland on Tafuna Plain (from deposits buried by layers of volcanic ash) indicate relatively early settlement of the interior.

Aunu’u

Directly across the channel from Matuli Point, lies the small islet of Aunu’u. GIS analysis suggests that the western half of the island may contain early archaeological deposits (Figure 10). Early subsurface survey on Aunu’u recovered plain ware pottery which identifies an early period of colonization (Best 1992). However, more detailed archaeological analysis is needed to evaluate the chronological and spatial extent of archaeological materials on the islet.

Ofu and Olosega Islands

In contrast to Tutuila, the smaller islands of Ofu and Olosega, would have provided more available land for Lapita settlement (Figure 11). The entire southern coast of Ofu, including the coastal flat of Toaga would have been above sea level and flat enough to permit large scale settlements. Likewise, the east coast near Ofu village was also likely attractive. On Olosega, the eastern coastline, especially near Olosega village would have been optimal for early settlement.

Ta’ū Island

Ta’ū Island like Ofu and Olosega provide several good locations to investigate the possibility of Lapita deposits (Figure 12). Along the northwest coast, areas near Ta’ū village and Faleasao were highlighted by the GIS model. The entire eastern coast also met the model requirements with substantial areas illuminated near Fitiuta Village and the prehistoric village of Saua.
Figure 8. Optimal settlement areas c. 3000 BP – Eastern Tutuila and Aunu’u Islands.
Figure 9. Optimal settlement areas c. 3000 BP – Central Tutuila Island.
Figure 10. Optimal settlement areas c. 3000 BP – Western Tutuila Island.
Figure 11. Optimal settlement areas c. 3000 BP – Ofu and Olosega Islands.

Figure 12. Optimal settlement areas c. 3000 BP – Ta’u Island.
Discussion and Conclusion

The GIS model results provide a series of important hypotheses to systematically test with future fieldwork. While it should not be uncritically assumed that the areas identified by the model will contain early cultural materials, based on earlier studies of the location of Lapita settlements and the environmental variables at work in the Pacific Basin over the last 3000 years, these areas provide the most likely areas for initial settlement in American Sāmoa.

Upon inspection of the model results it is relevant to note that Tutuila Island circa 3000 cal BP may have offered poor coastal locations comparable to other islands settled during the Lapita expansion (Kirch and Hunt 1988; Kirch 1997). Although it is inappropriate to extrapolate the model results beyond the islands of American Sāmoa, limited suitable land area may have affected the number and distribution of early settlement deposits elsewhere in the archipelago. However, this suggestion is speculative at present as similar modelling must be considered for the remaining Sāmoan Islands.

The extension of the GIS model to the remaining islands of Sāmoa is currently underway. The unique geography of each island will lead to different model results that vary according to local tectonic history and island geography. Future research will be directed by the GIS modeling. Subsequent subsurface testing and dating of both cultural and geological deposits will help refine the chronology of colonization and human settlement across the archipelago.

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References


Towards a Relative Chronology of the Pottery in Mbuke Island in the Manus Province of Papua New Guinea

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Abstract - As a part of the research initiative: Globalization in the past and the present — a Joint Anthropological-Archaeological Research Project in Manus Papua New Guinea, initiated by Professor Helle Vandkilde—a team of eight persons, archaeologists and anthropologists from Aarhus University, went to do fieldwork in the Manus Province and its surrounding islands, Baluan and Mbuke. This paper presents the results of a season of fieldwork in the Manus region, including the discovery of a rare prehistoric skeleton and features from an open-area settlement site.

Introduction

As a part of the research initiative: Globalisation in the past and the present — a Joint Anthropological-Archaeological Research Project in Manus — fieldwork in the Manus Province and its surrounding islands including Baluan, and Mbuke in Papua New Guinea was conducted by a team of eight persons composed of archaeologists and anthropologist from Aarhus University Denmark.

This paper concentrates on the results from the archaeological fieldwork, surveys and excavations carried out in the islands of mainly Mbuke just south of the island of Manus (Figures 1, 2, & 3). From December 2006 to January 2007, 31 m² in Baluan and Mbuke were excavated. A large quantity of ceramics, obsidian pieces and stone axes from Baluan, Mouk Island and Mbuke were recorded and photographed. Additionally, a number of soil samples, charcoal samples, animal bones and a human skeleton from a grave (X502) in Mbuke were removed abroad for further analysis. The excavation in Mbuke revealed, a settlement consisting of a concentration of ancient fireplaces in the north-eastern end of the village (AAL 28). The ceramics in these fireplaces date from more than 1600 years ago, however ¹⁴C dates have still not been finalized. In the central part of the village a grave was revealed (AAL 31). The grave called A3 consisted of a prehistoric mature female skeleton, being placed in an extended position, probably dating to more than 1,600 years ago.

Figure 1. Overview of the research area. Focus has been on the islands of Baluan, Mouk Island (see Figure 2), just northeast of Baluan. Excavations were carried out primarily in Mbuke (Graphics: Mads Ravn).
Little research has been done on the tectonic movements and the past sea-level rise in the area around Mbuke (Johnson & Davies 1972; Johnson et al. 1978). Local geologists suggest that Mbuke is a volcanic island with no recent activity. Mbuke and its surrounding islands could be a crater, where the center is just north of the present village in the Island. Most of the soil is a red and clayish, testifying to the presence of iron in the ground. The soil layer is thick the few volcanic rocks found suggests that volcanic activity is of pre-quaternary age. Although one may expect an acidic soil, a number of skeletal remains from animals and humans are relatively well-preserved, pointing to a presence of calcium carbonate in the ground. Shells found at the surface were common and must have helped in preserving skeletal remains. The island of Mbuke consists of a flat platform, where the

Figure 2. Baluan and Mouk Island. The (yellow) crosses are sites that have been surveyed. The (red) dotted lines are survey lines and their routes (Graphics: Mads Ravn).

Figure 3. Sites investigated in Mbuke and surrounding islands. The squares are sites that have been located from surface finds. The circles are sites that have been excavated by test pitting in the area. The triangles are clay sources known today (Graphics: Mads Ravn).

**Landscape – Topography and Soil**

**Mbuke**

Landscape – Topography and Soil

Mbuke

Little research has been done on the tectonic movements and the past sea-level rise in the area around Mbuke (Johnson & Davies 1972; Johnson et al. 1978). Local geologists suggest that Mbuke is a volcanic island with no recent activity. Mbuke and its surrounding islands could be a crater, where the center is just north of the present village in the Island. Most of the soil is a red and clayish, testifying to the presence of iron in the ground. The soil layer is thick the few volcanic rocks found suggests that volcanic activity is of pre-quaternary age. Although one may expect an acidic soil, a number of skeletal remains from animals and humans are relatively well-preserved, pointing to a presence of calcium carbonate in the ground. Shells found at the surface were common and must have helped in preserving skeletal remains. The island of Mbuke consists of a flat platform, where the
The present village is located on the north side of the island. Towards the south — just behind the village — the landscape rises more than 40 degrees and reaches quickly its highest point of 183 m — a point cemented by the American Navy around 50 years ago. Due to the steep slopes above the northern platform of the village, heavy rainfall causes soil erosions. Therefore, a potential prehistoric site could be expected to lie deep beneath the present surface. The present village is really the only possible place for a coastal settlement, forming, as it does, an excellent platform. Until 1947, however, the Titans lived in houses on stilts in the water on the east side of the island as well as off the neighboring island of Buttengulo. Even today, on the east side of Mbuke, we find heavy surface concentrations of pottery, shells, and shell axes (See Figures 3 & 6).

**Method of Surveying, Excavation and Registration**

**Baluan, Mouk, and Mbuke**

The research strategy was to locate as many sites as possible on the islands, but particularly to identify new coastal sites (Figures 2, 4, 5, 7, 8, 9, & 10). The choice quickly fell on the area where the present village in Mbuke is situated. Due to the remoteness of the island, the test pitting method was implemented. A systematic test pitting placed around 25 m apart was initiated, however the dense population of houses in the area sometimes made it necessary to place pits with more than 25 m in-between.

![Figure 4](image1.png) **Figure 4.** A view at the interior of the Malsu crater of Baluan. From left to right: Signe Helles Olesen, Anders Emil Rasmussen, third person unknown (Photo: Mads Ravn).

![Figure 5](image2.png) **Figure 5.** View looking south from Pukali, with the natural “platform” of the present village. There cannot have been any other place to build a village on the island itself. In historic times a previous offshore village on stilts in the sea was situated towards the east around the point towards the left in this picture (Photo: Jeanette Varberg).

![Figure 6](image3.png) **Figure 6.** Air photo taken by the U.S. Navy around 1945. Seen from the east. According to my informant, Selan Kaluwin, this is the Bolol site just east of the island of Mbuke. Today we find in this area heavy concentration of pottery, shell axes, and collected shells on the slopes. (The picture, names, and information are kindly provided by Selan Kaluwin). The “Titans” left this village in 1947 and settled at the present site.
The aim was to search between 2-3 m above present sea level, taking into account a sea level retreat that since prehistoric times has been estimated by some researchers to be 1-1.5 m (Summerhayes, pers. comm. & Summerhayes 2003). We also considered not to excavate too deep due to the expected soil erosion from the slopes. The pits were excavated with the kind help of the locals. They recorded and put finds in bags for every artificial 20 cm spit. In some places (AAL28) a larger area of up to 6 m² was opened up. From here finds (X1 etc.) were related to contexts (K1 etc.). Contexts were recorded and their connection to a construct (A1 etc.) was related. All information was entered into an Access-based database (ArchaeoInfo software program), making it possible to relate photos, (F1 etc.) drawings (T1 etc.) and finds in detail to contexts and constructs. The sites and test pits were measured in a traditional way, supplemented by GPS and put onto a map. A number of flotation samples were taken from the fireplaces (A1 & A2) as well as carbon samples for radiocarbon dating. The same was done to the graves (A3 and A4).

**Results**

**Mbuke**

Upon arrival on the 31st of December, a large number of sherds, obsidian flakes, blades and stone axes were presented to us by a local amateur archaeologist named Selan Kaluwin. Most of these finds he had collected in the Tandralos and Bolol area and they are considered to be of a relatively recent date (Figure 3). The first three days were spent surveying the bush behind the village on the steep slopes looking for sites belonging to the previous inhabitants, the so called Matankols. Several sites were found there at the steep slopes of the island, especially on the north and east side of Mbuke Island (Figure 3). The large concentration of finds at the sea shore

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*Figure 7. Mouk Island seen from west (Photo: Mads Ravn).*

*Figure 8. Finds of pottery from Mouk Island (Photo: Mads Ravn).*

*Figure 9. Present cemetery site in Mouk Island, seen from northwest. The finds are located towards the left of the large tree by the palm tree. According to informants, a previous excavation was made to the left; where a group of people are standing in the picture (Photo: Mads Ravn).*

*Figure 10. Rock paintings at the north side of Mouk Island — all recorded in detail by Chris Ballard (Photo: Jeanette Varberg).*
of the east side of Mbuke supports local information that this area was inhabited by the Titans until 1947, when they moved to the present location of the village. The sites marked on Figure 3 with squares are likely to be recent sites. The Bolol sites are seen as the recent Titan settlement where houses were placed on stilts in the water just towards the east of the present shore line\textsuperscript{13}.

Most notable here are sites AAL 28\textsuperscript{14} and AAL 31\textsuperscript{15} where undisturbed contexts were revealed. In AAL 28 two fireplaces were revealed, one with well-preserved layers of burnt red clay at the bottom and layers of ash and charcoal above (Figure 11). Above A1 & 2, a layer full of shells contained pots that may date the fireplace. The fireplaces are located approximately 1.40 m over present sea level. This area indicates the presence of a settlement. Future $^{14}$C dates may support the preliminary dating of pottery suggesting that it is more than 1600 years old. In AAL 31 the undisturbed context (A3) of a relatively well-preserved skeleton X502 was revealed (Figure 12). Within few days, however, it started to disintegrate rapidly. This skeleton located 1.10 m below surface i.e., at 1.81 m above present sea-level, is estimated to be relatively old.

In a dark distinct layer above the grave A3, pottery dating between 1600-2000 years ago was found, suggesting that the grave is older. An exact date remains to be confirmed by $^{14}$C dating, as we have had problems extracting enough calcium from the present samples. The skeleton was fragile but is estimated to be 1.60 m tall. Preliminary analyses by Frederique Valentin suggests it to be a mature female, her teeth having much in common with Polynesian teeth structure. To the east another possible grave (A4) appeared, in fact a part of a skull has also been identified here. It was located slightly higher than grave A3.
General Observations of the Pottery from Mbuke

Some of the pottery retrieved immediately above the burial had shell impressions (Figures 13 & 14), suggesting a date of the skeleton to be as old or older than the Puian phase. Before this discussion, I have to present a general impression of the pottery. The impression from observations of all pottery retrieved in Mbuke is that it was largely composed of medium coarseness, followed by fine ware (Figure 15). Also slip was present at some pottery from the lower layers. The most dominating rim form on Mbuke was pointed lip, followed by flat lip. The direction of the rim seems to be mostly outcurving followed by incurving direction (Figure 16). The dominating decoration elements present at the island are round grooves and stabs in rows, followed by horizontal lines (Figure 17). The most dominating technique of decoration is spatula stab, followed by incision (Figure 18).

A Relative Chronology of the Pottery in Mbuke

Since Mbuke has been a place of pottery production, it is obvious that the creation of a relative chronology of a pottery sequence should be possible. As most pots are broken, rim-sherd and their decoration techniques are used, as those pieces contain techniques that are most likely to change over time. The use of correspondence analysis in Scandinavian studies has revealed useful chronologies of rim-sherd forming the basis for an understanding of further theoretical issues such as migration and cultural contacts in the neolithization process (e.g., Madsen & Petersen 1984:99; Madsen 1988; Madsen 1990). When decoration on pots have been assessed to be chronological, it is likely that the remaining decoration may reflect aspects of identity and ethnicity (Hodder 1982; Jones 1997), thus making it possible to conduct regionalization studies where material groups reflect either clans or ethnic groups (Høilund Nielsen 1997; Ravn 2003). I suggest that a similar analysis in the Pacific will pave the way for a comparable high-resolution understanding of migrations and cultural contacts here. No previous chronology has been attempted on excavated material in Mbuke per se, as no excavations have been made in Mbuke before. A correspondence analysis undertaken on the stylistic decoration elements of the rim-sherds of the pottery revealed a division into two, possibly three groups of decoration techniques (Figures 19a, b, & c).
In the right side of the scattergram we have a group of decoration techniques where incision and applied relief are dominating. In the left side stabs with spatula and cylinders, as well as finger impressions, and slip are dominant. The test pits, their location and the stratigraphy suggest that the group (Group I) to the left is older than those to the right (Groups II & III), because the finds generally are located in deeper layers in Group I than Group II and III16.

Figure 19a. Decoration technique found in Mbuke in combination with test pits (TPx:x). TP-numbers refer to test pits and subnumbers refer to layers; 1-5 means that the layer is between 0-100 cm below surface (every spit is 20 cm); AAL-numbers refers to sites.

Figure 19b. Decoration technique found in Mbuke.
The lower levels of site AAL 28 and AAL 31 especially seem to dominate in the “old side” of the scattergram, and it is clear from pottery found in this level that those layers should be dated to the Puian ware phase (1600-2000 BC) or older. The layer just above the skeleton X502, K5, is also situated in the left side of the scattergram and in a similar layer at similar depth pottery with shell impressions was found. To conclude, combinations of spatula stabs, cylinder stabs, slip and finger impressions are early decoration techniques, whereas notches and applied relief seem to be late techniques.

Decorated Elements and their Relative Chronology

Looking at decoration elements in the same perspective suggests a seriation. A seriation is a strong indication of a gradual chronological development of a pottery sequence (Figures 20a & b). Also here we find the deeper layers in the left side of the scattergram, suggesting that this side represents the older decoration elements, gradually moving into higher layers in the right side of the scattergram. Combinations of lips with dots, dots on the inside of rim and vertical lines are thus early elements. This is followed by round grooves and stabs in rows, followed by lines, rows and furrow at rim. Also angles are found in this “younger/late” side, waves and chevrons being the latest decoration element. So the general tendency goes from vertical via horizontal lines, rows and grooves to angles and waves (Figure 20b).
Rims and Their Relative Chronology

Various forms of the rim occur throughout a long time period. A correspondence analysis places two relative clear groups relatively distinct from each other (Figures 21a and 21b). Here outcurving rims occur mostly in combination with pointed lip form. Looking at the stratigraphy, most finds of this combination are found in the deeper layers. On the other side of the scattergram, rims with incurving direction appear with a 45 degree rim or a flat lip form, whereas the direct direction seems to be an outlier and thus appears less often in this combination. The sherds in this side of the scattergram appear in the higher layers of the excavated test pits.

Summary of the Pottery Analysis

The conclusion from combination analyses suggest that spatula and cylinder stabs in combinations with slip are an older decoration technique that can appear with incision. Applied relief and applied lists and notches is a younger decoration technique. Of decoration elements, vertical lines occur more often in combination with dots. Gradually vertical lines change to horizontal rows that appear in combinations with angles. In the latest section, chevrons and wave patterns occur in combination. Outcurving rims in combination with pointed rims are older than incurring rims in combination with 45 degree angles or flat rim form.
Spatial Observations

From the spatial distribution of the sites, observations suggest that the northern side of the Mbuke Island from around 120 cm down, covers an ancient site of possible Puian date. Test pits determined that the site is located within a diameter of c. 200 m (Figure 22). The eastern part of this site was a habitation area, due to the number of hearths. The western end may be a cemetery area, due to the fact that at least two skeletons were identified there. To summarize: A well-preserved site for future excavation has been discovered, which will contribute to the understanding of the settlement history in the area.

Conclusions and Perspectives

The above relative chronology has revealed the most likely combinations of decoration elements, techniques and rim forms and rim directions linked to the stratigraphy of the test pits. Additionally in Mbuke our archaeological investigations have revealed that settlement history can be pushed back more than 1600 years, as suggested by...
ceramic finds from just above the fireplace A1 & A2 and the graves A3 & A4. Few sites from this period have been found in the entire Manus region. In addition, skeletal remains were initially so well-preserved that future excavations in this region may support the qualified hypothesis that there is a cemetery in the area where grave A3 was found. Finding more burials in the Western Pacific is essential for gaining insight into the pattern of origin, interaction and especially movement of people in this region. Many see the previous Lapita culture marking the spread of a population with an entirely new “package” of material culture, a new technology and a new economy (Bellwood & Renfrew 2003; Bellwood 2005; Fredriksen 2000). This denotes a change in the linguistic affinity, the Austronesian language family, which is seen by linguists and archaeologists as being linked to a new cultural identity, kept alive through a close network of contacts (Green 2002). Pawley (2004) suggests that it marks the origin of the Polynesians and their language. Less attention has been paid to the end of Lapita and the subsequent cultures, and interactions following. The Mbuke burial, therefore holds the key to a better understanding of this interaction of people after the Lapita expansion. If, as preliminary analyses suggest, the skeletal remains has more in common with Polynesian people, the female must be seen as a descendant of the intruding Lapita culture living on in relative isolation from the local Melanesian people. When aDNA analyses of the skeletal remains and 14C dates have been completed, further investigations would benefit greatly from:

a) Extending the excavation area around the fireplaces A1 and A2, since there is good reason to believe that further settlement material is preserved here. Hence, the settlement pattern of these ancient people living at the shore of Mbuke in prehistory can better be understood.

b) Extending the excavation trench around the burial would make it possible to assess a) whether other skeletal remains (A4) indeed were as intact as the former (A1) and b) whether there is a cemetery in this area.

The end of the settlement is a puzzle and it could be argued, but not proved, that a large landslide may have caused the termination of this settlement. This needs to be assessed by further 14C dates testing and refining the above relative chronology put forward here.

Finally, the establishment of a pottery sequence is not only important for a better understanding of settlement patterns on Mbuke, but in the whole region, as Mbuke in the historical period exported large amounts of pottery to the whole southern region of Manus. Thus, this small island holds the key to an archaeological understanding and dating of a number of sites in the entire southern region of Manus and related off-shore islands (Kennedy 1981a; Kennedy 1981b; Kennedy 1982; Wahome 1999). With regard to prehistory, an improved pottery sequence is important for solving the pertinent question how regionalized was post-Lapita development? The whole Bismarck region is central to this discussion, and the results of this project suggest that further investigations at Mbuke would be a promising starting point.

Notes


2. <http://www.galathea3.dk/dk/Menu/Forskning/Globalisering+i+fortid+og+nutid/Project+specification>


4. The team consisted of Helle Vandkilde & Ton Otto, Mads Ravn, Jeanette Varberg, Steffen Dalggaard, and the students Anders Emil Rasmussen, Signe Helles Olesen, and Christian Suhr Nielsen (Aarhus University, Denmark). The project was undertaken from December 24, 2006 to January 22, 2007. Thanks to "Dansk Ekspeditionsfond". The present work was carried out as part of the Galathea 3 expedition under the auspices of the Danish Expedition Foundation. This is Galathea 3 contribution no. P23.

5. The archaeological field report was written by this author in late January and early February 2007 when he was a Research Fellow at the Australian National University. He thanks Matthew Spriggs and Sue O’Connor at the Research School for Pacific and Asian Studies, Australian National University, who allowed him to use the facilities there in such a short notice. Also many thanks to Jack Golson, Jean Kennedy, and Wal Ambrose for spending time with the author and for showing him collected finds from the Manus region. This paper was submitted August 2007. The expedition was kindly financed and supported by; “Dansk Ekspeditionsfond” and “Bikubenfonden”, the “Faculty of Arts at Aarhus University” Denmark, “Danida”, “Jyllandsposten”, “Carlsbergs Mindelegat”, “Institute of Anthropology, Archaeology and Linguistics”, “Moesgård Museum”. “Polaris
Electronics and Thrane & Thrane” kindly provided satellite communications equipment while “Trimble” and “Geoteam A/S” provided GPS support. All correspondences were undertaken by Helle Vandkilde, Ton Otto, Jeanette Varberg, and Steffen Dalsgaard. All visas and permissions were kindly provided by Jim Robbins OBE, National Research Institute, P.O. Box 5854, Boroko NCD, Port Moresby in Papua New Guinea (675-326-0300/0061) and Nick Araho, National Museum and Art Gallery of Papua New Guinea, P.O. Box 5560, Boroko (675-325-2422). The Post-Courier of Papua New Guinea reported on the results of the expedition on the 24th of January and 2nd of February. Jeanette Varberg and Steffen Dalsgaard were regularly in Web log contact with the Danish newspapers Jyllandsposten and Politiken.

6 So-called Puian ware.

7 By kind agreement with the traditional leaders of the village and the former principal of the local school in Mbuke, most original material was stored in the village school in Mbuke. Here two paper boxes were placed with the title “Danish Expedition 2007” containing selected finds of obsidian, ceramics, and stone axes. Until further notice from the National Museum and this author, the finds will remain there for a future exhibition. By agreement with the traditional leaders of Mbuke and by permission by the Manus Provincial Government, as well as the National Museum in Port Moresby, samples of animal teeth, animal bones, and soil were removed abroad for analysis and dating. Also a human skeleton (X502) was taken out for further analysis and dating. An agreement was made with the local leaders and the National Museum that it must be returned not more than two years after the project fieldwork ended (January 24, 2007 ). Initially, the samples and the skeleton were to be sent to a laboratory in the Australian National University (ANU) to the attention of David McGregor, School of Archaeology and Anthropology. Anthropologist Frederique Valentin examined the skeleton there in April 2007. Some of the samples were sent on to a 14C laboratory at Aarhus in Denmark to the attention of Jan Heinemeier Aarhus, National AMS 14C Dating Center, Institute of Physics and Astronomy, University of Aarhus. The animal samples were sent on to Durham University, to the attention of Keith Dobney, Department of Archaeology, University of Durham, for inspection and possible analysis. The samples were selected and sent by this author in early February.

8The local team consisted of a number of people — most notably Selan Kaluwin, Kevin Tokois, Kisakiv Niakuan, and the chief Potuku. Mads Ravn and Signe Helles Olesen were the daily leaders of the archaeological project and excavations.

9 All original drawings are held by this author and a copy is to be sent to the National Museum of Papua New Guinea along with the final report and selected photos. All remaining original material, as well as digital data, will be stored at Moesgård Museum 8270 Højbjerg, Denmark. The GPS system implemented is WGS84 being degrees east of Greenwich and south 10 of Equator. All GPS positions are precise; i.e., within c. 5 m. Map and sites were recorded in the GIS system Map-Info 8.0.

11 Finance for further analysis of these is not clear at the moment.

12 Site number (AAL9).

13 See below for more detailed account of each site.

14 Tatoo’s house.

15 Brian’s house.

16 TP21:1 stands for Test pit 21:1; 1 means that the find is located from 0 to 0.20 cm below surface and hence forth for every 20 cm spit. AAL 28 is the site number and indicates a location that can be found on the map.

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References


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Cranial Evidence of Ethnicity on the Sepik Coast, Papua New Guinea

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Abstract - This study reviews the several dimensions of social and biological identity as revealed in craniometric and nonmetric data and the patterns of skull curation and modification in a series of villages along the north coast and the lower Sepik River of Papua New Guinea. Collections now at The Field Museum of Chicago, USA and the Staatlichen Museum fur Volkerkunde in Dresden, Germany were acquired from this area in the late 1800s and the first decades of the 1900s, and represent the coastal population of what was then German New Guinea. These collections have been used previously to represent Papua New Guinea in macro-scale regional investigations of biodistance, but diversity has not been examined at this local micro-scale. Here we address the question of how biological relatedness is affected by — or reflects — the tremendous linguistic diversity on the northern coast of this island continent. The complete dataset includes 34 measurements and variation in 22 nonmetric traits assessed in 129 adult crania, including both males and females (with some raw data provided by Michael Pietrusewsky). The Mean Measure of Divergence statistic is utilized to examine combined-sex non-metric variation between the villages, while measurements are analyzed by sex using multivariate statistical analyses (e.g., discriminant function, Mahalanobis’s D2) and a clustering program. Neither Austronesian / Non-Austronesian language divisions nor simple geographic proximity suffice to explain the biological patterns observed here and we draw on ethnographic and historical data to interpret the relationships between particular villages. We also discuss evidence for social identity at individual and collective scales as revealed by the treatment of the dead. Skulls were curated and modified in a variety of modes, ranging from cleaning and painting with a red wash of clay at the western edge of the Sepik coast to the complete over-modeling of the face by Iatmul people on the Sepik River. The Iatmul portrait skulls represent obvious individual on, but study of the design motifs on skulls with incised designs on the frontal bones reveals both subtle individuation and the rendering of traditional inherited designs on the skulls of ancestors. The iconography of skull decoration is not unique but rather the design elements are common to a wide range of material culture in both painted and carved media, representing the incorporation of human remains into the realm of things made sacred at the hand of the master carver and painter. The designs and their execution provide another layer of cultural data added to the biological history already encompassed in the cranial morphology and life history of the individual.

Introduction

The nature of ethnicity and the extent to which we can identify ethnic groups in the past is a recurrent theme in archaeology. As multidimensional and situational constructs, ethnicities may be based on biological distance, language, religion, economic and political infrastructure, material culture, or all of these. And it is increasingly apparent to archaeologists that neither material culture, language taxonomies or DNA haplotypes can be used alone to address this complex and nuanced aspect of human social behavior as represented in the archaeological record.

As a socially constructed entity (Sofaer 2006) the human skeleton is a record of social practice both before and after death, and as such has much to offer the exploration of ethnicity in the past. Here we examine two quite distinct dimensions of ethnicity as they are recorded in human crania: biological distance and skull modification in mortuary ritual. In this analysis we examine the biological and ritual indications of ethnicity from the study of skulls obtained from the North Coast of Papua New Guinea between 1905 and 1913. These are not archaeological collections, but are the remains of people who lived in the last decades of the 1800s: before the arrival of missionaries, labor recruiters, plantation owners, and the German colonial government. We interpret the biological and social data in the framework of a practice-theory of ethnicity which posits that ethnic groups are actively created- and consciously maintained through language, religion and physical characteristics (Jones 1997:84).

Language and Biological Distance in New Guinea

The larger picture of human biology — and also the larger picture of prehistory — in New Guinea is typically framed by the
division between Austronesian (AN) and Non-Austronesian (NAN), or Papuan language speakers. But within both of these groups there is tremendous linguistic diversity, with some 760 languages spoken in a country about the size of Sweden (Kunck 1992). In every village of more than 500 persons, there are at least two identifiable hamlet dialects (Laycock 1982:34). This linguistic diversity is greatest along the coast and in the island groups; it is not the product of isolation but is purposely fostered and maintained as a means of distinguishing small groups from each other; as markers of group identity (Kalick 1992:1-2; Laycock 1982:34).

The question of how this linguistic diversity is related to biological diversity has been addressed in various studies typically focusing on population origins. Early studies used anthropographic and anthropometric data (e.g., Hambly 1940) and were cast in the "racial typology" framework. With the increase in accessibility of computers, multivariate statistical methods, and DNA evidence, research into the biological relationships and population histories of coastal, highland, and island peoples has expanded considerably (e.g., Attenborough & Alpers 1992; Pawley et al. 2005).

Recently, the colonizing, migration and social history of AN and Papuan speaking peoples in New Guinea and other parts of Melanesia have been addressed using fine-grained genetic studies of community-level variation (Cox & Lahr 2006; Eastal et al. 2005; Friedlaender et al. 2005; Harley et al. 2005; Tommaseo-Ponzetta et al. 2002) which "elucidate patterns of population interaction within small geographical regions" (Cox & Lahr 2006:48). Marriage and residence practices are reflected in patterns of mtDNA and Y chromosome diversity: patrilocality results in high mtDNA diversity and low Y chromosome diversity within groups, and low mtDNA and high Y chromosome diversity between groups (Oota, et al. 2001). This pattern is evident for West New Guinea groups where males stay in or near their ancestral home and females move to their husband's village (Harley et al. 2005; Kayser et al. 2003; Tommaseo-Ponzetta et al. 2002).

While these genetic studies address nuanced aspects of population history, craniometric research has been predominantly focused on large-scale population comparisons within New Guinea and between New Guineans and others (e.g., Howells 1973; 1989; Green 1990; Pardoe 1984; Pietrusewsky 1983; van Dijk 2005). For the most part, these analyses lump multiple small series of skulls into composite regional samples, which may mask considerable variability (van Dijk 2005:809) and which in some cases have no basis in biological or social reality.

All of the analyses find biological distinctions between people living in the Highlands and people living along the coast and offshore islands. Also evident is the fact that language relationships are not perfect predictors of biological relationships and neither is geographic proximity. Geography is certainly a factor in the social basis of population history here. The linguistic diversity of the region is matched by physical, climatic, and ecological variability (Kirk 1992:178) which impacts social interaction and economic networks, and ultimately population biology at the local level.

The lack of correlation between language distinctions and cultural distinctions along the north coast of New Guinea has been examined by Terrell and Welsch of The Field Museum. Trade is essential between the island groups and the mainland, and up and down the coast: anchored by the islanders' need for sago and yams which they cannot grow themselves (Terrell & Welsch 1990). Trade "friendships relying on generosity and established between individuals, are inherited and persist even today (Welsch et al. 1992). The trading friendships unite people in a region-wide social and economic network resulting in a degree of uniformity in material culture among coastal peoples that surprised the earliest anthropologists in the region, especially in light of the fantastic Linguistic diversity (Terrell & Welsch 1990; Welsch & Terrell 1991; Welsch et al. 1992; Welsch 1998; Welsch & Terrell 1998; Foley 1992; Gordon 2005). As Terrell (2001) has shown in his sociolinguistic approach to language on the North Coast of Papua New Guinea, the fact of language diversity predisposes us to think of people as separated in other ways as well. Thus, although the "community of culture" is a unifying element, people use language and subtle cultural differences, for example stylistic or decorative elements such as those found on string bags (Welsch et al. 1992), ritual practices, and religious beliefs to identify themselves and to distinguish themselves from others.

Other aspects of population variation and similarity are related to the small scale of social groups and vulnerability to natural disasters. Villages are comprised of small patrilocal hamlets which may fission as population increases or as disagreements occur. Aside from the social instability of settlements, geologic instability of the Sepik region has resulted in the destruction and relocation of many villages, most recently after the inundation of Sissano Lagoon in the July 1998 earthquake and tsunami.

In sum, we can point to many facets of social, economic, and biological interaction that contribute to the dimensions of distinctiveness and to the fundamental similarities of people along the Sepik coast. The
ethnographic research done along the Sepik coast is primarily in German language sources (e.g., Hauser-Schäublin 1989; Tielsr 1969) and does not reach the volume of ethnographic works addressing the highlands and Papuan Gulf regions. But every small village has a history, and we can examine the material (in this case skeletal) record of that history in a more fully informed context than is available for most archaeological collections.

Materials

The crania in the morphology sturdy were obtained by anthropologists and other collectors between 1905 and 1913 (Welsch et al. 1992:570). This was a period of intensive collecting by museums in the United States, Europe, and Australia (O’Hanlon & Welsch 2000). Curators bought or traded for items from local agents, ship captains, and independent dealers in ethnographic curios. The cranial metrics and non-metrics study uses collections from two different museums: The Field Museum in Chicago, and the Museum Für Völkerkunde in Dresden. There is ample documentation that these two series were actually collected at the same time, by the, same agents, with parts of larger collections being sold to the two museums (Welsch 2000). Contemporaneous with A.B. Lewis’s activities on the Field Museum’s Joseph N. Field Expedition, Otto Schlaginhaufen, an anthropologist with the Deutsche Marine Expedition to the Pacific (1907-1909), assembled a collection of skulls for the Staatliches Museum für Völkerkunde in Dresden (Pietrusewsky 1986, 1990). This collection from the Sepik region includes 44 crania from a cluster of three Sepik coast villages which complement the Field Museum collections from the western end of this stretch of coastline. Michael Pietrusewsky of the University of Hawai’i analyzed these crania in 1973 and graciously supplied his raw metric and non-metric data for this project.

The western and eastern clusters of villages are shown on the map (Figure 1), as is the easternmost provenience of crania in the study: Murik, a NAN-speaking village located in the mouth of the Sepik River. The other NAN speakers represented in the study are from Warapu village which is located at Sissano lagoon, with Sissano and Arop Villages — both AN-speaking. The cluster of AN-speaking villages visited by Schlaginhaufen — Paup, Yakamul, and Ulau are located between Sissano and the Sepik River. The skulls were not obtained by grave robbing or plundering the cult houses: they were traded for such items as paint, metal knives, mirrors, and fishhooks (Welsch 2000:162). The provenience and accession records for the Dresden collection include the name of the hamlet or subdivision of the village, as well as the sex and personal name of each specimen supplied to Schlaginhaufen by living villagers (Pietrusewsky 1986:25).

The 129 crania include 80 males and 49 females (Table 1). It seems likely that the larger number of males in the collections is the result of preferential curation and more elaborate modification of male skulls, hence their availability for trade and attractiveness to collectors.

The language affiliations of these villages are shown in Table 2. All the AN village languages are part of the

Figure 1. North Coast Papua New Guinea villages in cranial metrics and non-metrics study, with Austronesian and Non-austronesian language affiliation indicated. (Note that “Takamul” is a variant spelling for “Yakamul”).
Siau family, with several language dialects represented in both the eastern and western village clusters. The NAN villages represent the Sko and Nor language families. The obvious questions about the residents of these villages are whether their language distinctions are mirrored in biological distances, and whether proximity overrides linguistic distinction in shaping marriage or mating patterns.

Cranial Morphology

The cranial dataset includes 34 measurements (Table 3, Howells 1973; Martin & Sailer 1957) and variation in 22 non-metric traits (Hauser & DeStefano 1989; Hanihara, et al. 2003) assessed in 129 adult crania, including both males and females. The sample sizes vary slightly between the metric and non-metric analyses because of missing measurements, lack of sex estimates, and cranial modifications, especially of the foramen magnum. These are small sample sizes and all of the small sample size caveats apply. All statistical analyses were accomplished with Microsoft Excel and Statistica 7.0 (StatSoft 1984-2005).

Cranio metric Analysis

Multivariate analysis of cranial measurements has proven a valuable tool in skeletal biology and forensic applications for the estimation of sex and ethnicity (Pietrusewsky 2000; Larsen 1997). The metric analysis includes step-wise discriminant function, canonical analysis, Mahalanobis’s D2, and the unweighted pair-group average (UWPGA) clustering method (Pietrusewsky 2000). Discriminant function analysis is most effective in data with no missing values, so the cranial series were examined for missing values. Missing values may be filled with mean values calculated from all those individuals with that measurement, a procedure which tends to reduce variability. Or, as done here, the missing values may be filled by multiple regression analysis using other
Table 3. Cranial Measurements.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>MAXCRANL</td>
<td>Maximum cranial length (M-1)</td>
</tr>
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<td>NASOCCIL</td>
<td>Nasio-occipital length (M-1d)</td>
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<td>BASINASI</td>
<td>Basion-nasion (M-5)</td>
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<tr>
<td>BASIBREG</td>
<td>Basion-bregma (M-1 7)</td>
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<td>MAXCRANB</td>
<td>Maximum cranial breadth (M-8)</td>
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<td>MAXFRONB</td>
<td>Maximum frontal breadth (M-10)</td>
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<tr>
<td>MINFRONB</td>
<td>Minimum frontal breadth (M-9)</td>
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<td>Bistephanic breadth (H-STB)</td>
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<td>Bizygomatic breadth (M-45)</td>
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<tr>
<td>BIAURICB</td>
<td>Biauricular breadth (M-1 1 6)</td>
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<td>MINCRANB</td>
<td>Minimum cranial breadth (M-14)</td>
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<td>ORBBTHLF</td>
<td>Orbital breadth (M-51a)</td>
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<td>Bijugal breadth [M-45(1)]</td>
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<td>ALVEOLAE</td>
<td>Alveolar breadth (M-61)</td>
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<td>Mastoid height (H-MDL)</td>
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<td>Biorbital breadth (H-EKB)</td>
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Note: The measurement source is given with a capital letter followed by the name or number of the measurement in that source. H = Howells 1973; M = Martin & Sailer 1957.
measurements made on that particular cranium to predict the missing measurement.

One of the first observations made as the analysis proceeded was the separation of the crania into two different groups — the western village group and the eastern village group — a separation which corresponds to the two different datasets: our original data and the raw data provided by Pietrusewsky. The use of raw data collected by another researcher always raises the issue of interobserver errors in measurements. In this case, both authors were trained by Pietrusewsky in cranial measurement and non-metric observations, and both authors have extensive technical experience. To check for systematic bias in the measurements, we tested for statistically significant differences in univariate means between the cranial series, and then we eliminated those measurements and reanalyzed the data. The results did not change, suggesting there is not a systematic bias. As well, four crania from Arop were measured by Pietrusewsky and combined with the Field Museum series. In the course of analysis, if there was measurement discrepancy, these crania would be expected to cluster with the other Dresden crania and they do not, suggesting the east-west dichotomy is real and not a result of differing techniques.

The measurement list in the male sample is shown with the village means in Table 4. Most of the cranial height measurements had to be discarded because of foramen magnum modification as noted above. The Mahalanobis’s generalized distances in seven male groups (Table 5) and the resulting dendrogram (Figure 2) show a clear division between the western villages of Sissano, Warapu and Arop and the eastern villages of Paup, Ulau, and Yakamul. Of particular note here is the relationship between NAN-speaking Warapu and AN-speaking Sissano. Also, contrasting with geographic proximity as a biological predictor, Murik, the easternmost village clusters with the Sissano Lagoon villages in the west.

![Diagram of relationship based on cluster analysis (UPMGA) of Mahalanobis’s D Squared using 18 cranial measurements in 7 male groups.](image)

In the male individual scatterplot (Figure 3) based on the first two canonical variates, the distinction between the western and eastern villages is again quite evident. It is noteworthy that there is a wider dispersion of individual males in the western group than in the eastern group. As well, there is overlapping among the villages. A validation procedure checks if an individual crania is classified in its original group, this gives an indication of the heterogeneity of the samples. The classification results for the male groups are greater than 60% correct. The lowest result is seen in the Sissano sample, where two individuals are misclassified as Warapu. Means for the cranial measurements utilized in the female analysis are provided in Table 6. The female sample sizes are much smaller and the village of Yakamul is not represented, so there are six village groups. Unlike in the male analysis, cranial height measurements were possible in the female crania and are included in this
### Table 4. Cranial Measurement Means in 7 Male

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Table 5. Mahalanobis’s Generalized Distances for 7 Male Groups.

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Note: 18 measurements in 76 males. Bold indicates statistically significant differences p<0.05.

Figure 3. Scatterplot of males in 7 groups on the first two canonical roots using 18 cranial measurements.

The female individual scatterplot (Figure 5) based on the first two canonical variates reflects discrete village groups with very little or no overlap between the villages. The east-west distinction is not as obvious as in the male analysis. Some of this discreteness may be related to sample size but it is interesting to note the
Table 6. Cranial Measurement Means in 6 Female Groups.

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<td>17.820</td>
<td></td>
</tr>
<tr>
<td>Murik</td>
<td>102.143</td>
<td>42.930</td>
<td>40.165</td>
<td>39.973</td>
<td>41.363</td>
</tr>
</tbody>
</table>

Note: 19 measurements in 41 females. Bold indicates statistically significant differences p<0.05.

Figure 4. Diagram relationship based on cluster analysis (UPMGA) of Mahalanobis’s D Squared using 19 cranial measurements in 6 female groups.

Table 8. Formulae used to generate MMD and Z scores.

<table>
<thead>
<tr>
<th>Freeman Tukey Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \theta (k) = (0.5^* \arcsin (1-(2^<em>k)/(N+1)) + (0.5^</em> \arcsin (1-(2^*k+1)/(N+1))) ]</td>
</tr>
<tr>
<td>where k is the number of sides with the trait and N is the number of sides observed</td>
</tr>
</tbody>
</table>

The variance of MMD = \( 2/k \sum V^2 \)

\[ Z = \sqrt{(2^*k) - \sqrt{(2^*k-1) \cdot S^2}} \]

Bartlett's adjustment

If p=0 then p=1/N
If p=1 then p=1/(1-4N)
where N is the number of observations

From: Jackes, et al. (1997)
"misclassified" individuals: An Ulau female clusters with the Arop series, and an Arop female clusters with the Warapu series. Classification results in the female analysis are greater than 75%.

The craniometric analyses support an east-west dichotomy among the villages. Warapu is most closely related to villages with a different language, while Murik is most closely related to Warapu and the western villages. The males are more closely related among the village clusters than females. The female analysis upholds these relationships and suggests the females are more biologically isolated than the males.

Cranial Non-metric Analysis

Although not as popular as multivariate analysis of metric data, the strengths of non-metric analysis are the ability to use partial crania, combined sexes, and the use of crania without sex estimates. Village frequencies for the 22 non-metric variables are shown in Tables 9 and 10. Traits that occur bilaterally are scored on both sides and summed for these frequencies (Ossenberg 1981). The MMD (Mean Measure of Divergence) statistic has proven useful in fine grained analyses of non-metric variation (Ishida & Dodo 1993; Jackes, et al. 1997; Sjövold 1977; Stefan & Chapman 2003). Several steps are involved in the calculation: transformation of the sample frequencies to estimate the population frequencies and a further standardization of the MMD to a Z score that allows for graphing the differences. The MMD is statistically significant (α=0.05) if it is greater than twice its standard deviation. To compensate for very small sample sizes, the Freeman-Tukey transformation was used (Jackes, et al. 1997, Sjövold 1977). In addition, in cases where a trait is completely absent (p=0) or occurs in 100% (p=1) of the observations in one or more of the samples, Bartlett’s adjustment smooths the results (Sjövold 1977). At present there is no available software program for calculating the MMD and as such each individual author must recreate the statistic for themselves. To assist in this endeavour the formulae (following Jackes, et al. 1997: Table 3) are provided in Table 8. Microsoft Excel was used for calculating the adjustments, transformations, MMD, and Z scores. To graph the Z scores the Ward's method of clustering is recommended and this was accomplished with Statistica 7.0 (StatSoft 1984-2004).

The MMD using the full sample of crania (N=129), sexes combined, shows the smallest distances are between the eastern village cluster of Paup, Ulau, and Yakamul (Table11). The non-metric analysis replicates the east-
west dichotomy of the villages seen in the craniometric analyses (Figure 6). But in this analysis the NAN-speaking Warapu is an outlier to all the other villages, while Murik, also NAN-speakers, clusters with Sissano in the western group.

Looking at the MMD in the male crania (N=80) from seven villages (Table 12, Figure 7), again the east-west division is evident. It is noteworthy that among the males there are two groups of AN / NAN-speaking village pairs in the western cluster: Murik males group with Arop males, and Warapu males group with Sissano males.

The smallest MMD distances in the female analysis (N=4 (Table 13) are between Sissano and Warapu and within the eastern village grouping of Paup and Ulau. The dendrogram (Figure 8) shows Murik females, a very small sample of only two crania, clustering with Arop females before hooking on to the western village group.

The non-metric analyses again support the east-west separation of coastal villages. Biological relationships are suggested between linguistically distinct and geographically distant groups.

Table 9. Cranial non-metric variation in 7 groups (sexes and sides combined).

<table>
<thead>
<tr>
<th>Trait/Variation (A/O)</th>
<th>Sissano</th>
<th>Warapu</th>
<th>Arop</th>
<th>Paup*</th>
<th>Yakamul*</th>
<th>Ulau*</th>
<th>Murik</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metopism</td>
<td>2/12</td>
<td>0/28</td>
<td>0/26</td>
<td>1/33</td>
<td>0/5</td>
<td>2/11</td>
<td>1/15</td>
</tr>
<tr>
<td>Supraorbital foramen present</td>
<td>19/25</td>
<td>49/56</td>
<td>39/51</td>
<td>48/66</td>
<td>9/10</td>
<td>20/22</td>
<td>19/30</td>
</tr>
<tr>
<td>Spina trochlea present</td>
<td>6/22</td>
<td>10/55</td>
<td>5/52</td>
<td>2/66</td>
<td>0/10</td>
<td>0/22</td>
<td>2/26</td>
</tr>
<tr>
<td>Multiple infraorbital foramina</td>
<td>6/26</td>
<td>53/53</td>
<td>5/51</td>
<td>14/66</td>
<td>3/10</td>
<td>2/22</td>
<td>3/26</td>
</tr>
<tr>
<td>Multiple zygofacial foramina</td>
<td>14/24</td>
<td>33/49</td>
<td>38/49</td>
<td>45/64</td>
<td>3/10</td>
<td>14/22</td>
<td>15/28</td>
</tr>
<tr>
<td>Infraorbital suture present</td>
<td>11/26</td>
<td>22/50</td>
<td>20/49</td>
<td>26/66</td>
<td>2/10</td>
<td>7/22</td>
<td>13/27</td>
</tr>
<tr>
<td>Subnasal blurred</td>
<td>9/26</td>
<td>25/50</td>
<td>31/46</td>
<td>54/66</td>
<td>10/10</td>
<td>20/22</td>
<td>11/24</td>
</tr>
<tr>
<td>Foramen ovale/spinosum open</td>
<td>14/26</td>
<td>25/46</td>
<td>26/47</td>
<td>0/63</td>
<td>0/10</td>
<td>2/22</td>
<td>14/30</td>
</tr>
<tr>
<td>Ant. cond. for. spurred/double</td>
<td>2/26</td>
<td>5/48</td>
<td>3/49</td>
<td>2/55</td>
<td>1/6</td>
<td>4/22</td>
<td>2/21</td>
</tr>
<tr>
<td>Post, condylar canal patent</td>
<td>20/26</td>
<td>46/52</td>
<td>37/45</td>
<td>48/57</td>
<td>2/6</td>
<td>12/20</td>
<td>17/26</td>
</tr>
<tr>
<td>Precondylar tubercle</td>
<td>4/12</td>
<td>5/22</td>
<td>2/24</td>
<td>1/21</td>
<td>1/3</td>
<td>1/11</td>
<td>0/12</td>
</tr>
<tr>
<td>Ossified apical ligament</td>
<td>1/13</td>
<td>2/23</td>
<td>4/24</td>
<td>0/22</td>
<td>0/3</td>
<td>1/11</td>
<td>0/12</td>
</tr>
<tr>
<td>Paramastoid process</td>
<td>10/25</td>
<td>8/53</td>
<td>12/50</td>
<td>46/61</td>
<td>6/9</td>
<td>19/22</td>
<td>2/30</td>
</tr>
<tr>
<td>Parietal foramen present</td>
<td>22/26</td>
<td>41/50</td>
<td>37/49</td>
<td>48/66</td>
<td>5/10</td>
<td>18/22</td>
<td>18/28</td>
</tr>
<tr>
<td>Coronal wormian bone</td>
<td>4/22</td>
<td>1/32</td>
<td>6/41</td>
<td>0/66</td>
<td>0/10</td>
<td>0/22</td>
<td>5/28</td>
</tr>
<tr>
<td>Sagittal wormian bone</td>
<td>0/11</td>
<td>1/22</td>
<td>2/23</td>
<td>2/32</td>
<td>0/5</td>
<td>0/11</td>
<td>3/12</td>
</tr>
<tr>
<td>Lambdoidal wormian bone</td>
<td>16/22</td>
<td>17/51</td>
<td>13/47</td>
<td>30/64</td>
<td>1/10</td>
<td>8/22</td>
<td>17/29</td>
</tr>
<tr>
<td>Epiteric bone</td>
<td>5/24</td>
<td>14/33</td>
<td>7/44</td>
<td>13/64</td>
<td>2/10</td>
<td>4/21</td>
<td>3/28</td>
</tr>
<tr>
<td>Asterionic bone</td>
<td>0/24</td>
<td>4/56</td>
<td>8/50</td>
<td>17/66</td>
<td>1/10</td>
<td>5/22</td>
<td>3/30</td>
</tr>
<tr>
<td>Tympanic thickening</td>
<td>5/23</td>
<td>7/39</td>
<td>20/48</td>
<td>6/66</td>
<td>0/10</td>
<td>2/22</td>
<td>0/23</td>
</tr>
<tr>
<td>Tympanic dehiscence</td>
<td>9/24</td>
<td>26/47</td>
<td>24/49</td>
<td>10/66</td>
<td>5/10</td>
<td>2/22</td>
<td>5/22</td>
</tr>
</tbody>
</table>

Note: Affected/Observed, sexes and sides combined. Crania with unknown sex estimates are included. * Indicates data from the Dresden collection courtesy of Michael Pietrusewsky. The Arop series includes four crania from the Dresden collection and 22 from the FMNH collection.
Table 10. Cranial non-metric variation in 7 groups, by sex.

<table>
<thead>
<tr>
<th>Trait/Variation (A/O)</th>
<th>Sissano</th>
<th>Warapu</th>
<th>Amp</th>
<th>Paup*</th>
<th>Yakamul*</th>
<th>Ulau*</th>
<th>Murik</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>Metopism</td>
<td>0/5</td>
<td>1/6</td>
<td>0/9</td>
<td>0/12</td>
<td>0/14</td>
<td>1/20</td>
<td>0/13</td>
</tr>
<tr>
<td>Supraorbital foramen present</td>
<td>6/9</td>
<td>10/12</td>
<td>32/38</td>
<td>17/18</td>
<td>17/24</td>
<td>22/27</td>
<td>29/40</td>
</tr>
<tr>
<td>Spina trochlea present</td>
<td>4/10</td>
<td>2/8</td>
<td>8/37</td>
<td>2/18</td>
<td>4/24</td>
<td>1/28</td>
<td>0/40</td>
</tr>
<tr>
<td>Multiple infraorbital foramina</td>
<td>2/10</td>
<td>4/12</td>
<td>35/35</td>
<td>18/18</td>
<td>4/24</td>
<td>1/27</td>
<td>6/40</td>
</tr>
<tr>
<td>Multiple zygofacial foramina</td>
<td>5/10</td>
<td>7/11</td>
<td>22/31</td>
<td>11/18</td>
<td>18/23</td>
<td>20/26</td>
<td>27/40</td>
</tr>
<tr>
<td>Infracranial suture present</td>
<td>0/10</td>
<td>9/12</td>
<td>16/34</td>
<td>6/16</td>
<td>10/23</td>
<td>10/26</td>
<td>14/40</td>
</tr>
<tr>
<td>Subnasal blurred</td>
<td>3/10</td>
<td>6/12</td>
<td>15/36</td>
<td>10/14</td>
<td>15/20</td>
<td>16/26</td>
<td>32/40</td>
</tr>
<tr>
<td>Foramen ovale/spinsum open</td>
<td>5/10</td>
<td>8/12</td>
<td>16/30</td>
<td>9/16</td>
<td>13/22</td>
<td>13/26</td>
<td>0/37</td>
</tr>
<tr>
<td>Ant. cond. for. spurred/double</td>
<td>0/10</td>
<td>2/12</td>
<td>3/32</td>
<td>2/16</td>
<td>2/22</td>
<td>1/27</td>
<td>1/33</td>
</tr>
<tr>
<td>Post. condylar canal patent</td>
<td>8/10</td>
<td>9/12</td>
<td>32/37</td>
<td>14/15</td>
<td>15/19</td>
<td>22/26</td>
<td>28/34</td>
</tr>
<tr>
<td>Precondylar tubercle</td>
<td>1/4</td>
<td>2/6</td>
<td>5/14</td>
<td>0/8</td>
<td>1/10</td>
<td>1/14</td>
<td>1/12</td>
</tr>
<tr>
<td>Ossified apical ligament</td>
<td>1/5</td>
<td>0/6</td>
<td>1/15</td>
<td>1/8</td>
<td>3/11</td>
<td>1/13</td>
<td>0/13</td>
</tr>
<tr>
<td>Paramastoid process</td>
<td>4/9</td>
<td>6/12</td>
<td>4/37</td>
<td>4/16</td>
<td>5/24</td>
<td>7/27</td>
<td>26/37</td>
</tr>
<tr>
<td>Parietal foramen present</td>
<td>10/10</td>
<td>9/12</td>
<td>29/34</td>
<td>12/16</td>
<td>14/21</td>
<td>23/28</td>
<td>26/40</td>
</tr>
<tr>
<td>Coronal wormian bone</td>
<td>1/7</td>
<td>3/11</td>
<td>0/18</td>
<td>1/14</td>
<td>4/17</td>
<td>2/24</td>
<td>0/40</td>
</tr>
<tr>
<td>Sagittal wormian bone</td>
<td>0/3</td>
<td>0/6</td>
<td>0/13</td>
<td>1/9</td>
<td>2/10</td>
<td>0/13</td>
<td>2/19</td>
</tr>
<tr>
<td>Parietal notch bone</td>
<td>1/10</td>
<td>4/12</td>
<td>8/38</td>
<td>0/18</td>
<td>2/24</td>
<td>4/28</td>
<td>5/40</td>
</tr>
<tr>
<td>Asterionic bone</td>
<td>0/8</td>
<td>0/12</td>
<td>4/38</td>
<td>0/18</td>
<td>1/22</td>
<td>7/28</td>
<td>11/40</td>
</tr>
<tr>
<td>Tympanic thickening</td>
<td>1/8</td>
<td>2/11</td>
<td>4/27</td>
<td>3/12</td>
<td>9/22</td>
<td>11/26</td>
<td>2/40</td>
</tr>
<tr>
<td>Tympanic dehiscence</td>
<td>4/8</td>
<td>4/12</td>
<td>14/30</td>
<td>12/17</td>
<td>12/23</td>
<td>12/26</td>
<td>6/40</td>
</tr>
</tbody>
</table>

Note: Affected/Observed. Sides combined. * Indicates data from the Dresden collection courtesy of Michael Pietrusewsky. Ant. = anterior, post. = posterior, for. = foramen.
Table 11. Matrix of MMD Values (above the diagonal) and Z Scores (below the diagonal) for 7 Groups (sexes combined).

<table>
<thead>
<tr>
<th></th>
<th>Sissano</th>
<th>Warapu</th>
<th>Arop</th>
<th>Paup</th>
<th>Ulau</th>
<th>Yakamul</th>
<th>Murik</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sissano</td>
<td>0.214</td>
<td>0.092</td>
<td>0.271</td>
<td>0.222</td>
<td>0.291</td>
<td>0.098</td>
<td></td>
</tr>
<tr>
<td>Warapu</td>
<td>7.674</td>
<td>0.254</td>
<td>0.448</td>
<td>0.498</td>
<td>0.405</td>
<td>0.352</td>
<td></td>
</tr>
<tr>
<td>Arop</td>
<td>3.440</td>
<td>11.676</td>
<td>0.243</td>
<td>0.216</td>
<td>0.269</td>
<td>0.130</td>
<td></td>
</tr>
<tr>
<td>Paup</td>
<td>9.225</td>
<td>17.874</td>
<td>11.603</td>
<td>0.019</td>
<td>0.074</td>
<td>0.262</td>
<td></td>
</tr>
<tr>
<td>Ulau</td>
<td>6.220</td>
<td>13.034</td>
<td>7.108</td>
<td>0.887</td>
<td>-0.020</td>
<td>-0.018</td>
<td></td>
</tr>
<tr>
<td>Yakamul</td>
<td>6.086</td>
<td>7.619</td>
<td>5.506</td>
<td>1.851</td>
<td>0.084</td>
<td>0.244</td>
<td></td>
</tr>
</tbody>
</table>

Note: 22 variables, 128 cases. Freeman-Tukey transformation. Bold indicates statistically significant MMD values.

Table 12. Matrix of MMD values (above the diagonal) and Z Scores (below the diagonal) for 7 male groups.

<table>
<thead>
<tr>
<th></th>
<th>Sissano</th>
<th>Warapu</th>
<th>Arop</th>
<th>Paup</th>
<th>Ulau</th>
<th>Yakamul</th>
<th>Murik</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sissano</td>
<td>0.034</td>
<td>0.108</td>
<td>0.292</td>
<td>0.316</td>
<td>0.133</td>
<td>0.192</td>
<td></td>
</tr>
<tr>
<td>Warapu</td>
<td>0.5096</td>
<td>0.260</td>
<td>0.469</td>
<td>0.526</td>
<td>0.444</td>
<td>0.343</td>
<td></td>
</tr>
<tr>
<td>Arop</td>
<td>2.3113</td>
<td>7.248</td>
<td>0.278</td>
<td>0.318</td>
<td>0.223</td>
<td>0.120</td>
<td></td>
</tr>
<tr>
<td>Paup</td>
<td>5.6039</td>
<td>13.847</td>
<td>8.033</td>
<td>0.021</td>
<td>0.021</td>
<td>0.177</td>
<td></td>
</tr>
<tr>
<td>Ulau</td>
<td>4.2246</td>
<td>9.410</td>
<td>5.684</td>
<td>0.811</td>
<td>-0.065</td>
<td>-1.260</td>
<td></td>
</tr>
<tr>
<td>Yakamul</td>
<td>1.4346</td>
<td>6.553</td>
<td>3.772</td>
<td>0.607</td>
<td>0.901</td>
<td>0.161</td>
<td></td>
</tr>
</tbody>
</table>

Note: 22 variables, 80 cases. Freeman-Tukey transformation. Bold indicates statistically significant MMD values.

Table 13. Matrix of MMD values (above the diagonal) and Z Scores (below the diagonal) for 6 female groups.

<table>
<thead>
<tr>
<th></th>
<th>Sissano</th>
<th>Warapu</th>
<th>Arop</th>
<th>Paup</th>
<th>Ulau</th>
<th>Murik</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sissano</td>
<td>-0.015</td>
<td>0.087</td>
<td>0.224</td>
<td>0.083</td>
<td>0.010</td>
<td></td>
</tr>
<tr>
<td>Warapu</td>
<td>0.106</td>
<td>0.249</td>
<td>0.345</td>
<td>0.402</td>
<td>0.431</td>
<td></td>
</tr>
<tr>
<td>Arop</td>
<td>2.161</td>
<td>6.490</td>
<td>0.162</td>
<td>0.069</td>
<td>0.325</td>
<td></td>
</tr>
<tr>
<td>Paup</td>
<td>4.576</td>
<td>7.827</td>
<td>5.454</td>
<td>-0.033</td>
<td>0.657</td>
<td></td>
</tr>
<tr>
<td>Ulau</td>
<td>1.630</td>
<td>5.477</td>
<td>1.301</td>
<td>0.277</td>
<td>1.625</td>
<td></td>
</tr>
<tr>
<td>Murik</td>
<td>0.722</td>
<td>3.732</td>
<td>2.677</td>
<td>5.063</td>
<td>2.800</td>
<td></td>
</tr>
</tbody>
</table>

Note: 22 variables, 80 cases. Freeman-Tukey transformation. Bold indicates statistically significant MMD values.
Table 14. Cranial modification samples, by location and village group.

<table>
<thead>
<tr>
<th>Location</th>
<th>Village group</th>
<th># of villages</th>
<th># of crania</th>
</tr>
</thead>
<tbody>
<tr>
<td>West of the Sepik River</td>
<td>Sissano</td>
<td>5</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Wewak</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Mouth of Sepik</td>
<td>Murik</td>
<td>2</td>
<td>47</td>
</tr>
<tr>
<td>On the Sepik</td>
<td>Lower-Mid Sepik*</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>East of the Sepik</td>
<td>Watom</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>15</td>
<td>196</td>
</tr>
</tbody>
</table>

* Includes some crania in the FMNH collections without specific/village names listed in the accession records (Adapted from Stodder 2006).

Figure 6. Diagram of relationships based on Mean Measurement of Divergence for 22 cranial non-metric traits in 7 groups (sexes pooled).

Figure 7. Diagram of relationship based on Mean Measure of Divergence for 22 cranial non-metric traits in 7 male groups.
Summary Cranial Morphology

Clearly, there are multiple factors at work in the biological relationships of these small village groups along the north coast of PNG, but the results of our analyses of cranial morphological variation are consistent on a number of fronts. A clear biological distinction is apparent between the eastern village group of Paup-Ulau-Yakamul, and the Sissano lagoon group to the west. This does correspond to a language (dialect group) division within the Siau family of languages.

There are clear indications of a relationship between Sissano and Warapu. Warapu village was originally located on an island off the coast of the Sissano lagoon which was submerged, along with some of the coastline, after an earthquake in 1907 (Welsch 1998 citing A.B. Lewis’s diary). At the invitation of Sissano, the Warapu village was moved to the lagoon area where it was wiped out again in 1998 and is now located farther inland.

Evidence of biological relationships between Murik and some of the western villages may reflect trading relationships between the Sissano lagoon and the Sepik delta people. The Murik villages (currently there are 5) are in the Sepik River estuary and their unique location is the key to their entrepreneurial trade practices and role as middlemen between the Sepik River people and those along the coast, and between villages to the east of the delta and villages to the west of the delta (Lipset 1985).

The lack of evident relationships between the proximate village groups of Paup and Murik suggests the former has affiliations with other groups not included in this study, possibly those in the foothills district of the Toricelli Mountains. While these interpretations are limited by the small sample sizes, females appear to have reduced biological diversity within village groups, while males seem to have closer biological ties to males from other villages. This distinction may reflect the relatively greater mobility of men in their trading partnerships.

These data support the notion that geographic proximity familial, language and trading relationships all might contribute to aspects of individuation encompassed by ethnicity along the north coast of Papua New Guinea.

Ethnicity and Mortuary Ritual

The importance of language as an ethnic signifier in New Guinea is perhaps more easily understood in the context of the striking uniformity of material culture and the relatively close affinity between small groups. We think that, like language, distinctions in mortuary ritual — particularly in the modification and curation of skulls — was an important means of localized ethnic signification on the North Coast.

Our consideration of ethnicity in mortuary ritual is based on 196 skulls in The Field Museum collections from 15 villages on the Sepik coast (Table 14). The village samples are grouped from the west to east; from the Sissano Lagoon group — Sissano, Warapu and Arop, to the Murik villages at the mouth of the Sepik, villages on the lower Sepik and a few villages east of the Sepik River mouth (Figure 9). These include some of the same individuals as the biodistance study, but the two samples are not strictly comparable.

<table>
<thead>
<tr>
<th>Modification Type</th>
<th>Sissano Group</th>
<th>Murik Group</th>
<th>Lower Sepik</th>
<th>Watom Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reductive modifications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>foramen magnum</td>
<td>42</td>
<td>85</td>
<td>81</td>
<td>67</td>
</tr>
<tr>
<td>defleshing/ cutmarks</td>
<td>9</td>
<td>83</td>
<td>67</td>
<td>86</td>
</tr>
<tr>
<td>drilled holes</td>
<td>0</td>
<td>78</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td><strong>Additive modifications</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carrying frame</td>
<td>2</td>
<td>50</td>
<td>26</td>
<td>5</td>
</tr>
<tr>
<td>paint</td>
<td>30</td>
<td>54</td>
<td>6</td>
<td>67</td>
</tr>
<tr>
<td>nose, eyes, hair</td>
<td>0</td>
<td>85</td>
<td>79</td>
<td>10</td>
</tr>
<tr>
<td>incised</td>
<td>0</td>
<td>88</td>
<td>46</td>
<td>10</td>
</tr>
<tr>
<td>overmodeled</td>
<td>0</td>
<td>2</td>
<td>13</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 15. Cranial modification frequencies as % of observable crania per village group.

Adapted from Stodder (2006).
Cranial Modification

The curation of skulls and other skeletal elements is a common aspect of mortuary practice in Melanesia and Papua New Guinea (Bateson 1936; Fortune 1935; Goodale 1985; Gorecki 1979; Malinowski 1987). Ethnographic data and the analysis of skulls in the Field Museum collections reveal variation between villages: whether just the cranium was kept or also the mandible, the extent to which the skull was modified, and which other elements were kept (Parkinson 1979; Welsch 1998; Stodder 2005, 2006). Some kinds of skull modification are well known, such as the completely over-modeled portrait skulls made by the Iatmul on the Sepik River. These represent the extreme in the degree of cranial modification (Stodder 2006).
Reductive modifications include enlargement of the foramen magnum during cleaning, or from mounting the skull on a pole or hanging it from the skull rack (Figure 10). Some degree of foramen magnum modification is present on almost every skull examined in this study. This ranges from slight edge polishing or beveling to damage to the occipital condyles to major breakage on the basicranium, sometimes including the palate. Holes were sometimes drilled in the mandible (Figure 11) and temporal for re-attachment of the mandible, and sometimes a hole was drilled at bregma for attachment of a carrying frame as well. Cuts on the skull resulted from de-fleshing and cleaning as well as from the fiber ties used in re-articulation and attaching the frame.

Paint — typically a red wash — is the most common of the additive modifications, but some skulls have intricate painted designs or several broad bands of red, white or black pigment in combination with other additions. Pith eyes, noses, and fibre whiskers were added (Figure 12). Designs were carved on the frontal bones, decorative frames or more utilitarian handles were attached, and farther up the Sepik, the deceased's likeness was recreated in the over-modeled skull.

As Table 15 shows, additive modification to skulls is minimally practiced west of the Sepik River. There are painted skulls from these villages, but no added noses or eyes, no carrying devices, and no incised designs or over-modeled skulls. Modification increases with proximity to the Sepik River culminating in the over-modeled skulls from villages on the Sepik proper, and then declines again in the coastal villages east of the Sepik.

**Incised Skulls**

Of particular interest here are the skulls with designs incised on the frontal bone. These come from four (NAN speaking) villages in the Field Museum collections: Ibunda on the lower Sepik, Murik and Karau — 2 of 5 Murik villages in the Sepik estuary — and Bure which is just east of the Sepik Mouth. Incised skulls are also known from the Fly River, Purai Delta and elsewhere in the Papuan Gulf region of Southern New Guinea (Field Museum Catalogs; Newton 1961; Pietrusewsky 1986, 1990), but they are rarely illustrated and essentially unexplained in the literature on Papua New Guinea art. An early essay by Holmes (1897) discusses a small assemblage of incised skulls in the Field Museum collections, but unfortunately this collection, which was obtained by Franz Boas, does not have any more detailed provenience than New Guinea.
In terms of the designs and extent of decoration there are three identifiable groups of incised skulls: 1) those with single elements which include abstract designs but also plants and zoomorphic figures: flowers, butterflies, stars, turtles. 2) Skulls with headbands, some depicting daily headgear and others more elaborate headdresses. 3) A third group of skulls have more elaborate composite designs which are bordered by the coronal suture and the temporal lines. In a few cases the design extends onto the parietals. The basic elements of the incised designs are common to many items of material culture in the Sepik region. They appear on bowls and platters, cups and combs, house frames and lintels, masks and canoes in the Sepik region. The decorated skulls are clearly part of the regional art style which involves embellishment by painting and carving of practically everything. But no two of the incised skulls in the Field Museum collections are exactly alike. Individuation of the deceased is evident in the execution of the design elements and in their unique combination in the composite designs (Stodder 2007).

Looking at the designs by provenance reveals stylistic differences between the two villages with the largest numbers of incised skulls: Ibunda with seven and Karau for which there are 15. There are fewer skulls from Murik, but these too have their distinctive attributes and elements. The incised skulls from Ibunda (Figure 13) have two themes: shell rings; and headbands of plaited fiber, some with dog teeth and feathers as well as shell rings — all aspects of ceremonial regalia.

Incised skulls from Karau have paired elements which can be interpreted as eyes or butterflies (Figures 14 and 15). These are single spirals, interlocking spirals, or concentric circles with lozenge shapes as proximal and distal central elements. Some have hatching that seems to accentuate the eyes and suggests the looming, watchful eyes of ancestors and spirits featured in Semk and Murik art (Beier & Aris 1975; Lipset 2005). Some of the Karau skulls have two different eye forms while in some the two eyes are the same. These are subtle distinctions, but suggest that the designs were an aspect of individuation.

Murik skulls include the eye motifs similar to those from Karau, the other Murik village, as well as star elements (Bodrogi 1961) (Figure 16) and a design that was identified by a contemporary Murik artist as symbolizing the Fish Eagle (Beier & Aris 1975).

While it is clear that each incised skull is unique, there are thematic and stylistic continuities apparent in the village assemblages. In several cases there are two or more skulls that seem to have been carved by the same hand. Murik ethnography reveals that there were only a few master carvers in each generation, and that the art of carving and the right to use specific designs were passed through bilateral descent groups of both male and female siblings (Lipset 2005; Lipset & Silvernan 2005). Since the designs are present on ceremonial heraldry
such as baskets, shell ornaments, vests, and headdresses, it seems reasonable to propose that the designs on the incised skulls represent the inherited designs that belonged to Murik (and Karau) descent/groups in the late 1800s (Stodder 2007).

Thus the incised skulls are a perfect example of the importance of mortuary ritual in presenting and preserving group distinctions. The unique treatment of each skull within the local thematic framework simultaneously creates the social memory of the individual and of the group.

**Conclusion**

This work diverges from other studies of New Guinea crania in two substantial ways. First, our study uses small samples of crania from contemporaneous small villages, and we have not lumped them together for the sake of clearer statistical results. Despite this, there are consistent findings in the metric and nonmetric analyses that suggest we are looking at real, albeit subtle, patterns in biological and hence social relationships between people living on this stretch of coast in the mid-to late 1800s. And second, we examine crania as ritual artefacts and not...
just sources of biological data. The variation in the curation and modification of the skulls and the utilization of village — and even sub-village — specific designs on the incised frontal bones reveal the multiple scales of social identity expressed in mortuary ritual.

These two disparate kinds of information add to the rich and complex picture of social life on this island continent. Fundamentally similar material culture shared along this coastline perhaps explains why identity is expressed in language and mortuary ritual. Language is a consciously manipulated aspect of group identity but is not an inevitable biological barrier. Linguistic variation is echoed by variation in treatment of the dead. These aspects of Sepik coast cultural variation have multiple implications for the archaeological reconstruction of ethnic identities and population histories in the past. No single aspect of biology, social organization, or material culture can suffice to reveal the multiple dimensions of ethnicity. The challenge is to consider the multiplicity of small scale processes that constitute human social interaction and the many kinds of archaeological materials — including of course the skeleton — which can add to our understanding of the past.

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References


Perspectives on Pre-Colonial Human Introduction of Woody and Forest Species in the Pacific Islands: Prospective Ethno-Anthracological Research in New Caledonia

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Abstract - This article presents the results and perspectives of a preliminary study of woody species manipulation in pre-colonial New Caledonia. The study aims to use anthracological analysis to investigate vegetation changes linked to pre-colonial settlement patterns, and the human management of woody resources. In the first part of the research, archaeological field surveys have been associated with botanical collections and ethno-botanical observations in order to construct a wood reference collection and database. This new tool for regional archaeology is presented here. It should enable more archaeo-botanical studies in New Caledonia and a better understanding of the past dynamics of woody vegetation in relation to human activity. Meanwhile, analysis of data collected during botanical fieldwork and through literature review raises a number of questions about pre-contact translocation of woody species in New Caledonia, which have implications for the wider Pacific region.

Introduction

The development of “anthracology”¹ in New Caledonia is a way to answer the necessity to increase palaeoenvironmental data in the archipelago and throughout the Pacific. However, the distinctive role of trees and tubers among Austronesian societies implies that this kind of study is also significant for the definition of subsistence system models, as well as for the history of inter-island human voyages and associated introduction of plants. These themes are addressed through preliminary results of a research program focusing, among other points, on the human management and use of woody species on the “Grande Terre” island of New Caledonia, during the kanak pre-colonial period (second millennium AD) (Dotte-Sarout 2010). This research combines palaeoenvironmental and archaeological approaches. It is mainly based on anthracological analyses but it also uses general archaeological data relating to settlement patterns and horticultural practices, as well as sociocultural data. Importantly, it is the first attempt to apply the methods and perspectives of anthracology to New Caledonia, thereby testing its potential for palaeo-ecological and archaeological research in Southwest Pacific islands generally.

The project involved the constitution of a botanical reference collection, associated with an anatomical, ethno-botanical and ecological database. The work of bibliographical investigation, linked with archaeological and botanical field surveys, produced a first set of observations on the botanical/ethno-botanical characteristics of New Caledonia ligneous vegetation² and hypotheses on past human management of woody or forest resources by pre-colonial societies. These analyses address wider questions, such as the history of subsistence systems dynamics and the concept of domestication applied to trees and forests in New Caledonia (Dotte-Sarout 2010). They also relate to the diffusion of vegetal species and horticultural practices throughout the Indo-Pacific region. These issues are related, of course, to the history of human voyages, for colonization or exchange, between the islands of the Pacific Ocean.

This paper will focus on the botanical aspects and perspectives developed by the first results of our work relating to the constitution of the reference collection and database on New Caledonian woody plants. One of the main issues of these preliminary analyses is the question of plant introductions to New Caledonia. We will, firstly, try to locate that matter within the current model of colonization of Oceania. Secondly, we shall describe the current state of knowledge concerning archaeological characteristics of kanak pre-colonial societies and their
subsistence system. Thirdly, we will present the methods and significance of the reference collection and database. Fourthly, we will focus on data gathered during the fieldwork and bibliographic analyses relating to questions of woody and forest species manipulation (i.e. practices of domestication and translocation). This will lead us, finally, to discuss the perspectives offered by this kind of study for examining pre-colonial human movements throughout Oceania and their consequences for the manipulation of Pacific islands vegetation.

Background

New Caledonia Environmental Data

New Caledonia is the southernmost archipelago within the region of Melanesia, in the Southwestern Pacific (Figure 1). The main island, or “Grande Terre”, on which we focus here, is 400 km long by 50 km wide. It is surrounded by a barrier reef and wide lagoon (24 000 km²). The central axis of the island is a mountainous chain (highest point: 1628m) that draws a sharp environmental frontier between the windward east coast, characterized by deep and narrow valleys, and the leeward west coast, with larger plains and wide river mouths. The “Grande Terre” is an ancient part of Gondwanaland, marked by a complex geological history that produced a uniquely diverse geology (Picard 1999).

Geomorphological variety is coupled to climatic conditions that are highly differentiated, depending upon periods and areas of the Grande Terre. Within a general tropical to subtropical climate (annual mean temperature minimum at 17°C and maximum at 29°C), the south and west coast (leeward) tend to be under a dry tropical climate with more than 2000 mm/year, while the north and east coast (windward) are subject to a wet tropical climate. Moreover, the rainfall patterns of New Caledonia are characterized by high annual irregularity and are strongly influenced by the El Niño Southern Oscillation phenomenon: the mean annual rainfall can be reduced

Figure 1. New Caledonia and the Tiwaka valley. Sampling area A: species from archaeological sites, ruderal formations and savannas, evergreen rainforests, sclerophyllous forests, mangroves and littoral formations. Sampling area B: species from ruderal vegetation, mangroves and littoral formations.
from 20 to 50% during El Niño events, or on the contrary can increase from 20 to 80% during a La Niña phase (quantitative data: Timbal et al. 2004; www.meteo.nc).

With its variable climatic conditions, diverse physical environment, complex geological history, antiquity and pre-human isolation, New Caledonia has one of the world’s richest floras: more than 3200 indigenous species of vascular plants (pteridophyta or ferns and spermatophytes or seeds plants) among which 77% are endemic. It has been described, alone, as one of the distinctive floristic regions of the world (Jaffré et al. 2004:28-34). By comparison, Fiji, with the same approximate landmass as New Caledonia, has “only” 1700 species of vascular plants, and Papua New Guinea, well known for its biodiversity, has 5 to 7 times more species of vascular plants for a landmass that is 33 times larger than that of New Caledonia.

Among the seven plant formations defined by botanists (Jaffré et al. 1994), the richest is the evergreen rainforest. It has more than 2000 vascular plants species and covers approximately 20% of the archipelagic land area (mainly on the mountainous parts and east coast of the Grande Terre). The sclerophyllous woodlands, or dry forests, are thought to have been spread over nearly the entire west coast up to 300 m in altitude before human colonization, although nowadays they cover only 350 km² of the 25 000 km² of the archipelago. Today, the most widespread formations are the savanna woodlands (indigenous species), as well as secondary shrub lands and ruderal vegetation (invasive introduced species, mainly from the colonial period) (Jaffré et al. 1994, 2004).

The Place of New Caledonia Within the Current View of Pacific Settlement Processes

The archaeology of Oceania has been engaged for a few years in a process of gradual refinement of the classic model for Pacific settlement. New data, associated with new or existing views (among others, from Solheim 1984-85, 1996; Terrell 1989, 2004; Gosden 1991; Smith 2002, 2004; Bedford et al. 2007; Addison and Sand 2008; Matisoo-Smith 2009) have led to development of a more precise and complex interpretation, although one still grounded in the general model that was produced during the 1990’s (see Kirch 2000) (except for Addison and Matisoo-Smith 2010). Research addressing the diffusion and domestication or management practices of plant species has been notable for its contribution to the construction of this more complex scenario.

Dates for the human settlement of Near Oceania, between 60 000 and 40 000 BP, by nomadic groups of hunter-gatherers crossing the Wallacea, are still in debate, depending on the dating method considered (Allen 2003; O’Connor and Chappell 2003 ; O’Connell and Allen 2004). Part of this process is the arrival of human populations on the first islands of Oceania, in the Bismarck and Northern Solomon archipelagoes, by 35 000 BP (Pavlides and Gosden 1994) to 28 000 BP and more regularly from 20 000 BP, 15 000 and 12 000-10 000 BP (cf. Leavesley 2006). These groups were, necessarily, already maritime voyagers, but their subsistence system, although combined with some maritime components, was especially adapted to tropical rainforest environments and based, particularly, on the exploitation of terrestrial plant resources: wild tubers, fruits and seeds (Loy et al. 1992; Barton and White 1993; Pavlides and Gosden 1994; Spriggs 1997; Denham 2004; Leavesley 2006).

Only some time after Holocene sea levels rose did the second phase of maritime exploration and human settlement of the Pacific Islands occur, towards the archipelagoes of Remote Oceania. Considered as part of the same movement, migrations have been identified throughout Southeast Asia from the early fifth millenium BP (Bellwood 1997; Spriggs 1997; Oppenheimer 2003). New Caledonia was one of the first islands of Remote Oceania that were reached by human groups, from at least from 3200 cal. BP (Sand 2010). The exact dating of the end of Pacific islands prehistoric peopling is still a matter of debate, but Easter Island and New Zealand were settled between 1200 and 700 years ago (Kirch and Green 2001; Anderson 2003).

What is now widely accepted as the Lapita cultural complex (Green 2003), represents the first set of migratory movements that crossed the boundary between Near and Remote Oceania, peopling the Southwest Pacific and in the mean time, New Caledonia. The material culture linked to this complex first appears in the Bismarck but, as many have argued (Allen 1984; White et al. 1988; Gosden et al. 1989; Terrell et al. 2001), most of the Neolithic aspects of the “Lapita culture” have been considered as Austronesian introductions of practices and techniques developed in Island Southeast Asia (or eventually in China) (Bellwood 1978, 2005; Kirch 1997; Spriggs 1997: 67-151): pottery, horticultural practices and plants (tubers and fruit trees) or animals (chicken, dog, pig) and, possibly, settlement modes in sedentary villages along coasts associated with various types of short-term specialized sites (Kirch 1997, 2000; Green 2003). Moreover, the spatial pattern of settlement, representing mainly littoral and small island locations, supported the idea of a maritime oriented culture (see also Valentin et al. 2010).
However, recent developments in archaeological investigation seem to require reconsideration of the importance of terrestrial plants exploitation and inland occupation (Torrence and Stevenson 2000; Horrocks and Nunn 2006), although without resolving debate on the modes of plant exploitation, i.e. horticulture and domestication vs gathering of wild plants (cf. Davidson and Leach 2001; Kirch and Green 2001; Anderson 2003). In addition, re-examination of archaeozoological data shows that the animal domesticates trilogy thought to be part of the Austronesian transported Neolithic “kit” has a more complex history of origin that domestication in Asia, and is rarely documented securely in Lapita sites (Anderson 2009; Matisoo-Smith 2009). Meanwhile, studies since the 1990’s have consolidated the idea of local innovations and integration of indigenous Papuan elements (on socio-cultural and human aspects) within the immigrant Austronesian groups (Green 2000, 2003; Donohue and Denham 2008). Indeed, research on horticultural practices, origins of Remote Oceanian introduced plants, domestication and exploitation modes of forest resources, have emphasized the important contribution of Pleistocene and Holocene developments in Papua New Guinea, and possibly in Wallacea and Near Oceania, within the set of subsistence modes and plants diffused throughout the Pacific, especially within the scope of arboricultural practices and tuber exploitation (Barrau 1962, 1970; Yen 1974a, 1991, 1995; Allen et al. 1989; Gosden 1992, 1995; Lepofsky et al. 1998; Walter and Sam 1999; Latinis 2000; Lebot 2002; Blench 2004; Denham 2004, 2005; Kennedy and Clarke 2004; Lentfer and Green 2004).

**Kanak Pre-colonial Territorial and Subsistence Systems**

After two millennia of local socio-cultural diversification and adaptation to the environment, the pre-contact “traditional Kanak cultural complex” of New Caledonia (Sand 1995: 180) seems to have emerged around the end of the first millennium AD (Sand et al. 2000). The arrival of James Cook on Grande Terre in 1774 signified the beginning of a period of contact lasting nearly one century and launching important changes in Kanak societies, even before the beginning of French colonization in 1853 (Sand 2000) (hence the differentiation between a strictly pre-contacts period and a pre-colonial period). The rise of Kanak societies is associated with a more extensive human occupation of the land, linked to the intensification of resources exploitation systems and of anthropogenic manipulations of the landscape. According to archaeological data, these dynamics are related to an important demographic increase, as well as to the development of complex chiefly systems and territorialization (Sand 2002).

**Settlement Patterns**

On Grande Terre, the settlement system appears to have been organized within a framework of overlapping spatial, social and economic units, evolving through forms of mobility within a sedentary territorial setting (Saussol 1990; Sand et al. 2000; Dotte et al. in press). According to ethnological data, this territory coincided ideally with an alluvial valley and was linked to a chiefdom also related to a large kinship group of “house” type (Bensa et Rivierre 1982:32-33).

The minimal settlement unit, sometimes called “allée” (the local term “path” defining the central axis around which are organised the habitations in the ideal model), represented the dwelling of a restricted patrilineal descent group (a 2-3 generations line or segment of lineage) (Leenhardt 1953:18-21; Bensa and Rivierre 1982). Archaeological surveys have shown that the pre-colonial groups had developed varied settlement site plans adapted to their environment (Sand 1997). Nevertheless, it appears that the most frequent layout in Central-Northern Grande Terre is the ideal elongated one remembered in Kanak oral traditions (Dotte et al. in press). It is seen as the spatial and material representation of kinship ties and social hierarchy (Leenhardt 1953:18-21; Bensa and Rivierre 1982: 34-41). This layout is also specifically adapted to location along the narrow ridges of New Caledonia’s mountain chain (Sand 1997). Furthermore, a study focusing on kanak settlement patterns in the Tiwaka valley showed that occupation of elevated areas, including ridges but also mountain slopes and hilltops, was generally favoured during the pre-colonial period (Dotte et al. in press).

**The Intensive Horticultural System**

Most of the sites identified by archaeology on Grande Terre are associated with, or even integrated with, horticultural surface areas. These are divided into two kinds of structures, corresponding to two strategies of water management and crop types: drainage or irrigation. The partition follows the well known model, throughout Oceania, of a landscape organized between dry and wet areas (Barrau 1965; Kirch 1994).
Dry crops, mainly yams (numerous local varieties of *Dioscorea alata* and *Dioscorea esculenta*), were cultivated on elongated mounds arranged in parallel or in lines, according to topography (Barrau 1956) (Figure 2). These structures could entirely cover some alluvial plains, where channels for drainage or for diverting creeks were running through them.

![Figure 2. Hill slopes horticultural structures, irrigated pondfields and arched dry mounds (background).](image)

Irrigated pondfields along slopes or beds in valleys and thalwegs, were constructed for wet cultivation (Figure 2). Descriptions mainly indicate taro (several local varieties of *Colocasia esculenta*), associated with sugarcane (*Saccharum officinarum*) and banana (*Musa* spp.). These structures were also based on a network of channels, this time canalizing and diverting creeks for irrigation purposes (Barrau 1956). Ethnohistorical accounts report pondfields under cultivation that were expanded on extensive areas, also observed by archaeological surveys (Forster 1777; Labillardière 1799; Glaumont 1897; Sand 1995, 2002).

According to current knowledge, it seems that the horticultural structures and the associated channel networks were developed around the end of the first millennium AD, probably from more ancient practices. What is seen as a process of cultivation intensification, associated with an increase in demographic pressure and coercive political power, led to a rapid multiplication of these structures during the second millennium AD (Sand 2002). These constructions are considered as a socio-economical development allowing better management of weakened soils. These would be due to progressive intensification of presumed slash and burn practices during the preceding two millennia of human presence on the island (Sand 1995, 2002), which could have transformed ancient forests toward more open vegetation types (Sémah 1998; Stevenson 1999); although these hypotheses can be discussed according to recent archaeobotanical analyses (Dotte-Sarout 2010).

**Forest Exploitation and Arboricultural Practices as Part of the Horticultural System**

Ethno-botanical studies by Barrau on traditional kanak subsistence economy report the exploitation of forest plants, either as infrequent plantations of a few individuals placed in gardens joined to habitations, or through regular and more occasional gathering in forests. There are accounts of several types of gramineae or brassicaceae (local varieties of cabbage and bamboos shoots), pteridophytae (consumption of ferns sprouts) and numerous woody plants, indigenous or introduced (consumption of leaves, fruits, seeds, almonds and tubers) (Barrau 1956, 1962; Leenhardt 1953). These practices were considered as a relic of “pre-agricultural” subsistence modes, and presented as subsidiary ones. Excepted for the cultivation of coconut (*Cocos nucifera*), and seldom breadfruits (*Artocarpus altilis*), tree exploitation occurred mainly through forest harvesting of wild species during post-colonial times. No management system of the woodlands has been described for New Caledonia, though such a work seems to have been planned by Barrau (1956).
However, bibliographical review and survey fieldwork undertaken as part of our research for the wood reference collection, underlined possible domestication or manipulation processes of the forests and woody plants in New Caledonia. These data are coherent with the results recently yielded by the anthracological analyses subsequently led on three precolonial sites of the Tiwaka valley (Dotte-Sarout 2010). Such processes have already been proposed for other parts of Oceania by several authors (Yen 1974a, 1991, 1996; Lepfosky 1992; Lepfosky et al. 1998; Gosden 1995; Latinis 2000; Walter and Lebot 2003; Kennedy and Clarke 2004). These specific practices can be seen as part of the horticultural system and of its territorial organization, being distinguished by the degree of either “socialization” or “uncultivation” (but not “wilderness” – see Haudricourt 1964) of their ecological circumstances and of the plants exploited (Dotte in press). Indeed, the transformation - maybe more than direct deforestation - of New Caledonian forestlands seems to have occurred through various practices of plantation, translocation, caring or simple protection of several tree species, treated mainly on an individual scale within the forest (Dotte-Sarout 2010). This cultivation mode is precisely at the core of the horticultural system: a production model in which each plant is cultivated individually and punctually, based on biodiversity, according to ecosystem patterns, and where humans play an occasional but crucial role (Michon 2005:70-71, from Haudricourt and Hédin 1943; Barrau 1956). Linked fundamentally to exploitation of tropical forest plant resources, mainly tubers and trees (Latinis 2000), it can thus be said that the horticultural system necessarily encompasses arboricultural practices.

**Prospective Ethno-anthracology in New Caledonia: First Results from the Reference Collection Work**

**Applying Anthracology to New Caledonia Archaeology: Method**

Archaeobotanical and palaeo-ethno-botanical data for New Caledonia have remained few and spatially limited until now. They are the result of three pioneer palynological research programs on New Caledonia Holocene vegetation changes, one in the extreme south of Grande Terre with a palaeoenvironmental focus (Stevenson 1999; Stevenson et al. 2001; Stevenson and Hope 2005), and the other two in the extreme north of the island with associated archaeological investigations (Sémah et al. 1996; Sémah 1998; Hope et al. 1999; Wirrmann et al. 2006). The idea thus, was to try developing anthracology as a complementary and potentially far reaching approach. Indeed, its material of study (trees and possibly tubers) is particularly related to Oceanic subsistence modes, and it can connect palaeoenvironmental and palaeo-ethno-botanical aspects, given the direct association of charred woody remains with human activity on archaeological sites.

The first phase of the program was the construction of a wood reference collection on New Caledonia (Dotte-Sarout 2010). This was necessary because, except for the older and significant work of P. Sarlin (1954), few species from the archipelago have been described in published wood identification atlases (CIRAD 1992, and some of the species described in Détienne and Jacquet 1999). These publications are hardly functional for anthracological identification, as they are oriented to forestry exploitation uses, but served, nevertheless, as a foundation for our work. The reference collection has been turned into an anthracological database in which are gathered the anatomical description of each specie and family represented. Botanical inventories were associated either with botanical sampling or archaeological surveys that aimed to characterize vegetation types around pre-colonial kanak sites. Systematic lists of species present were made on and around six sites located in the Tiwaka valley (Figure 1), and their analysis integrates general observations made during archaeological surveys and excavations throughout Northeastern Grande Terre. This fieldwork was coupled with a study of botanical references about tree and forest species as well as ethno-botanical and archaebotanical records.

Excavations and systematic anthracological sampling on pre-colonial sites constituted the second phase of the research, while archaeological and anthracological analysis represent the last phase of the program (Dotte-Sarout 2010). We present here the botanical and ethno-botanical results of the first phase: methods and significance of the reference collection, and then questions on plant introduction and manipulation in New Caledonia, which arose through our work on literature for the database (socio-ecological aspects from the botanical inventories are presented in Dotte, in press).
The New Caledonia Anthracological Reference Collection: Socio-ecological Significance

As presented in the first part of this paper, New Caledonian vegetation is outstanding for its unique diversity and endemcity. It has more than 3200 known species of vascular plants, among which it is difficult to know exactly the percentage of trees and what we call here “analogous” species. It is thus clear that making a nearly complete collection will take a long time. Therefore, to begin with, we had to define a list of priority taxa that should be included in a first, partial, reference collection aimed at increasing the chances of identification and the pertinence of interpretations. The priorities were established through the use of ethno-botanical and botanical or ecological references on New Caledonia and the Pacific. On this list are:

- No taxa with a limited spatial range (many plants being endemic to a valley or a specific area of the archipelago), in order to place in priority the most frequent ones in terms of numbers and spatial range.
- “Leading” species, the most representative of the main vegetation types found in the valley and/or strictly associated with a specific plant formation, in order to give more confidence to ecological interpretations.
- “Social” species, plants with a known symbolic, medicinal or utilitarian (consumption, esthetic or ecological use, i.e. construction, fuel) function within kanak socio-cultural system.
- Pan-Pacific species, being labeled “indigenous” or introduced”, so as to increase the area of expertise of the database and reference collection, and in order to be able to identify potential introduction of plants and date their presence in New Caledonia.

Within this inventory were taken into account non-ligneous species that would fit in one of the criteria cited above and that could be identified through anthracological analysis.

This list contained 220 species, whereas the reference collection currently contains 142 species, 130 of which have been anatomically described.

The collection of samples was made in association with archaeological surveys in the Tiwaka valley, and on other parts of Grande Terre depending upon the required ecosystem (see Figure 1). Nineteen of the Pan-Pacific taxa which are part of the reference collection were collected on the Polynesian island of Huahine.

After charring (in controlled conditions) of one part, each sample was observed under a reflecting light microscope for a description of its anatomical structure and discriminating features. Among these, more than seventy taxa have no previously published anatomical description. The anatomical information was systematically compiled within a database that also contains pictures of the features (light microscope or SEM when possible) for each taxa (Dotte-Sarout 2010).

Finally, the ecological representation of the collection and of the identification atlas associated with it, appears, from a general point of view, to be in accordance with the main ecological conditions found in alluvial valleys of Northeastern Grande Terre. Indeed, it contains 65% of rainforest associated species, with 1/3 being specific to plants formation (non exclusive association). The remaining 35% is equally divided between species related to wetlands and coastal formations, ruderal or anthropogenic vegetation types, and sclerophyllous forests (Dotte-Sarout 2010). It has to be emphasized that the majority of the taxa associated with dry forests have a multiple ecological affiliation, mainly to evergreen rainforests, and/or sometimes also with ruderal or coastal formations.

Within this general frame, the collection presents a strong emphasis on anthropogenically related plants, regardless of their ecological affiliation. As a result, and in relation to its archaeological and socio-cultural focus, the collection offers an over-representation of non endemic species: 76 endemic taxa for 62 Pan-Pacific taxa, the majority of which being classified by botanists as “indigenous”. Providing that the “leading” and more frequent species present in the collection would help us identify vegetation types in anthracological samples, it is intended that this bias will not have negative consequences on the use of the database for ecological interpretation. On the other hand, we hope it will open a more archaeologically related potential for identification, making it usable in other parts of the Pacific and more effective in recognizing pre-contact introduced species.
Archaeo-botanical Surveys and Literature Review: The Question of Plant Introductions in New Caledonia

During our work on the bibliographical sources and on the botanical inventories of archaeological sites, we have recorded a list of trees and analogous plants that have various degrees of functional or symbolic importance in Kanak societies (Dotte in press). From the literature and surveys, diverse modes of exploitation can be reconstructed that range from direct cultivation and domestication to less visible practices of individual care and translocation within forestlands. The majority of these plants have a wide regional distribution around New Caledonia, and a shared economic or social role throughout their area of occurrence. Table 1 lists the main Pan-Pacific ligneous plants, manipulated by men, that have been recorded in New Caledonia. It also shows which ones we were able to integrate into our reference collection.

Table 1. Valuable Pan-Pacific ligneous or analogous plants recorded in New Caledonia: statuses and pre-contact regional distribution.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Native Range</th>
<th>Introduced and/or Domesticated</th>
<th>Current botanical status in NC</th>
<th>Ethno-botanical references</th>
<th>NC Reference collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenanthura pavonina</td>
<td>Coral pea, red bean tree</td>
<td>X, X, X, SE, NE, Australasia</td>
<td>X</td>
<td>Indigenous</td>
<td>Pre-contact introduction</td>
</tr>
<tr>
<td>Aleurites mollucca</td>
<td>Candle nut</td>
<td>X, X, X, X, Aust</td>
<td>X, X, X, X, X</td>
<td>Indigenous</td>
<td>Pre-contact introduction</td>
</tr>
<tr>
<td>Alocasia macrorrhiza</td>
<td>Giant taro, elephant ear</td>
<td>X, X, X, X, X</td>
<td>Western Polynesia</td>
<td>Indigenous</td>
<td>Naturalized</td>
</tr>
<tr>
<td>Artocarpus altilis</td>
<td>Breadfruit</td>
<td>X, X, X, X, X</td>
<td>Western Polynesia</td>
<td>Indigenous</td>
<td>Cultivated</td>
</tr>
<tr>
<td>Barringtonia asiatica</td>
<td>Cut nut</td>
<td>X, X, X, X</td>
<td>Indigenous</td>
<td>Indigenous cultivated</td>
<td></td>
</tr>
<tr>
<td>Broussonetia papyrifera</td>
<td>Paper mulberry</td>
<td>X, X, X, X, X</td>
<td>Indigenous</td>
<td>Pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Citrus macroptera</td>
<td>Ghost lime</td>
<td>X, X, X, X</td>
<td>Guam</td>
<td>Indigenous</td>
<td></td>
</tr>
<tr>
<td>Cocos nucifera</td>
<td>Coconut</td>
<td>X, X, X, X, X</td>
<td>Indigenous</td>
<td>Indigenous cultivated</td>
<td></td>
</tr>
<tr>
<td>Colocasia esculenta</td>
<td>Taro</td>
<td>X, X, X, X, X</td>
<td>Indigenous</td>
<td>Pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Cordyline fruticosa</td>
<td>Ti</td>
<td>X, X, X, X, X</td>
<td>Indigenous</td>
<td>Pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Dioscorea alata</td>
<td>Winged yam</td>
<td>X, X, X, X, X</td>
<td>Ponape</td>
<td>Pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Dioscorea bulbifera</td>
<td>Wild yam</td>
<td>X, X, X, X, X</td>
<td>Indigenous</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Dioscorea esculenta</td>
<td>Yam</td>
<td>X, X, X, X, X</td>
<td>Guam</td>
<td>Pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>SPECIES</td>
<td>Native range</td>
<td>Introduced and/or Domesticated range</td>
<td>Current botanical status in NC</td>
<td>Ethno-botanical references</td>
<td>NC Collection</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------</td>
<td>--------------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Inocarpus fagifer tahitian chestnut</td>
<td>X</td>
<td>Wallacea X X</td>
<td>pre-contact introduction</td>
<td>pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Morinda citrifolia</td>
<td>Indian mulberry</td>
<td>North East Australasia X? drift X?</td>
<td>indigenou s post-contact</td>
<td>indigenous cultivated</td>
<td></td>
</tr>
<tr>
<td>Musa sapientilis a tree</td>
<td>X</td>
<td>X X X X X</td>
<td>pre-contact introduction</td>
<td>pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Pandanus tectorius pacific pandanus</td>
<td>X X?</td>
<td>X X X X</td>
<td>indigenou s post-contact</td>
<td>indigenous cultivated</td>
<td></td>
</tr>
<tr>
<td>Pueraria lobata kudzu</td>
<td>X X?</td>
<td>X? X X X</td>
<td>indigenou s pre-contact</td>
<td>pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Saccharum officinarum</td>
<td>Sugar cane</td>
<td>X X X X X X</td>
<td>pre-contact introduction</td>
<td>pre-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Syzygium malaccense</td>
<td>Malay apple, mountain apple</td>
<td>X X excpt NC and Fiji X X X excpt Hawaii post-contact</td>
<td>indigenou s post-contact</td>
<td>post-contact introduction</td>
<td></td>
</tr>
<tr>
<td>Terminalia catappa</td>
<td>Indian / Sea almond</td>
<td>X X excpt NC and Fiji X X X excpt Hawaii post-contact</td>
<td>post-contact introduction</td>
<td>indigenous cultivated</td>
<td></td>
</tr>
<tr>
<td>exploit ed species</td>
<td>Calophyllum inophyllum</td>
<td>baunut X X</td>
<td>indigenou s</td>
<td>independent cultivated</td>
<td></td>
</tr>
<tr>
<td>with unsettled</td>
<td>Dendrocalamus sp bamboo</td>
<td>X X X?</td>
<td>indigenou s</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>botanical status</td>
<td>Erythrina variegata coral tree, tiger's claw</td>
<td>X X X?</td>
<td>1 endemic variety</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>throughout the Pacific</td>
<td>Hibiscus alaceous beach / sea hibiscus</td>
<td>X X X?</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mimusops elengi</td>
<td>X X North East Australia X X X X X X</td>
<td>1 endemic variety</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thespesia populnea</td>
<td>porta tree X X X X X X X</td>
<td>indigenou s</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
**New Caledonia “Indigenous” vs “Introduced” Species**

Among the 38 species in Table 1, 21 are labeled as pre-colonial human introductions in other Pacific Islands where they are present, and 7 have an uncertain status in botanical studies. Still, 29 of these species are classified as indigenous to New Caledonia by current botanical studies, and one is seen as a post-contact introduction (see Table 1). This discrepancy would make of New Caledonia a remarkable exception, being the only island of Remote Oceania and island Melanesia where the functional plants that have been introduced by humans throughout Oceania were already indigenous. This peculiar condition could possibly be explained by the Australian affinities of its vegetation, but this would apply to only three cases where the plants are recorded as indigenous to tropical Australia (*Adenanthera pavonina*, *Mimusops elengi* and *Morinda citrifolia*).
Furthermore, the first of these trees is involved in another source of conflict about botanical status. A few species that were classified as “ancient introductions” by ethnobotanists Barrau (1962) and McKee (1985) are listed as indigenous in current botanical inventories (Jaffré et al. 2004). This is especially the case for *Adenanthera pavonina* and of the well known *ti* (*Cordyline fruticosa*) (Table 1). We also have to note the inverse case of *Syzzygium malaccense* and *Terminalia catappa*. Both are reported as exploited in New Caledonia and sometimes even cultivated in Pacific Islands (Yen 1974a; McKee 1985; Barrau 1956; Walter and Sam 1999). However, the former has been classified as indigenous to New Caledonia whereas current ethno-botanical studies name it as a post-contact introduction (Walter and Sam 1999:238), while the second is now considered as a post-contact introduction in the archipelago whereas McKee suggested in his study of introduced plants that it might be a cultivated indigenous tree (1985:31). Given the long period of poorly documented European voyages to New Caledonia before 1853, it seems to us that the status of these two species remains uncertain. They could have been introduced during the first period of regular contacts with sandalwood traders or whalers or even as part of botanical experiments made by the explorers (see the journals of J. Cook or LaPérouse), and integrated within the kanak subsistence system. On the other hand, it would be surprising that these widely distributed trees, which share important economic and symbolic roles throughout the whole of the Indo-Pacific region (see Walter and Sam 1999; Blench 2004) would not have been introduced in New Caledonia – at least tentatively – in pre-contact times.

The Question of Regional Valuable Species Absence in New Caledonia

We have observed that several important trees cultivated in Oceania and/or diffused by human voyages are absent from New Caledonia (Table 2). The majority have their origin in Papua New Guinea and/or Island Melanesia, either in Near or Remote Oceania. The anthropogenic character of their diffusion throughout the Pacific Islands is not always asserted, but they all occur as cultivated plants and play similar roles in the different islands where they have been observed. As there have been no archaeobotanical studies in New Caledonia focusing on arboricultural practices, particularly nuts or fruits identification, it is difficult to know if this absence results from a recent evolution or is a pre-contact pattern. Besides, it appears unwise to look at all of these species as representing one homogenous group dispersed through one set of voyages.

For instance, *Artocarpus altilis*, *Inocarpus fagifer*, or *Broussonetia papyfera*, are all recorded by McKee as pre-contact introductions in New Caledonia, observed only as cultivated individuals in gardens (1985: 80, 97). However, they are nowadays rare throughout the archipelago, or even exceptional (*Broussonetia papyfera*, *Inocarpus fagifer*). In addition, 19th century accounts of the Otaheite apple tree (*Spondias dulcis*, syn. *S. cytherea*) as a peculiar cultivated tree have been reported for New Caledonia (McKee 1985: 30), but this species is now considered to be absent from the archipelago. These widespread plants characterized by important anthropogenic manipulation could thus have been introduced to New Caledonia but remained scarce and were reproduced exclusively through cultivation. This would have made them highly sensitive to any disruption of the territorial and subsistence system, such as happened during the contact period (see Sand 2000). Moreover, these four species are all important Polynesian domesticates. We would need archaeobotanical and biomolecular studies to know if these species could have been introduced more recently to New Caledonia through Polynesian voyages, and appended to the local subsistence system, as it has been proposed for the sweet potato (*Ipomea batata*) (Barrau 1962; Yen 1974b). Such a process could explain their peculiar and fragile presence in New Caledonia.

This idea though does not fit the five trees restricted to Melanesia, for which indigenous or introduced status is unsettled in the greater part of their distribution range (Table 2), i.e. mainly island Melanesia. Here we have two possible explanations for this gap, depending upon the status preferred for the plants. If we regard them as indigenous, the extremely strong peculiarity of the New Caledonia flora, including long isolation, might be a reason why such widely dispersed Melanesian plants were not present in the archipelago. The great diversity of the local vegetation might have represented a valuable alternative to these plants (for lists of local exploited trees see Barrau 1956, 1962; Dotte in press), and thus the reason why they were not introduced, or more probably, why their cultivation could have been abandoned. Following a more diffusionist point of view, we might also consider the analysis of Barrau regarding the creation of “marginal zones” beyond the path of diffusion throughout Oceania (1962:233). He observed that while the west to east decrease of the vegetal complex diversity is well known, there also exists a gradual latitudinal loss of species from the center to the margins of a migration sector limited “to the South by Indonedia, New Guinea and the Melanesian chain, to the North by the Micronesian islands” (id.). This explanation is consistent with the segregated location of New Caledonia, and it is also visible in Hawaii, where several plants listed in both tables seem also to have been absent during pre-contact times. We can note here that the Hawaiian archipelago is, similarly to New Caledonia, characterized by a
flora showing a high diversity and endemism, at least in comparison to other Polynesian islands. It appears then probable that the two reasons cited here are to be taken together to explain the absence of several valuable species in these islands. These lists, though, focus on New Caledonia archaeobotanical issues and do not present a complete inventory of Indo-Pacific exploited plants (see Blench 2004 for a more complete regional list). This pattern of presence/absence will need further investigation, embracing ethno-botanical, biogeographical and archaeobotanical data.

### Table 2. Regional valuable ligneous or analogous plants rare to absent from New Caledonia.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>Indigenous Range</th>
<th>Introduction Range</th>
<th>NC Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sea</td>
<td>Wallacea-PNG</td>
<td>Island Melanesia</td>
</tr>
<tr>
<td>Barringtonia spp</td>
<td>cut nuts</td>
<td>X? except NC</td>
<td>PNG?</td>
</tr>
<tr>
<td>Burkea obovata</td>
<td>burkea</td>
<td>X</td>
<td>X except NC &amp; Fiji</td>
</tr>
<tr>
<td>Gnetum gnemon</td>
<td>two leaf</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Metroxylon spp</td>
<td>sago palm</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cyrtosperma chamissonis</td>
<td>giant taro, elephant ear</td>
<td>Philippines</td>
<td>X</td>
</tr>
<tr>
<td>Ficus tinctoria</td>
<td>red dye fig</td>
<td>X</td>
<td>North East Australia</td>
</tr>
<tr>
<td>Pometia pinnata</td>
<td>laun tree</td>
<td>X</td>
<td>X except NC &amp; Fiji</td>
</tr>
<tr>
<td>Spondias dulcis (syn. S. cytherea)</td>
<td>golden/oil aholea apple</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pan-Pacific species</td>
<td>rare and exclusively cultivated in New Caledonia</td>
<td>rare and exclusively cultivated in New Caledonia</td>
<td>rare and exclusively cultivated in New Caledonia</td>
</tr>
<tr>
<td>Artocarpus altilis</td>
<td>breadfruit tree</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Broussonetia papyfera</td>
<td>paper mulberry</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Inocarpus taglieri</td>
<td>tahitian chestnut</td>
<td>X</td>
<td>Wallacea</td>
</tr>
</tbody>
</table>


### Forests and Plant Manipulation “Invisibility” Throughout the Pacific

Finally, in table 1, questions arise in relation to pan-Pacific indigenous or unsettled status plants. *Bischofia javanica, Calophyllum inophyllum* and *Thespesia populnea* are strictly labeled as indigenous (cultivated for the second one) in New Caledonia, although their status throughout Oceania and especially in Polynesia (Florence 1998, 2004:3.3, 20.1, 27.19), seems uncertain. They are strongly attached to human activity, being highly valuable trees, especially in Micronesia and Polynesia (Clarke and Thaman 1993), and occur either cultivated or growing spontaneously throughout Oceania. The classification of these species as indigenous to New Caledonia appears highly peculiar, and could have been influenced by the existence of other species, some of them endemic, from the same genera (Jaffré et al. 2004). Similarly, *Hibiscus tiliaceus* which has multiple uses in Pacific Islands, is regarded as an indigenous tree to most islands of the Indo-Pacific region, yet the botanist J. Florence points out that the species displays many local cultivars throughout Polynesia that could have been
directly introduced by people (2004:25.10). Comparatively, we noted that two widespread valuable species, sometimes cultivated, are present under endemic varieties in New Caledonia (Jaffré et al. 2001), while the general species are neither cited as introduced nor indigenous in local flora (Erythrina variegata and Mimusops elengi). It is difficult, with current data, to know how such a pattern could relate to a process of local cultivar production similar to the Hibiscus tiliaceus manipulation in Polynesia.

The arboricultural model of exploitation is based on biodiversity and vegetative reproduction, meaning barely visible transformation of species and forestlands (Michon 2005). It seems to us that we should be aware that diversification and naturalization can also be part of its processes and hence hide ancient practices of manipulation, either by diversification or introduction.

**Discussion: Implications for the Archaeology of New Caledonia and the Pacific**

We have presented here a part of the first results gained from a research applying anthracology to pre-colonial New Caledonian archaeology. A reference collection and an associated database for anthracological identification and interpretations, i.e. palaeoenvironmental as well as palaeoethno-botanical, has been created. It includes 142 taxa, 130 with their anatomical descriptions, specifically related to New Caledonian vegetation and kanak uses; but it is also representative of Pan-Pacific valuable trees. To identify priority plants for the collection, and to compile ethno-botanical and ecological information for the database, a review of the literature was associated with joint botanical/archaeological surveys in the Tiwaka valley, Northeastern Grande Terre.

This work has revealed some interesting patterns and contrasts related to the issue of plant introductions in pre-colonial New Caledonia. We have noticed that several species nowadays classified by botanical listings as indigenous to New Caledonia might need reconsideration of their possible pre-contact introduction by people, according to ethno-botanical observations and regional data. Other plants have been noted as absent or scarce in New Caledonia, whereas they have homogeneous regional distribution and important socio-economical values in other Pacific islands.

The examination of these various situations demonstrates that we have to evaluate dynamics of plant management and introduction as a complex phenomenon that was not only achieved with manifestly cultivated and domesticated species. It could also have integrated trees exploited to a less visible degree, and it might have resulted in naturalization processes of some species or in the abandonment and rarefaction/disappearance of others. This last possibility is particularly relevant to New Caledonia (and maybe to Hawaii, which shares some similar conditions), where the indigenous and endemic vegetation is highly rich and diverse, even in comparison with Papua New Guinea when considered on a landmass/species ratio.

These data are centered on New Caledonia and are thus incomplete as regards to regional patterns, making it difficult to observe geographical regularities about the general distribution of plants in the Pacific. Nevertheless, we can already note that the majority of the taxa listed here are present in the three regional areas of Oceania (mainly the pre-colonial introductions but also most of the indigenous and uncertain status species). Throughout the tables, we can then detect a first group of plants found in Micronesia, Melanesia and Western Polynesia only (5 species). Another group is related to Melanesia and Polynesia only (3 species), while 2 species introduced in Polynesia and originating from Southeast Asia are completely absent from Melanesia. Finally, among the valuables trees which are only present in Melanesia, 5, hence most of them, are absent from New Caledonia (3 with an unsettled status, 1 pre-colonial introduction, 1 indigenous).

Moreover, this study also draws attention to the long-time span and differentiated dynamics that we should incorporate into our vision of Pacific plant manipulation: even after the Lapita migrations began, departing from an area close to the geographical origins of several Oceania valuable trees and plants, processes of plant diversification, domestication and diffusion could have continued, in Near as well as in Remote Oceania. It appears that we thus have to consider New Caledonian introduced plants not only as part of the Lapita ideal “horticultural/arboricultural set”, but also as later introductions from several sources or diffusion routes.

**Archaeological and Archaeobotanical Implications: Integrating Complexity**

These observations have two main implications for the archaeological history of New Caledonia and, beyond, of the Pacific. Firstly, they reassert the specificity of Pacific subsistence systems and domestication processes, as linked to the fundamental role of forests and trees. This issue was highlighted by Haudricourt and Hedin (1943),
Barrau (1962, 1970) and Yen (1974a, 1991, 1995, 1996) more than 50 years ago, and since then has been consolidated in several specialized works (Allen et al. 1989; Gosden 1992, 1995; Lepofsky 1992; Lepofsky and al. 1998; Walter et Sam 1999; Latinis 2000; Lebot 2002; Blench 2004; Denham 2004; Kennedy and Clarke 2004; Lentfer et Green 2004). These authors have shown that arboricultural practices are an important part of the Pacific subsistence system and the basis of the horticultural modes that have been developed and diffused throughout Indo-Pacific Islands. Yet, it appears to us that this specific production mode is still underestimated and very partially understood in its processes, effects on present-day environments and past dynamics, especially in New Caledonia (Dotte-Sarout 2010). Tropical forests often remain perceived as wild areas, and pre-colonial human action on island vegetation is either portrayed as a destructive process, a point of view often favored by Pacific socio-cultural studies, or on the contrary as marginal to “natural” dynamics, an approach regularly adopted by naturalist studies on New Caledonia. The “domestication” of tropical forests and trees or analogous species is a process involving diverse degrees of manipulation of plants: from direct domestication (cf. Lepofsky et al. 1998), transformation, selection and cultivation, to translocation and maintenance of individuals within the forests (Michon 2005). This set of practices involves the diversification of varieties or cultivars, and the disappearance or naturalization of introduced plants that blurs our perception of past dynamics in the current landscapes.

It seems we need now to take on a more complex point of view, crossing botanical, archaeological, palaeo- and present day ethno-botanical data, if we want to be able to better encompass the ancient socio-ecological dynamics that shaped societies and environment in the Indo-Pacific region. Going back to the pioneer ethno-botanical studies of Jacques Barrau and Douglas Yen for the Pacific, we should perhaps reassert the importance of anthropogenic manipulation of trees and forest species throughout the Pacific, even for some pan-Pacific valuable species now classified as “indigenous” or forests labeled as “wild”.

Secondly, the inventories presented here and the questions related to plant introduction highlight the need to consider diversity and fusion, on the issues of origins but also of diffusion pathways. Indeed, it appeared in our study that the hypothesis of introduction during Polynesian voyages will need to be investigated additionally for some trees in New Caledonia. This confirms the idea that diffusion of plants between Pacific Islands is not only the result of one homogenous event, involving an ideal horticultural set diffused by Lapita voyages. Besides, we need to consider the demonstration by several authors that the South East Asia/Wallacea/Papua New Guinea zone (and most probably Near Oceania islands) can be perceived as one sphere of long-term interactions (Barrau 1962, 1970; Allen and Gosden 1996; Latinis 2000; Oppenheimer 2003; Denham 2004; Szabo and O’Connor 2004; Bedford and Sand 2007; Torrence and Swadling 2008). Cultural diversity characterizing the peopling of Pacific Islands is also highlighted by the recent synthesis favoring Lapita diversity (Bedford et al. 2007). This position now argues for “multiple departures of diverse groups in various directions over a couple of centuries, who did not all stop in the same places along their journey” (Bedford and Sand 2007: 4), and who thus might not have brought the same kit of techniques and items, especially plants. Finally, we need to keep in mind the remark of Barrau that we should distinguish between places of natural origin, and those of diversification and domestication (1962).

Thus, it appears that processes of plant introduction and domestication in New Caledonia should be considered as involving several specific movements of people and items, throughout the three millennia of human presence. It appears probable that the related horticultural/arboricultural practices and species that were brought to New Caledonia are the result of complex dynamics of fusion engaged around the Wallacean region well before, and after, Lapita development. The homeland of Oceania plants seems more complex than a simple dichotomy - South East Asia/Papua New Guinea - and closer to a spatially and chronologically extended sphere of interaction from Near Oceania/Papua New Guinea/Wallacea to South East Asia/South Asia (see Barrau 1962; Latinis 2000; Lebot 2002; Denham 2004) (Figure 3).

It is generally considered that around AD 1000, regional interactions and long-distance voyages re-developed after a period of atrophy during the preceding millenium. Concomitantly to these renewed trans-oceanic connections is the new dynamic of human migrations responsible for East Polynesia and Polynesian outliers colonization. Polynesian voyages introduced some plants from as far as the Pacific coast of South America, sometimes resulting in inter-breeding that blurred evidence of the origins and diffusion routes (sweet Potato Ipomoea batatas, cf. Ballard et al. 2005; bottle gourd Lagenaria siceraria, cf. Clarke et al. 2006). Similarly, some new introductions of species that had been transformed and domesticated in Polynesia, even though originating from the Wallacea sphere of interactions, might again have complicated the current evidence in island Melanesia (see Barrau 1962).
Moreover, even though the first millennium AD appears to have been characterized in some archipelagos by processes of isolation, the Micronesian case shows that this was not a pan-Pacific situation. Indeed, atolls of the Northwestern Pacific were colonized at this time, and continuing voyages took place, within Micronesia, but also to or from South East Asian, Melanesian islands (Rainbird 2004) and possibly, as argued recently, towards Western Polynesia (Addison and Matisoo-Smith 2010). Hence, exchanges and contacts sustained during this period could have resulted on some direct plant introductions and hybridization processes that would influence later sub-species and cultivar distribution. Examples of such processes are the differentiation and later hybridization of Artocarpus altilis cultivars between Melanesia and Micronesia (Zerega et al. 2004) or the diffusion of Cyrtosperma through or from Micronesia towards Polynesia (Barrau 1962:233, 1965). Finally, the distribution patterns of the species examined in our analysis could illustrate specific interaction spheres in Oceania, in relation to the case of New Caledonia (Figure 3). Some of them do appear related to archaeological regions: one associating Near and Remote Oceania (with the exception of the “margins”: Hawaii, New Caledonia, Guam or the Marianas), another one gathering the Lapita area and Micronesia. A secondary zone appears, joining Island Melanesia with Papua New Guinea and the Wallacea but excluding New Caledonia; while a last one – although less clear – takes together Melanesia and Polynesia but excludes New Caledonia on 2 cases out of 3. These observations could demonstrate specific cultural and economic dynamics in New Caledonia, especially when comparing these facts with the introductions of animal domesticates in Oceania. These ones are now also considered under the point of view of multiple introductions, with the noticeable absence of the pig (Sus scrofa) and the dog (Canis sp.) in New Caledonia (the case of chicken – Gallus gallus – being itself very uncertain) (Sand 2010; Anderson 2009; Matisoo-Smith 2009). Moreover, we should still keep in mind the possibilities for refusal of introductions or phenomenon of disappearance/abandonment of introduced species, especially in connection with the environmental specificities of the New Caledonian archipelago. No definitive conclusion about these observations can thus be achieved before we can have more archaeoenvironmental data and clear botanical statuses, not only for New Caledonia but for the whole Oceania area. The main idea resulting from this partial spatial analysis is the emergence of specific regional areas highlighted by the distribution patterns of some valuable plants, which can be useful to think about human voyages and spheres of interactions throughout the whole of the pre-colonial period.

Figure 3. Distribution patterns of some valuable plants and regions of Oceania (from Lilley 2006, fig.1.1; references cited in text for dates).
Conclusion and Prospects

Future studies on forests, trees and analogous species exploitation in New Caledonia will have to integrate two underestimated aspects of plant manipulation and diffusion. First, they will need to consider the specificity of horticultural (encompassing arboricultural practices) processes of domestication and the relative “invisibility” of plant manipulation within its scope. Secondly, they will have to reevaluate the role of plant and cultivation practice introductions, and to envisage different mechanisms of integration within the existing system. This has to be contextualized within a pattern of multidirectional movements of people, not only during the initial settlement of Remote Oceania, but during the whole of the last 6000 years throughout the entire Pacific Ocean, from its Asian to American limits and right up during the contact period.

It appears clear that we need more specific palaeoenvironmental and archaeobotanical data on these questions, in New Caledonia but also throughout the region, to be able to identify the timing and places of exploitation, diversification and diffusion of Pan-Pacific valuable trees. At the same time, it is necessary to undertake a complete review of published palaeoenvironmental and archaeobotanical studies, not only focusing on the most ancient dates, but investigating the whole spatial and chronological range of Pacific pre-colonial history, also encompassing the contact period. Such a synthesis will obviously highlight specific patterns of diffusion, to be compared with linguistic data and current pan-Pacific distribution, statuses and uses of New Caledonia valuable trees analyzed in this study. Finally, there is an obvious lack of dialogue between botanical and archaeo-environmental/archaeobotanical disciplines, and we need an interdisciplinary approach to reassert the botanical status of indigenous/introduced species. Only then will questions of plant introduction to New Caledonia that have been raised in this paper be more securely answered, and with them also those on the history of Pacific human voyages.

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Notes

1 Anthracology (from the greek “anthrax”: charcoal) is the study of ancient woody vegetation and its human exploitation, from anatomical identification and analysis of archaeological wood charcoal macro-remains (4mm being the ideal size for tropical environment, see Scheel-Ybert 2002 (Chabal 1992; Chabal et al. 1999; Asouti and Austin 2005). It also represents a potential approach for identification of burnt tubers macro-remains (Hather and Kirch 1991; Hather 1993).

2 Woody or “ligneous” plant is a term strictly used for perennial plants with a stem containing true wood, i.e. primarily composed of structures of cellulose and lignin creating a vascular system. Woody stems grow concomitantly in height and width. Any specie that does not produce true wood cannot be called woody specie
nor “tree” in a strict botanical meaning, although many tropical non-woody species grow towards an arboreal stand with hard stem. It is the case for example, of the tree ferns (*Cyathea spp* and *Dicksonia spp*, pteridophytes), and of many monocotyledons such as palm trees and coconut trees (palmaeae), ti plants or cordyline (agavacea), bamboos and sugar cane (gramineae). Moreover, tubers such as taro (*Colocasia spp*, *alocasia spp*) yams (*Dioscorea spp*) and sweet potato (*Ipomea batatas*), have an anatomical cellular structure close to woody tissue, with some vascular elements. These species that we call “analogous” to woody species can thus potentially be identified through anthracological analysis if charred, and have then been integrated as much as possible in our reference collection.

3Botanical terms definitions: “Indigenous” or “native” species: species which natural area of distribution (not resulting from human translocation) extends beyond the boundaries of the geographical zone under consideration, here the New Caledonia archipelago. “Endemic” species: native species which natural distribution area is restrained to New Caledonia. “Ruderal” species: anthropogenic and degradation plants formations associated species (Jaffré et al. 2004: 7-8)


5The botanical identification of sampled taxa was done on site and in the IRD Herbarium in Nouméa with the help of botany specialists, see acknowledgements.

6Domestication: morphological and/or physiological transformation of a specie by selection of individuals in relation to particular favoured characters (for plants, most often the size, but also the colour, taste, odour, etc.), through a control of reproduction and/or development modes of the individuals.

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**References**


Matisoo-Smith, E. 2009. The commensal model for human settlement of the Pacific 10 years on: what can we say and where to now? *Journal of Coastal and Island Archaeology*, Special Issue, 4: 151-163


Websites:
www.endemia.nc, Association Endémia
www.meteo.nc, Météo France Nouvelle-Calédonie
www.traditionaltree.org, Pacific Island Agroforestry
www.unu.edu/unupress, United Nations University Press
Language Contact in the Reef Islands: Keeping One’s Distance at Close Quarters

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Abstract - The two languages of the Reef Islands, Äiwoo and the Polynesian Outlier Vaeakau-Taumako, have been in regular contact since the arrival of the Polynesians some 700-1000 years ago. This paper examines the linguistic effects of this contact situation, and suggests an interpretation of these effects in terms of the sociolinguistic history of the area. Historically, the Polynesians were a high-prestige group, as evidenced by a large proportion of Polynesian loanwords throughout the languages of the area. The Polynesians were traders and navigators, and for a considerable time were bilingual in VAT and Äiwoo, as evidenced by structural adaptations in VAT on the model of Äiwoo (metatypy). Since the collapse of the trade network, their main source of economic and social prestige has disappeared; more recent linguistic change goes towards differentiation from the neighbouring language (esoterogeny), suggesting that for present-day VAT speakers, their language is a significant emblem of in-group identity.

Introduction

This paper examines the language-contact situation in the Reef Islands, with a view to determining two main points: Firstly, which structural and lexical features of the two languages in the Reefs, Äiwoo and Vaeakau-Taumako (VAT), can plausibly be understood as the result of language contact? Secondly, what can these contact-induced features tell us about the settlement and social interaction history of the speakers of the two languages? We show that plausible contact-induced changes in VAT are of two main types: metatypy or structural alignment on the model of Äiwoo (cf. Ross 1996); and esoterogeny or changes in phonological and morphological structure rendering the language more distinct from its larger neighbour and therefore more suited as an in-group language (Thurston 1987, 1989). This evidence suggests that Äiwoo was the language used in interaction across the linguistic border until the fairly recent arrival of Solomon Islands Pijin in the area, but that VAT speakers today go to considerable lengths to maintain their language as distinct from that of their neighbours. We furthermore suggest some interpretations of these observations with respect to the settlement and migrational history of the area.

The Language Situation in the Reef Islands

The Reef Islands are located in Temotu Province, the easternmost province of the Solomon Islands, about 390 km to the east of the main Solomons chain in the south-western Pacific Ocean. The province consists of a small and scattered group of islands, of which Santa Cruz (also known as Nedö or Deni) is the largest; the Reef Islands are located some 70 km to the north of Santa Cruz.

Temotu Province, with a population of around 19,000 in a land area of only 895 square kilometres, is one of the most linguistically diverse areas in the world. The small islands of Utupua and Vanikoro, to the south-east of Santa Cruz, traditionally had three languages each, though each of these islands is now dominated by a single language, with the others reduced to just a few speakers. Santa Cruz is home to two or three distinct languages, depending on where the line is drawn between language and dialect.

Two very different languages are spoken in the Reef Islands. By far the largest of these is Äiwoo (also known as Reefs), spoken by some 5,000-6,000 people in the main Reef Islands, as well as in a number of settlements on Santa Cruz and in the national capital, Honiara. Äiwoo is a member of the Reefs-Santa Cruz group of languages, whose genetic affiliation has been the subject of some debate (e.g. Lincoln 1978, Wurm 1978); the most generally accepted hypothesis has been that they are of mixed Papuan-Austronesian origin. However, recent research has shown that the alleged ‘Papuan’ structures in Äiwoo in fact have a plausible Austronesian origin, and indeed all the languages of Temotu Province, excluding the Polynesian Outliers, appear to form a single first-order subgroup of the Oceanic branch of Austronesian (Næss 2006a, Ross and Næss 2007). The difficulties
in arriving at a conclusive classification are, however, a clear indication that the Reefs-Santa Cruz languages appear at least superficially very different from other known Oceanic languages.

The other language in the Reef Islands is a Polynesian Outlier which has generally been known in the literature as Pileni. However, as Pileni is the name of only one of several islands where the language is spoken, and the residents of the other islands do not approve of this name being used for their language, we have chosen the name **Vaeakau-Taumako**, abbreviated VAT. Vaeakau is the name of the administrative district comprising the Polynesian-speaking islands in the Reefs, while Taumako is the largest of the Duff Islands, a group of islands to the north-west of the Reefs where a dialect of the same language is spoken.

VAT speakers in the Reefs live in the so-called Outer Reef Islands, a handful of tiny coral islets on the margins of the area, each capable of sustaining no more than 50-200 people. VAT is spoken today on the islands of Nifiloli, Pileni, Makalumu, Matema, Nukapu, and Nupani; altogether these islands are home to some 500 VAT speakers. An additional 1,500 speakers live in the Duff Islands, on Santa Cruz, and in Honiara.

The geographical distance between the speakers of these two languages is, in one sense, very small. The distance between Äiwoo-speaking Fenua Loa and VAT-speaking Nifiloli is about 800 metres; the gap can be waded at low tide. Matema, populated today by some 40-50 VAT speakers, is in a very central location with respect to the Great Reef after which the islands are named and from where the inhabitants obtain much of their food; it is closer to the Äiwoo-speaking Main Reefs than to the other Polynesian-speaking islands. It is also in a crucial position with respect to travel to Santa Cruz; the shortest and easiest route to Santa Cruz from the Reefs is from Matema, and Matema is the first island to become visible when travelling to the Reefs from Santa Cruz. Nupani island, on the other hand, is very remote and isolated, and has little regular contact even with fellow VAT speakers, let alone speakers of Äiwoo.

**Settlement History: Some Suggestions**

If the assumption that Äiwoo is an Austronesian language is correct, the present-day speakers are probably the descendants of the original Lapita population, of which archaeological evidence dating back some 3,000 years has been excavated at several sites in the Reefs (Spriggs 1997:129ff).

Exactly when Polynesian speakers first arrived in the area is unknown, but an estimate of some 700-1,000 years BP seems realistic. It is unlikely, however, that these initial settlers colonised the Outer Reef Islands immediately. As noted above, these islands are small and poor in natural resources, including both food and fresh water. By contrast, the Duff Islands are relatively large, hilly, forested islands with several rivers. We believe that the Duff Islands (Taumako) were the initial Polynesian settlement in the area. From there, the Polynesians sailed their sea-going canoes throughout the Reefs-Santa Cruz area, forming the basis for a trade network which was active in the area until the first half of the 20th century (Davenport 1968, 1972). The Polynesian settlements in the Reefs may have started as temporary trade and fishing outposts in the probably unpopulated or only sporadically populated smaller islands. The large reef with rich fishing resources, after which the Reef Islands are named, were probably a major incentive for the Polynesians to establish themselves in the area. They would then have gradually infringed on Äiwoo territory, probably not without conflict.

There is evidence that the linguistic border in the area has shifted over the past 100-150 years. The first mentions of the Äiwoo language give the name of the language as ‘Nifilole’ or ‘Nufiloli’ (Codrington 1885, Ray 1919) – deriving from Nifiloli island, which today is populated by Polynesian speakers. Ray (1919) describes the ‘Pileni’ language – i.e. VAT – as being spoken in Fenua Loa, Pileni, Matema, Nukapu, and Nupani. If this is accurate, the VAT language a century ago was not spoken in Nifiloli, which must be assumed instead to have had Äiwoo speakers, whereas it was spoken in Fenua Loa, which today is populated by Äiwoo speakers. The presence of place names of probable Äiwoo origin on Nukapu, Pileni and Nifiloli also suggest the earlier presence of Äiwoo speakers in these islands. The name Matema, pronounced [matema:] or [mdema:] may itself be of Äiwoo origin, from mua-Temââ ‘reef of Taumako (people)’; this is consistent with the hypothesis that the Polynesians came to the Reefs from Taumako with the explicit purpose of gaining access to fishing grounds. For more detail see Næss and Hovdhaugen (2007).

Today, despite the close geographical proximity between the two communities, day-to-day contact is marginal. There is a certain degree of intermarriage, with probably more VAT-speaking women marrying into the Äiwoo-speaking community than vice versa. A wife from a different language community is expected to use the language of her new home, not that of her original community. VAT speakers travel to the Main Reefs in order
to visit the trade store on Pigeon Island; but there is little travel in the opposite direction, and many adult Äiwoo speakers have never visited the Polynesian islands, with the exception of centrally located Matema.

When people do meet, the main language of communication today is the national lingua franca, Solomon Islands Pijin, though there is some degree of acknowledgement of the other party’s linguistic origin: The polite way of addressing or referring to someone from the other language community is with the word for ‘brother/friend’ in the addressee’s language, so that Äiwoo speakers address VAT speakers as *thokana* ‘same-sex sibling, friend (VAT)’, while VAT speakers address Äiwoo speakers as *gisi* ‘brother, friend (Äiwoo)’. (We have only observed such exchanges between male speakers.) Many Äiwoo speakers have at least a superficial command of VAT and use it in contact situations. VAT speakers in the Reefs, on the other hand, claim that Äiwoo is “too difficult” and that they neither speak nor understand it. In practice, however, it seems that at least male Vaeakau speakers often both understand and speak Äiwoo, and will do so if the situation requires it. By contrast, VAT speakers in the Duffs readily admit to speaking Äiwoo and do not consider it a particularly difficult language. Bilingualism, it seems, is a particularly sensitive issue in the Reef Islands, as witnessed also by the expectation that a wife abandon her native language and adopt that of her husband’s household.

**Cases of Possible Contact - Induced Language Change**

**Borrowing**

The Äiwoo lexicon contains a large number of Polynesian loanwords, presumably from VAT. Such loanwords are usually recognisable by their initial syllable *te-* or *to-*, a reflex of the Polynesian specific article *te*, though some fairly central words lack this marker, e.g. *kuli* ‘dog’, *kio* ‘chicken’, *poi* ‘pig’. Äiwoo speakers are often aware that a given word is a Polynesian loanword, and are sometimes able to suggest a ‘proper’ Äiwoo alternative.

By contrast, Äiwoo borrowings in VAT seem to be fairly few. Only a couple of dozen have so far been identified, though it should be emphasised that more are likely to appear as comparative work proceeds. Nevertheless, it seems clear that the proportion of Äiwoo loanwords in VAT is in no way comparable to that of VAT loanwords in Äiwoo.

From a sociolinguistic point of view, this would seem like an unusual situation. The Äiwoo community is by far the largest and most economically powerful, and it is generally more common for a smaller and less prestigious language to borrow vocabulary from a larger and more prestigious one than vice versa (Myers-Scotton 2002:238-239).

However, as noted above, the current situation is likely to be of fairly recent origins. The original arrival of Polynesians in the area, with their large, sea-going canoes, is likely to have caused considerable upheavals in the social and economic structure in the area, bringing into contact islands which may previously have been isolated from each other to a large extent, and establishing new patterns of trade and migration. As new and exotic arrivals, with sophisticated seafaring technology which became the backbone of an extensive trade network, the Polynesians are likely to have been a high-prestige group in the area for as long as the trade network existed, and indeed all the languages in the area, not just Äiwoo, show a large amount of Polynesian borrowings. As regards borrowing in the opposite direction, it is possible that VAT speakers in the Reefs, both currently and historically the smallest linguistic group in the area by far, attempt to protect their distinct linguistic identity by avoiding as far as possible lexical borrowing from Äiwoo.

**Structural Similarities**

Despite the fact that Äiwoo and VAT are, on the face of it, very different and certainly mutually incomprehensible languages, a number of striking similarities exist on all levels of structure. It is tempting to analyse these similarities as the result of language contact.

**Phonology**

The most striking aspect of phonology which is shared between Äiwoo and VAT is the apparently random alternation of the vowels [e] and [o] in a number of words. Examples include VAT *lohiu* or *lehiu* ‘ship’, *loimata*
or leimata ‘tear(drop), volo or velo ‘to spear’, Äiwoo singeda or singoda ‘woman’, beli or boli ‘to wrap’, tevali or tovali ‘refuse, reject’. This alternation is more frequent in Äiwoo than in VAT.

**Lexicon**

More study is needed of the comparative structure of the VAT and Äiwoo lexicon. One interesting development in VAT is that the Polynesian spatial prepositions i ‘locative’ and ki ‘directional’ have both taken on very similar, locative-directional meanings: ‘in, at, on, from, with, to’, etc. By comparison, Äiwoo has only a single spatial preposition with a range of meanings: ngä ‘in, at, on, from, with, to...’.

**Morphosyntax**

There are several interesting morphosyntactic parallels between VAT and Äiwoo; more are likely to emerge as comparative work proceeds. Among the most striking are the following:

Both languages form causatives through prefixation, and require an additional transitive suffix for the resulting form to be formally transitive:

VAT  
\[\text{hua-mo-kia CAUS-fall-TR ‘drop sth’; hua-inu-mia CAUS-drink-TR ‘make sb drink’}\]

Äiwoo  
\[\text{wâ-nubo-wâ CAUS-die-TR ‘kill’, wâ-nu-wâ CAUS-drink-TR ‘make sb drink’}\]

In both languages, an intransitive verb modifying a transitive verb must take a transitive suffix indicating ‘agreement’ in transitivity status. In VAT, nearly all transitive verbs show such a transitive suffix to begin with, meaning that a marker is found both on the transitive head verb and the intransitive modifier. Note, however, that while the suffix on the head verb can take a number of different forms (typically –a or –Cia), the modifying verb always shows the productive form of the transitive suffix, which is –ina: kave-a kato-ina carry-TR all-TR ‘carry it all away’; moti-a vaka-o-ina cut-TR encircle-TR ‘cut around it’.

The structure in Äiwoo is somewhat different. There is no obligatory transitive suffix in Äiwoo comparable to that found on transitive verbs in VAT (though Äiwoo does show certain predictable formal alternations between transitive and ‘semi-transitive’ forms of the same verb, see Næss 2006b). Äiwoo typically combines two or more lexical verbs into a single inflected form, in what may be labelled a nuclear-layer serial verb construction. Here, too, if the head verb is transitive, the modifying verb receives a transitive suffix, which in Äiwoo is –i: lôbâku-pâko-i fold-good-TR ‘fold it properly’, malei-eagâ-i raise-quiet-TR ‘raise (a child) secretly’.

Both languages make extensive use of clausal nominalisation, though by somewhat different means. Äiwoo has a largish set of different nominalising prefixes with specific meanings, e.g. de- ‘thing’, nye- ‘place’, nyé- ‘manner’, me- ‘person’, mi- ‘general’. These are prefixed to verbs or verb phrases to form nominal expressions referring to an instrument with which the act referred to by the verb is performed, the place in which it is performed, the way in which it is performed, a person or other entity which (habitually or in a specific situation) performs the act, etc. The ‘manner’ nominaliser is also used to form action nominals (cf. nyebakisi naanogo ‘his running’ in 1a). Verbs must be nominalised in order to function as the argument of a verb or other predicate (1b):

(1) ÄIWWO:

a. \[\text{Ngaa lâ nye-bakisi naanogo nà numoba tâ uubo-kâ} \]

so DEIC NOM-run 3MIN.POSS DEIC hole 3MIN.POSS:LOC forget-DIR

‘So while he was running, he forgot about his hole (i.e. the hole he had dug).’

b. \[\text{Ba i-kââ-no=gu nye-ku-ulu-pasele=nâ de-ki-bi} \]

NEG PFV-know-1MIN.A=NEG NOM-IPFV-3AUG.S-make=OP NOM-IPFV-gird

‘I didn’t know how to work the seatbelts.’
By contrast, VAT forms clausal nominalisations simply by replacing the tense-aspect particle of the phrase with an article or possessive pronoun:

(2) **Vaeakau-Taumako:**

a. \(Ko\ \textit{kilatou\ lato}=ko\ \textit{mathaku\ loa\ te\ toa\ ange\ kila}\)
   \(\text{TOP}\ 3\text{PL} \ 3\text{PL}=\text{TA}\ \text{afraid}\ \text{EMPH}\ \text{ART}\ \text{take}\ \text{DIR}\ 3\text{DU}\)
   ‘They (pl) were afraid to take them (du).’

b. \(A\text{-iau\ ne\ }u=ko\ \textit{toka\ taka\ afio\ ki\ muli}\)
   \(\text{PERS}\ 1\text{SG} \ \text{DEM}\ 1\text{SG}=\text{TA}\ \text{stuck}\ \text{1SG.POSS}\ \text{return to}\ \text{back}\)
   ‘I am unable to return home.’

A very common, though not entirely obligatory feature of VAT are the proclitic pronouns which typically attach to the tense-aspect marker, as seen in (2ab). Such proclitic pronouns are highly unusual in Polynesian languages, and they may be modelled on the Äiwoo subject prefixes found on intransitive verbs (transitive verbs take subject suffixes). Like the VAT clitic pronouns, the Äiwoo subject prefixes precede the tense-aspect marker (with the exception of the 3rd person augmented prefix \(li-/lu-\), which follows it):

(3) **Äiwoo:**

a. \(i\text{-}ku\text{-}wæ\)
   \(1\text{MIN}\text{-IPFV-go}\)
   ‘I go.’

b. \(mi\text{-}ku\text{-}wæ\)
   \(2\text{MIN}\text{-IPFV-go}\)
   ‘You go.’

c. \(ji\text{-}ku\text{-}wæ\)
   \(1+2\text{MIN}\text{-IPFV-go}\)
   ‘You and I go.’

**Discourse Structure**

In both VAT and Äiwoo, discourse structure, especially narrative structure, shows a very high frequency of so-called tail-head linkage: the repetition of the final phrase or clause of a sentence at the start of the next, a common feature of narrative discourse in the Melanesian area (Crowley 2002:69). The structure of these linked elements is also very similar in the two languages: the second occurrence of the repeated element (often also the first) is marked by a deictic element. In VAT this element is the medial demonstrative particle \(na\) (Næss 2004); in Äiwoo it is a distal deictic clitic of the form \(=C\ã:\)

(4) **Vaeakau-Taumako:**

\[
\begin{array}{l}
\text{Thai} & \text{langi} & \text{na} & \text{ko} & \text{nohonoho} & \text{na} & \text{ko} & \text{hano} & \text{loa} \\
\text{one} & \text{DEM} & \text{TA} & \text{RED/live} & \text{DEM} & \text{TA} & \text{go} & \text{EMPH} & \\
\text{ko} & \text{kaukau.} & \text{TA} & \text{bathe} & \\
\text{Ko} & \text{hano} & \text{ko} & \text{kaukau} & \text{na}, & \text{ioko} & \text{te} & \text{pakhola} & \text{ko} \text{ne-ho} \\
\text{TA} & \text{go} & \text{TA} & \text{bathe} & \text{DEM} & \text{then} & \text{ART} & \text{giant} & \text{TA} \text{go-down} & \\
\text{ko-i} & \text{toa.} & \text{TA-3SG} & \text{take} & \\
\text{Ko-i} & \text{toa} & \text{na} & \text{ko} & \text{hano} & \text{loa} & \text{ma} & \text{ia}. & \\
\text{TA-3SG} & \text{take} & \text{DEM} & \text{TA} & \text{go} & \text{EMPH} & \text{with} & \text{3SG} & \\
\text{‘One day she went to have a bath. She went to have a bath, and a giant came and took her. It took her and went off with her.’}
\end{array}
\]
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Structural Differentiation

Alongside the structural parallels described above, we also find a number of striking differences on various levels of structure. These are cases where VAT has developed in a direction different from other known Polynesian languages, and conspicuously different from Āiwoo.

Phonology

VAT has a fairly complex phonology for a Polynesian language, and shows, among other things, phonemic aspiration on the unvoiced oral stops p, t, and k; on the nasals m, n, and ŋ, and on the lateral l. Even more intriguing, however, is what Næss and Hovdhaugen (to appear) refers to as the “drift towards [h]”; the phonemes /s/, /th/, /kh/, /lh/ can all be realised phonetically as [h], in addition to /h/ being a phoneme in its own right. Āiwoo, by contrast, has no [h] sound at all, neither an /h/ phoneme nor any phonemes pronounceable as [h] in any context; English borrowings with /h/ in the source typically get a /v/ in Āiwoo: vatu ‘hat’.

Lexicon

VAT has an unusually large number of articles and quantifiers. Articles include the following: a ‘collective’, e ‘nonspecific singular’, ni ‘nonspecific plural’, ngha/nangha ‘specific plural’, te ‘specific singular’. Quantifiers include thai ‘one’, lua/la ‘two’ (differing in distribution from the numerals tahi ‘one’ and lua ‘two’), lui ‘two, a few’, i ‘some’, ngha/ngha/nangha ‘some’.

Āiwoo has no articles, though the numeral nyigi ‘one’ can be used to introduce new referents and so has a function similar to an indefinite article. In contrast to VAT thai ‘one’, however, nyigi in this use behaves no differently from other numerals. There are few genuine quantifiers, in the sense of a formally distinct class of morphemes, in Āiwoo; a plausible candidate may be dā ‘some’, though the distribution and exact function of this morpheme are somewhat unclear (Vaa 2006:28-32, 60-68). Terms like dāu ‘many’ and du ‘all’ are verbal and so cannot be said to belong to a distinct lexical class of quantifiers.

Morphosyntax

Reduplication is very common in Polynesian languages, but in VAT it is extremely frequent and fills a variety of functions, including repetition, durativity, emphasis, plurality. Both nouns and verbs may reduplicate, and there is both partial and full reduplication; indeed, both may be combined in a single form: noho ‘sit, stay, live’ > nohonoho > noho nohenoho.

Āiwoo does have some reduplication, but it is fairly rare, and apparently limited to verbs. Only partial reduplication is attested: lopā ‘speak’ > lolopā ‘chat’, meli ‘release’ > memeli ‘let down (a rope) gradually’.
Interpreting the differences and similarities

Metatypy

The similarities between VAT and Aiwoo can plausibly be understood as changes in VAT bringing the structure of the language closer to that of Aiwoo. Though we know little about the relatives of Aiwoo to suggest what Aiwoo might have looked like without prolonged contact with VAT, we do know that the points cited under “Structural similarities” above are points in which VAT differs from most other known Polynesian languages.

Such structural alignment, where the lexicon and morphology of a language is maintained but is rearranged, syntagmatically and/or paradigmatically, bringing it closer to the structure of a neighbouring language, is what Ross (1996) refers to as metatypy. Metatypy usually arises from extensive bilingualism: when most or all speakers of a community speak a second language which is used as an intergroup language, i.e. in communication with other language communities, “[s]peakers progressively adapt the semantic and morphosyntactic structures of their emblematic language [the language associated with ethnic and in-group identity, authors’ note] to the model of the more often spoken intergroup language” (Ross 1996:181-182). Ross suggests that such changes serve to ease the “burden of bilingualism”: keeping fluent in two different languages is easier the more these languages resemble each other in structure.

Interpreting the similarities in VAT and Aiwoo structure as metatypy in VAT on the model of Aiwoo fits well with what we know of the history of the area. Communication between the two groups must have depended on bilingualism until the arrival of Solomon Islands Pijin, and to a certain extent still does. As the Polynesians were the new arrivals, settling in the Reefs probably in quite small groups initially, it seems reasonable that they would have had to learn the language of their far more numerous and long-established neighbours. Indeed, even today it is probably the case that more VAT speakers use Aiwoo in contact situations than vice versa; though, as noted above, Aiwoo speakers readily claim to speak some VAT, their proficiency is usually at a “tourist” level, just enough for quite basic communication. Furthermore, Aiwoo to a certain extent serves as an intergroup language not just in the Reef Islands, but in the wider Reefs-Santa Cruz area, where it is claimed, for example, that the small language Nagu on Santa Cruz is in the process of being replaced by Aiwoo; there are also reports of Aiwoo being used as a lingua franca among immigrant communities on Vanikoro.

Although the Polynesians as exotic new arrivals, commanding previously unknown technology, probably enjoyed a considerable amount of prestige throughout the area historically, once small groups of Polynesians settled in the Reefs they were clearly outnumbered and to a certain extent marginalised by the Aiwoo speakers. This situation is likely to have led to just the kind of bilingualism which would have resulted in metatypy. It may also, however, go some way towards explaining the differences between the two languages noted above.

Esoterogeny

The changes in VAT which have led to greater structural differentiation from Aiwoo are, in a sense, on a different level from those resulting from metatypy. They are easily perceptible changes in phonetic structure (proliferation of h’s) and in the (type and token) frequency of certain lexical (articles, quantifiers) and grammatical (reduplication) categories.

Thurston (1987, 1989) and Ross (1996) suggest that changes in the emblematic language of a speech community may serve to clearly distinguish the language from that of other groups in the area, making it an ‘in-group’ language difficult for one’s neighbours to understand. Such an in-group language is called an esoteric language in Thurston (1989), and the process of differentiation is known as esoterogeny. Indeed, the changes in VAT listed under “Structural differentiation” appear to be of an ‘emblematic’ nature in that they emphasise certain aspects of VAT which are absent from or rare in Aiwoo, and which are easily recognisable as features of that particular language.

This process may appear to run contrary to that discussed above, but as Ross (1996:183) notes, there is no reason why metatypy and esoterogeny cannot co-occur in a single language. Crucially, they are both processes which operate on a group’s EMBLEMATIC language, and though they do so to speak pull in opposite directions, they do so at different levels of structure. Metatypy, as noted above, is the syntagmatic and paradigmatic realignment of already existing forms in a language. Esoterogeny, by contrast, typically produces phonological compactness, allomorphy – as seen in the VAT drift towards [h] – and allomorphy; the accumulation of irregular variants and the elaboration of the lexicon with numerous near synonyms and an increase in the frequency of opaque idioms (Thurston 1987:55-60, 1989:556). Several of these phenomena are recognisable in VAT.
Conclusion

Present-day Vaeakau speakers are in a sense ‘stranded’ on the resource-poor margins of the Reef Islands. Although they come from a proud tradition of seafarers who probably enjoyed considerable prestige in the Reefs-Santa Cruz area, the small communities of ‘colonists’ in the Reef Islands would have progressively lost their link to this tradition as time passed. The Polynesians were shipbuilders, traders and navigators, and must have depended on bilingualism in order to communicate with their customers throughout the Reefs-Santa Cruz area. However, with the decline and collapse of the trade network in which the Taumako Polynesians were the driving force, contact with Taumako would have been reduced to a minimum, leaving a few isolated colonies of Polynesians in an area dominated by the more numerous and powerful Āiwoo speakers. The lessened contact with the homeland would also have made the Vaeakau colonies much more dependent on their larger and richer neighbours for survival, a situation highly conducive to bilingualism; but at the same time, their distinct identity as Polynesians, no longer supported by their prestigious role as traders and navigators, will have been threatened by this new situation.

VAT speakers in the Reef Islands today have few cultural or historical traditions on which to build a distinct group identity. In contrast to most other Polynesian communities, there are no oral traditions recounting the geographical or genetic origins of the present-day people, and little remaining knowledge of the once-crucial seafaring skills – though competent navigators are still highly valued, with certain named individuals of a couple of generations ago revered for their skills in navigation. The speakers have few material resources and eke out a living on the margins of the larger, richer, more fertile Main Reefs. Indeed, while people in the Main Reefs never tire of repeating what a wonderful place the Reef Islands is, a visitor to the Polynesian-speaking islands is much more likely to be told tales of the hardships of everyday life on these tiny islets.

Nevertheless, VAT speakers are aware of their distinct identity as Polynesians, as manifested through their language – perhaps their only source of pride in their otherwise marginalised existence. In such a situation, the in-group language is likely to take on a great deal of importance as an emblem of group identity, as distinct from that of the dominant neighbours. This importance is reflected in the structure of the language, which shows a number of features marking out the language as clearly distinct from the language of these neighbours. This does not mean that the language has been immune to assimilative influence from its larger neighbour, as processes of metatopy appear to have aligned a number of grammatical structures in VAT with those of Āiwoo, as a result of the bilingualism of VAT speakers in Āiwoo. However, these changes are at a different level of structure from those resulting from esoterogeny. It is probably also significant that VAT speakers in the Reef Islands are reluctant to admit to knowing the Āiwoo language; in a situation where language itself is the main source of in-group pride and identity, bilingualism – especially in the sense of fluency in the language of the more powerful group – may be perceived as a threat to a unitary group identity.

Both their linguistic attitudes and the structure of their language itself, then, both reflect and reinforce the way in which VAT speakers use their language as their main source of identity construction. A cautious attitude towards bilingualism, processes of esoterogeny, and possibly the avoidance of lexical borrowing, all help VAT speakers ‘keep their distance’ and maintain their distinct linguistic identity in an ongoing contact situation where they are clearly the weaker party, and where other sources of in-group pride and identity construction are largely absent.
Notes

1 The term ‘Papuan’ does not refer to a well-defined genetic group, but simply to any non-Austronesian language spoken in the Pacific islands. The claim, then, is that there is a sub- or superstrate in the Reefs-Santa Cruz languages which is not of Austronesian origin.

2 Abbreviations used in glosses: A transitive subject, ART article, AUG augmented number, CAUS causative prefix, DEIC deictic particle, DEM demonstrative, DIR directional marker, DU dual, EMPH emphatic particle, IPFV imperfective, MIN minimal number, NEG negation, NOM nominalising prefix, OP oblique proform, PERS personal marker, PFV perfective, PH phasal aspect, PL plural, POSS possessive, PROG progressive, RED reduplication, S intransitive subject, SG singular, TA tense-aspect particle, TOP topicalising particle, TR transitive suffix. The symbols ä and â represent a front open-mid vowel [æ] and a low back vowel [ɑ], respectively. All examples are from the authors’ own field materials.

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References


Wurm, S.A. 1978. Reefs-Santa Cruz: Austronesian, but...! In Wurm and Carrington (eds), 969-1010.

Mythicization of Tsunami in the Ryukyu Islands: A Process of Seascape Formation in Island Societies

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Abstract - Concerning the origin of the Rapanui people, "Manuscript E" says that the people started to migrate over the sea, because of the rise of the sea (tsunami?). It is not easy to discuss the extent to which tsunami phenomena has actually been the causal factor for the migration of the Austronesians including Rapanui people, but a very good example to discuss the mythicization of tsunami is found in the southernmost islands of Japan, Ryukyu Islands. In the south-western end of the Ryukyu Islands, Yaeyama Region, the Great Tsunami of the Meiwa Period (1771) caused serious damage to the island societies. Ryukyu Islands have been often attacked by tsunami throughout history and a variety of tsunami legends have been told until today. Among these legends a particular type of legend is found on Ishigaki Island that is the closest to the seismic center of the Meiwa Period Great Tsunami: Men caught a mermaid which was an incarnation of sea spirit, and she predicted the coming of the Meiwa Period Great Tsunami. There are many natural and cultural features (e.g., tsunami stones) that are said to have originated in this tsunami. Recent geophysical studies indicate the distribution of this legend corresponds well with the distribution of the damaged area from the tsunami. Thus a real tsunami event has been partly mythicized incorporating folk beliefs. In this presentation, I analyze the relationship between (1) the distribution of "tsunami features" and the degree of damage caused by tsunami and (2) the type of tsunami legends and their degree of mythicization in Ryukyu Islands. I disclose the process in which disaster of the sea is mythicized, and discuss how natural phenomena have been culturally conceived in the formation of seascape among the people living in insular environments.

Introduction

Concerning the first settlement of Rapa Nui, "Manuscript E" states: a king was living with his five sons in the ancestral land. The eldest son, Moe Hiva said to the king that the sea is becoming higher, and that their land will be submerged in the sea bottom. Then the king decided to send his sons to search for new land (Barthel 1974:9-10).

The myth is much longer and not so simple, but an interesting point is that the rise of the sea or tidal wave (tsunami) is the prime mover of their migration. Including this myth on the origin of Rapanui people, there have been recorded many types of creation myths caused by flood or deluge in the Austronesian World of South East Asia and Oceania (Walk 1949). In Oceania, flood myths tend to be transformed into tsunami myths.

It is not certain whether the tsunami myths resulted from natural disaster that actually happened in the past or whether flood or tsunami was only a conceptual tool for the explanation of mythical events. But it is also true that the Austronesian people have experienced the submergence of land such as Sundaland, and even recently we have experienced volcanic activities and tsunamis like those in the Philippines, Indonesia, New Guinea and Solomon Islands.

Tsunami thus seems to be one of the most common natural hazards to the Austronesians, and it is important to discuss how Austronesians perceive this natural disaster, respond to it, memorize it and finally incorporate it in their oral history and mythology. Since tsunami often has an influence on geological features and causes damages on cultural assets, tsunami will be an important maritime factor in the formation of cultural landscape in the long term.

In this paper, I will examine how tsunami is told and mythicized, referring to tsunami that actually happened. The example comes from small coral island chain of Okinawa, the Ryukyu Islands, Japan.
Culture of the Ryukyu Islands

Okinawa or the Ryukyu Islands lie in the southern end of Japan, located between Kyushu Island and Taiwan. The Ryukyu Islands consist of four regions, from the north to south, the Amami Archipelago, the Okinawa Main Island, the Miyako Archipelago, and the Yaeyama Archipelago. The Miyako and the Yaeyama Archipelagoes are often grouped together as the Sakishima Islands which means "islands at far-end" (Figure 1).

Figure 1. Map of the Ryuku (Okinawan) Islands.

The Ryukyu Islands have been influenced by both Japan and China. Under these influence there formed an independent Ryukyu kingdom, and the kingdom had kept its independence until the beginning of the 17th century when the Ryukyu Islands subordinated to the Satsuma Clan under the Tokugawa Government Regime. Before the subordination, the Ryukyu Kingdom prospered by trade with China, Korea and Southeast Asia. Its political structure is characterized as sacred kingship in which men govern the political side and women had a central role in religious side. Kikoe-no-okimi, the most sacred official shamans, were close women relatives of the king. Under this sacred shaman, there existed a hierarchy of official religious authority throughout the kingdom. These official shamans, called noro, were women.

One of the most important aspects of the Ryukyu Island religion is that there was little influence of Buddhism or Shinto. For instance, the burial type of the Ryukyu Islands is totally different from those of Buddhistic burials in Japan. The Okinawan type of large burial is often called "turtle shell" burial, and included bones of patrilineal kin for generations.

In the 19th century, the new Meiji Government succeeded the Tokugawa Government after the civil war. At the end of the 19th century, the Meiji Government forced Okinawan people to adopt Shintoism, but the people have been practicing traditional religion based on shamanism until today. For instance a Shinto symbolic entrance is often situated in front of traditional shrine? "utaki" today while the inside of the utaki shrine remains the same. At the very end of the utaki shrine, there is the most sacred zone where only shamans are allowed to enter. In this zone, there is situated a sacred incense burner and a sacred rock which is the chair of the sacred spirit (e.g. Ouwehand 1985).

Because of the little influence of Buddhism and Shinto, the traditional belief and oral history in the Ryukyu
Islands possibly retain some aspects of ancient elements of Japanese culture before the influence of Buddhism. In particular, the Sakishima Islands are connected to Taiwan, and therefore they are situated as a kind of next door to the Austronesian homeland: a relatively strong Austronesian influence has been noted in the cultures in the Sakishima Islands from archaeology, linguistics and mythology (Ohbayashi 1973; Goto 2007).

**Tsunami Legends in the Ryukyu Islands**

There are many tsunami legends in the Ryukyu Islands. More than 110 examples have been recorded in the database of the Okinawan Oral-History Research Center. One of the typical tales is as follows:

1. In Ishigaki-jima Island, a fisherman went out of the sea and caught a big fish by net. The fish shaped like a human or mermaid. She said, “I came from sea paradise. If you let me go free, I will tell you something good”. The fisherman was scared of a fish speaking human words, and let the fish go away. The mermaid told the fishermen that tsunami incoming soon and that he should escape to the mountain. As soon as the fisherman arrived at his village, he warned the people against the coming tsunami. Few people believed in it. Only the fisherman who escaped to the mountain was saved. The big rock in the village was carried from the sea by the wave of tsunami (Figure 2).

2. In Miyako-jima Island (the main island of the Miyako Archipelago), a fisherman caught a fish. When he was going to cook the fish on the chopping board, he was scared because fish was of human shape. He let the fish go away. Or in another version, the fisherman heard a human voice from the sea, saying that “Yonatama, yonatama, come back soon!” Here yonatama is an old dialect that means “sea spirit.” Thus, the mermaid foretold the coming of tsunami. The fisherman who let the mermaid go was saved, but many others who did not believe in the prophet died (cf. Yanakita 1989). They say that the tsunami left the coastal ponds like Tooriike Pond (Figure 3).
Great Tsunami of the Meiwa Period (1771)

The above legends are mostly told to indicate the great tsunami of the Meiwa Period, 1771. The seismic center of this tsunami is considered to have been in the sea bottom, southeast of the Ishigaki-jima Island. The magnitude is estimated to have been 7.4. Historical record says that more than 8,000 persons died in Ishigaki-jima Island. More than 2,000 persons died in Miyako-jima Island. In total, it is considered that more than 10,000 persons died throughout the Sakkishima Islands. The south-eastern side of Ishigaki-jima Island had the most serious damage and several villages there were completely destroyed. The present settlements were re-established by immigrants from other islands (e.g., Institute of Sub-Tropical Studies 2000).

The map in Figure 4 indicates that the zones washed away by the tsunami wave correspond well to the distribution of tsunami legends collected in the database at the Okinawan Oral-History Research Center (Goto 2007).

The legend has it that in Ishigaki-City some utaki shrines were washed away by tsunami, and that some others were saved from the wave. In the latter cases, they say that the wave stopped just in front of the shrines. In one of these shrines, Maitzuba Utaki, there is a legend that a well-behaved mother foresighted the coming of the tsunami, and that she tied her baby to the tree in front of the shrine (Figure 5). Thus the mother and her son were saved. If we examine the distribution of the shrines that were not hit by the tsunami, we notice that they are located in the height of certain altitude: 30 m high. Nowadays, the Route 4 runs along the contour line of this altitude and the shrines that were saved from the tsunami are located along the upper side of the Route 4. The correspondence of the geological evidence of tsunami and the oral history of survived shrines may indicate that the tsunami legends of the Meiwa Period are not totally fairy tales. Oral history derived from an actual historical event, although the cause of the tsunami is mythicized incorporating retributive concepts and folk beliefs.
Background of Tsunami Legends of the Meiwa Period: Resources (Motif Pool) of Oral History

As is often argued, a myth or legend consists of several motifs. In this section, I will examine tale motifs relevant to tsunami legends in the Ryukyu Islands.

First of all, the earthquake and tsunami that hit the Ryukyu Islands are not limited to those of the Meiwa Period. Geologists estimate that Ryukyu Inlands have been frequently hit by earthquakes and tsunami (Institute of Sub-Tropical Studies 2000:264-265). So there must have been earthquakes and tsunamis before the Meiwa Period, and those previous events became the source of other tsunami legends that are not directly associated with the Meiwa Period tsunami.

In the Ryukyu Islands, there is a folk belief that earthquakes are caused by a giant eel living in the very bottom of the sea. The eel usually holds the earth by winding its base, but sometimes a crab does a mischief: the crab bites the eel, and the eel shakes the base of the earth due to pain. That is the cause of an earthquake. Similar legends of eel and crab are reported from Bagobo Tribe, Mindanao, the Philippines (Goto 2000).

There is another type of legend in the Ryukyu Islands that states: there was a flood or tsunami and all the people died except for a brother and a sister. Or at the beginning there was only a sea. A brother and a sister arrived to a small rock in this primeval sea by boat, and they created islands and descendants. They did not know how to mate, but examining mating of hermit-crab, sea birds or dugong, they learned how to make a sexual intercourse, and children were born. They were the ancestors of the present islanders. The myths of first brother-sister, Izanaki and Izananami in Japanese official mythology, also belong to the same type of legend.

Similar to the above ancestral brother-sister marriage, there is another type of tale in the Ryukyu Islands saying as follows: humans became immoral, and as a punishment the gods made boiled oil rain Vail to burn the humans. A brother and a sister who foresighted the disaster escaped into a cave, and only they survived. They became the ancestors of new human generations. A similar tale states a tsunami or flood came. The only survivors were a woman and a dog. The woman escaped from the disaster in the cave that was a refuge of the dog. Later the woman mated with the dog, got pregnant and delivered a baby. Or, later a man came and he felt sorry for the woman who was living with a dog. The man killed the dog, and the man married with the woman, and later they had a baby (Institute of Sub-Tropical Studies 2000:1-14; also in the database at NPO Okinawan Oral-History Research Center).

This kind of retributive conceptual chain that God punished the immoral humans by water or fire, and this led to the re-establishment of human groups, will offer a background to the formation of the tsunami legends presented above.

Figure 5. Maistuba Utaki Shrine. It is said that the tsunami wave stopped just in front of this shrine, and a mother and her son tied to the tree were saved.(Ishigaki City, Ishigaki-jima Island.)
Discussion: Folk Belief and Cosmology as a Background for the Seascape Formation

The fish that speaks human words considered to be sacred in Japanese folklore. A folklorist, Kunio Yanakita collected legends of talking fish from throughout Japan, including the Ryukyu Islands (Yanakita 1989:447-458). Talking fish that Yanakita mentioned vary from shark to eel to dugong. In particular, there are many legends about mermaid dugong as a sacred aquatic animal in Japan and the Ryukyu Islands. For instance, there is a legend of an 800-year-old nun in Japanese folklore: A girl ate the meat of dugong or mermaid. As a result, she never got old. She married men for many times, but always the husband died earlier because of decrepitude. The girl of ever-beauty people were afraid of and she was exiled. She wandered throughout Japan, repeating the same history for 800 years. Finally, she became a nun and died in a cave of a temple. Here mermaid and dugong are understood as the symbol of immortality.

In the Ryukyu Islands, several legends are found on the origin of dugong. According to these legends dugong was originally a human, and a wife who was divorced from the husband went into the sea and became a dugong. Also in the Ryukyu Islands, there is a swan-maiden type legend concerning dugong: a beautiful girl from the sea visited a young fisherman. They married. But their happy life did not continue so long, and finally the woman went back to the sea and transformed back to a dugong. These legends will imply that the dugong is very close to human or a counterpart of human in the sea. On the other hand, the life of the sea should be separated from that of the land, in order to avoid a disorder between the sea and the land. To eat a dugong or mermaid means a threat to this natural order and therefore it should be taboo. This taboo custom seems to have a political background: the dugong is preserved as the tribute to the king and also a tribute to China. In an utaki shrine on Aragusuku Island near Ishigaki-jima Island, there is a sacred altar to accumulate skulls of dugong that were killed as a tribute. Common people were not allowed to eat dugong.

The thought of the separation between the sea and the land is also observed in another legend on the magical method to protect tsunami. In the Yaeyama Archipelago, once a year the people make a partition by rope between the beach and the land, and women shamans in a sacred white dress dance around it, singing a chant. According to the oral history, this is the way to avoid tsunami, which a sea goddess taught them when a great tsunami came in the ancient period. The people believe that the partition is a reinforcement of the separation between and the sea and the land. This means that tsunami will occur when the separation is disordered. Interestingly enough, a similar way of thinking is found in Indonesian legends (Forth 1989). Today in the Miyako Archipelago, the big rock that is said to have been moved by the tsunami is itself worshiped in order to mark the border between the sea and the land (Figure 6).

Figure 6. Tsunami Stone that has become a place of worship (Irabu-jima Island, the Miyako Archipelago.)
This does not mean the people in the Ryukyu Islands have a negative feeling toward the sea. The truth is opposite. The people living in coral islands bordered by a reef contrast between the inside of the reef and its outside. They believe in the existence on the paradise far beyond the sea. It is called Nirai-kanai. Nirai-kanai is the land where ancestral spirits are living, where evil and disease should be exiled away, and where fertility comes from. Once a year, the people practice a ritual to welcome their ancestors to visit them with fertility of the land and the sea. Thus the concept of the separation between the sea and the land is a more positive way of thinking on the very essence of their life, that is, the sea: the sea should be kept sacred. I argue that the process of the formation of tsunami legend in the Ryukyu Islands should be understood in multiple contexts, geological, ecological, historical, political and cultural ones.

The tsunami of the Meiwa Period has resulted in a considerable transformation of the landscape on the islands. There are many geological features and historical sites that are said to have derived from the Meiwa Period Great Tsunami. But it does not seem that all of them were actually made by this tsunami event. Rather, the tsunami was so serious and its experience was so drastic, the Meiwa Period Great Tsunami has been used to explain the origin of many extraordinary geological and cultural features on the islands.

In conclusion, the life, society and cosmology of the Ryukyu Islanders have been structured and re-structured continuously by the sea. Since the tsunami is the very phenomenon of the sea, the Meiwa Period Great Tsunami has a definite impact on the formation of seascape among the people in the Ryukyu Islands.

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References


Chapter 6

Miscellaneous Papers
Swedish Large-Scale Historical Maps as Sources for Archaeological Research:
-Examples from Gotlandic Maps from 1693-1705

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Abstract - Historical maps are a vital and often used source in a variety of disciplines and applications in Sweden today. For a decade or two, they have moved into the GIS-community. A large scanning project by Lantmäteriverket will make most of the maps in Sweden available as raster images. In this article some different applications are presented, which goes beyond the traditional use of historical maps in GIS. These brief examples involve data mining, statistics, retrogressive analysis and hypothesis testing.

Introduction

Sweden has an enormous treasure in its vast number of large-scale historical maps archived over a period of 400 years. These maps also contain text descriptions of the mapped features and additional information depending on the mapping purpose. Use of information from historical maps has been a standard procedure for a long time in many domains in Sweden. Since so many populated areas have at least one historical map they are consequently of great importance as sources for historical knowledge of that area. The maps are frequently used in different studies of a variety of problems and also in different planning activities, such as the archaeological phase of preliminary investigations in construction planning and cultural management in both public- and private sectors. They are also used extensively for academic research in archaeology, geography, history, linguistics, and other disciplines. Examples of research areas are ecology, linguistics, agricultural development, ownership, spatial distribution of historical phenomena, etc.

The Swedish National Land Survey Agency has for some years had a very large and ambitious project, scanning all the historical maps in their archives (Lantmäteriverket - Historiska kartor för alla 2006). This means that hundreds of thousands (if not more than a million) historical maps will be accessible on the internet as raster images for anyone to download for a fee. This will even further boost the use of historical maps in GIS- and database applications. A method developed by the Department of Human Geography at Stockholm University in the 80’s was concerned with rectifying and transforming historical maps onto transparent plastic films. This method has long been used in comparative studies with contemporary maps (Cserhalmi 1997, Frisk 2000). It can be seen as an analogue overlay analysis, which is a standard technique in GIS analysis today. The introduction of GIS and other digital means has not fostered the development of new types of analysis and innovative approaches in the degree that could be expected. The maps have continued to be used more or less in the same manner. The full potential of the maps has never been used and all the text information has, so far, not been digitalised.

There are a multitude of smaller projects dealing with digitalisation of historical maps that are very narrow in their scope. They are set up for a restricted purpose and do not go beyond handling a few maps. The database modelling process is normally very limited and also poorly documented. Two projects have been dealing with historical maps in a more all-embracing fashion. They are Nationalutgåva av de äldre geometriska kartorna project (National Edition of the Older Geometrical Cadastres) at The National Archives of Sweden (Riksdarkivet 2006) and the Digitala Historiska Kartor, DHK (Digital Historical Maps) at The National Board of Antiquities of Sweden (Frisk 2000). The former project only deals with the maps from the first phase of Swedish large-scale mapping between 1633 and 1655 and is poorly documented, with the focus on the text descriptions. The text descriptions of these first Swedish large-scale maps were very brief. The other major project, Digitala Historiska Kartor (DHK) at The National Board of Antiquities of Sweden, is well documented with a series of preliminary reports and one final publication with a conceptual model (Frisk 2000). The focus of the DHK-project was the general information, which can be found in any Swedish large scale historical map. The analyses also focused on how the maps are used in the cultural heritage sector and mainly treat the information used in this sector. Our own project, The GM1700, is a pilot project with the objective of showing how advanced conceptual analysis and database modelling can benefit research and other usage of historical maps in GIS, mainly in the humanities.
The GM1700 database model aims on capturing all important information found on both the map- and in the text-portion, in a way never done before. The assumed users of the developed database are researchers of history, archaeology, human geography, and adjacent disciplines, while the purpose is to be able to create database views and queries based on their research questions at hand. For most researchers in the humanities and social sciences, access to the unadulterated source is vital. This project is an attempt to make these maps available and manageable in a way that can be trusted by researchers in these disciplines, thus reducing, or even eliminating, the need to go to the source itself for most of the problems formulated. This makes it vital to keep the original structure of the information. To do this there is a need for a broad perspective and a data oriented view of the maps and the text descriptions. For a deeper and more technical description of the system, see Svedjemo & Jungert (2005) and Svedjemo & Jungert (2006).

The Gotlandic maps made between 1693 and 1705 were chosen because they are quite unique with their rich text content and also because a private researcher, Jacob Ronsten, has typed out all the handwritten text into word-processing files. These maps will henceforth be referred to as the GM1700 maps. Furthermore the maps are also unique because they cover an entire province; the island of Gotland. The original purpose of the mapping was taxation and to gain knowledge about Gotland. The maps were made at the scale of 1:8 000 in the manner described in the instructions for the surveyors of the time. The map and text parts are linked by a code marking system, as seen in Figure 1.

Swedish Large-scale Mapping

In Sweden, domestic mapmaking dates back to the late 16th and early 17th centuries. Both small- and large-scale map productions have been quite extensive in various time-periods. Large-scale mapping is often called geometrical mapping and the large-scale is called geographical mapping. The real beginning of domestic small-scale map production can be traced to 1628 and this year can also be seen as the starting date for the Swedish National Ordnance survey.

Figure 1. Part of a map and text description from the GM1700 map series. The arrows show the linking of the map and text descriptions via the code marking system.
The main purpose for beginning the mapping was to gain insight of the resources of the realm. Sweden was expanding and rapidly developing in economical, political, scientific and cultural senses, but there was a lack of knowledge about the realm and there were no good maps available. The instructions for the mapping also demonstrate an ambition to reform farming to produce higher yields and help the peasants in different matters (Örback 1990, Tollin 1991).

What we now identify as the first phase of the geometrical mapping of Sweden’s countryside was between the 1630’s and 1650’s. Several thousand of villages and solitary farms were mapped (Örback 1990). These maps together with the text descriptions were bound in large books, or cadastras. They are called *Äldre geometriska jordeböcker* (Older geometrical cadastres). During this time-period no mapping was conducted by Lantmäteriverket in the provinces on the eastern and southern shores of the Baltic Sea. During the 1650’s and for some decades to come, the efforts of mapping Sweden were concentrated on small-scale geographical map production. The idea from the beginning was to use the geometrical maps as concept maps in the geographical map production (Bratt 1958).

The next phase in the geometrical mapping of villages and farms started in the 1670’s and had several goals. Sweden had been successful in the wars of the 1640’s and 50’s and large areas were incorporated into the realm. King Karl XI’s reduction of the nobles’ land entailed that many villages and farms came under the Crown. Fiscal reasons were also prominent with the mapping as the basis for setting taxes. These maps are often bound into books, but they also exist as loose maps. Skåne, Blekinge, Gotland and other incorporated parts were, to a large extent, mapped during this period.

Not all of Sweden was mapped during these first two phases. The maps are sporadically spread over the country and not all villages and farms in the mapped parishes have geometrical maps from these first periods, but most of Sweden was covered, as seen in Figure 2. The mapping by Lantmäteriverket was mainly conducted on freeholder’s farms and on the tenant farmers of crown-land. Some maps only cover vicarages, etc. The nobility land was normally not mapped. In the cases where a village had mixed forms of ownership, the nobility’s farms were most often missing on the maps. In some cases, the nobility had their estates mapped themselves, but not in conjunction with the mapping by Lantmäteriverket (Tollin 1991, Sporrong 1990).

Lagging behind England, Holland and other European countries, Sweden got its first modern act of redistribution of land, *Storskiftesförordningen* in 1749. This was the start of a series of land reforms. They were initiated by the fact that the land of each farm had been scattered in many small land parcels in the infields during the centuries, thus making farming very inefficient. Together with *bytwånget* – an act stating that all the farmers in a village had to synchronise and agree on how to work the land- the situation became untenable. There was no room for new techniques and improvements of the agricultural sector (Dannfelt 1928). The reforms aimed at aggregating the number of land parcels each farm had into fewer and larger parcels. In 1807 a new act of redistribution of land was established, *Enskiftesförordningen*. The act was modified in 1827 with the establishment of *Laga*
**Ancient Remains in Historical Maps**

When the maps were created, the landscape was full of visible ancient remains, many more than are seen today. The need to remove them was often not as necessary as it is today. Most of the destruction of archaeological monuments came with the urbanisation and expansion of the cities and the increased transport both on rail and roads which meant large building projects. Agricultural machinery requires large and straight fields which mean that the small fields with many impediments, both natural and man-made, vanished.

Ancient remains are often depicted on historical maps, either intentionally or unintentionally. In the latter case the ancient remains often show up as impediments in fields and meadows (Figure 3a-d). In a redistribution map from 1878 the land surveyor mapped fossilised field systems dating from 500 BC without knowing it. Due to the purpose of the map, redistribution of land, the mapping was very careful and accurate in soil quality assessment. The fields are depicted on the maps as regular patterns of different soil quality, which is the result of the farming techniques of the time (Lindquist 1974). It is not unusual that the surveyor intentionally depicted ancient remains.

In fact since 1643 the instruction for how the maps should be made contain a paragraph about the depiction of ancient remains (Styffe 1856). Examples are the biggest Bronze Age mound on Gotland, Uggarde roir, which is depicted on the oldest map of the area and also on a redistribution map from 1876 (Lantmäteriverket Visby, Rone socken). Sometimes there are also long descriptions of the mapped ancient remain, like in the hillfort Torsburgen on Gotland. On the map, parts of the myths and legends surrounding the hillfort are noted (Akt 2 Kräklingbo). Many surveyors during the centuries had a keen interest in remains from the past and depicted them on the maps. There even exist many special maps over more prominent areas with ancient remains (Tollin 1991, Jansson 1993). This is of course a very important source for archaeological research and is regularly used.

**Analysis of Historical Maps**

The usage of historical maps in GIS has in many ways been a continuation of how maps were used without the help of computers. With the introduction of GIS, it is mainly the tools that have changed, not the analysis or research questions in any higher degree. It is mainly overall landscape and land use that is studied, with the help of a limited amount of information from the maps. It is mostly the land use information, which is easy accessible in colours on the maps. The less accessible text part is seldom used. Analyses are very much based on map overlays to compare different features over time. Together with other types of spatial data they are used for visual interpretation. As an example the landscape analysis of Holm parish in Uppland, Sweden, can be mentioned. In this study, historical maps and archaeological sites are used as the main sources for landscape analysis and used in a GIS system, together with other sources (Larsson 2002). In The DHK publication, *Digitala historiska kartor*
– Tillämpningar i GIS för kulturmiljövården (Rentzog et al. 2002) a series of example applications are presented, which give a fairly good overview of how historical maps are used in different kinds of landscape analyses in GIS-system. Examples are given on how to use data from historical maps to visualize the impact of different activities, e.g. building a new road, to the historical continuity of the landscape. These types of studies are of great value and are often used in the pilot study phase of major building and planning processes, but do not go much beyond the traditional usage of historical maps. In the examples given in Rentzog et al. (2002), the maps are often visualised in 2-D or 3-D, where the map or reconstructed land use is draped over a digital elevation.
model (DEM). The examples in (Rentzog et al. 2002) cover much on how historical maps are used in cultural resource management and also point to some extended use.

In the following section we will give some examples of how we have used the information from the Gotlandic maps GM1700. Some of these examples go beyond the normal usage of historical maps in GIS. We have a firm belief that usage of GIS by researchers in the humanities will increase in all kinds of problem solving and reasoning concerning spatial dimensions.

**Locating Abandoned Farmsteads**

The geometrical cadastres from the 17th and 18th century depict the situation and features in Swedish villages or farms, which had bearing on the contemporary society and administration. The state of affairs shown in the maps was the result of a long development that goes far back in time. With proper analysis of the maps, together with other data, the situation in the area can be traced back in time to the medieval/Viking age or even further back. This kind of analysis is called *retrogressive analysis*, which is a firmly rooted tradition in Swedish and European historical geography. The organization of the cultural landscape that can be seen in the geometrical cadastres has its roots in a time period long before the creation of the maps and could be traced back perhaps as far as two thousand years (Riddersporre 1995). Dan Carlsson uses the GM1700-maps as the main source in a retrogressive analysis concerning the agricultural- and settlement development on Gotland during the Iron Age. In his thesis, he argues that the organisation and structure of the Gotlandic farms we see today was established during the older Iron Age (Carlsson 1979).

The older and younger cadastres are the most suited maps for these kinds of studies. This is of course because they are the oldest depiction of the cultural landscape, but also because later maps are made with the purpose of redistributing land and thus show two time horizons; the state of affairs before the redistribution of the land and the state after it. These two can sometimes be hard to separate in the maps (Riddersporre 1995). The cadastres are, on the other hand created primarily to depict the current state of affairs. In a retrogressive analysis both the map itself and the text part are important ingredients. As examples, the study conducted in GIS by Fabech & Ringtved (2001) can be mentioned. They used historical maps and other methods to recreate the prehistoric landscape and land use in the Bjerringbro/Hvorslev area in Denmark. With the proper retrogressive analysis, historical maps can be used for studies of phenomenon and processes with a much wider time frame than just the creation date of the map.

How a farmstead’s land parcels are scattered and spatially distributed can also be important clues to the history and age of a farmstead (Carlsson 1979). Together with other factors like soil type, land parcel names and ancient remains, the patterns of scattered land parcels can reveal the places of ancient farmsteads. As an example, the variables can be used in the following fashion: *Soil type*: A high degree of mould in a field indicates intensive farming during a long period. This is normally done in the fields closest to the farmstead lot. *Land parcel names*: One very important feature of historical maps is all the names they contain. Nearly all land parcels have names and these names can reveal a lot of the feature’s history. Most of these names are lost today. Parcel names can indicate disappeared farmsteads. *Ancient remains*: many different ancient remains are indicators for old settlement and farming. These facts and parameters are well known and factors like the ones listed are often used in retrogressive studies, such as Carlsson (1979) and Riddersporre (1995).

To graphically display the location of each farms land parcel, techniques based on SQL and GIS-functions can be used. The result is very easy to interpret and the visual power is vast, as shown in fig 4. The parameters of interest in this example are: ancient remains of Iron Age settlements, names of land parcels indicating old farmstead names and fields with mould that lay far from 18th farmsteads in “remote” areas where many different farmsteads own land. In Figure 4, the ownership is visualised with the arrows from each farm to it is land parcels. In the marked ovals we can see areas, with the names “Fylleqwie” and “Huusarfwa”, which can be old farm names, and are interesting for further investigation concerning abandoned farmsteads. These abandoned farms’ infIELDS have been requisitioned by the neighbouring farmsteads, probably due to desertion for some reason.

**Reconstructing Road Networks**

Roads, tracks and waterways are obvious features to all societies and therefore essential for historical studies. The geometrical cadastres were also intended to be the basis for geographical maps over larger areas. The idea
was to put all the village/farm maps together on smaller scale for regional maps. These maps were to depict the situation of villages, towns, main roads, lakes, etc. in a region (Bratt 1958). The roads are of central importance and the main road network is often well depicted in geometrical cadastres. This makes these maps quite suitable for studying older roads. There are some problems, however. First the hierarchy of different symbols can make it difficult to see the exact stretch of a road. Secondly, the surveyors do not have the same view of which road to depict. A road depicted in a map by one surveyor can suddenly disappear in the adjacent map made by another surveyor. A third problem is that all roads use the same symbol, so it is impossible to distinguish the size or importance of a road.

Figure 4. Maps showing areas which can contain sites of ancient, abandoned farms.
In a study by Huttu and Svedjemo (2007) concerning the older road networks around Roma kungsgård, a state demesne, large scale historical maps were used as one of the main sources. The purpose of the study was to show the changes in the road network between different time periods. Roma is considered by most scholars to be the place of the main thing (court) on Gotland, Gutna altingi, from at least the Viking Age and onwards. This was the body for the common governing and administration of justice for all of Gotland. From 1164 a very important Cistercians Monastery, S:ta Maria de Gutnalia (Roma kungsgård in Figure 5 and Roma 46 in Figure 6), owning land on Gotland, Öland and in present day Estonia. From the reformation in the 1530’s onwards it was first a Danish state demesne and, since the Swedish conquest of Gotland in 1645, a Swedish one. In modern times there has been a military airfield in the area and there is now a cultural centre in the old buildings and the land is cultivated by a tenant farmer. The area around Roma is very fertile and can best be described as fully cultivated and thus has been heavily disturbed archaeologically.

The starting point for the research was a narrow section of a bog separating the two farms Uppenbys and Kulstäde observed on a map from 1699. These two farms once belonged to the monastery of Roma and we believe there was a need to uphold communication with the monastery and this narrow part of the bog would have been an ideal place to cross it. The map was rectified and aligned with the Swedish national grid in GIS. The ancient remains database (FMIS), was overlaid and showed some Iron Age house foundations and fossil roads in the area, but not passing the bog. After field investigations we found traces that could be a stone pavement on one side of the bog (#3 in Figure 6). These pavements can be found where a road passes waterlogged areas. On the other side of the bog we found a gorge (#4 in Figure 6). We also talked with the owner of the farm, who helped his father to clear new fields in the area when he was young. He has an ardent interest in history and archaeology and told us that they had removed what he believed to be an old road and Iron Age house foundations. With this information we were able to reconstruct the extension of an old road across the bog. We could not date it and could not say if it existed already in the Iron Age, connecting the house foundations on both sides of the bog, or if it was constructed during the monastery period as a route between the Kulstäde farm and the monastery complex. A picture stone from the Iron Age (Roma 64 in Figure 6) indicates that the road is older than the monastery and probably can be dated to the Iron Age.

These first results inspired us to do a larger study, which covered a wider geographical area. The methodology was the same; with the starting point in the old cadastres, a retrogressive analysis was performed. Three time periods were chosen; 18th century, the monastery period (AD 1164-1530) and the Iron Age (AD 200-1150).
With retrogressive analysis of the many large-scale historical maps that exist over the area and other sources like ancient remains, stray finds, and different theories about settlement patterns on Gotland, the authors could reconstruct the road network in a plausible way. Some of the roads found on the old cadastres are not present today and some have an altered usage, e.g. an old main road, which today is used as a local road. Old roads may still be present, but stretches of the roads are altered. Old roads found on the maps and ancient roads together with other ancient remains like grave fields, picture stones and settlements, can be used to reconstruct old road networks. Studies has shown that graves and grave fields and picture stones have high correlation to roads (Huttu & Svedjemo 2007).

The Christianisation of Gotland

Sven-Olof Lindquist (1981) has conducted reasoning around the formation of parishes and the introduction of Christianity on Gotland. This is made from a chorological point of view, which is very well suited for performing in GIS-systems. In 1981, he had no access to GIS-systems, so all calculations had to be mad by hand in paper maps. This took very long time, even when only a sample of parishes were selected (31 of 92). In 2001 Lindquist, together with the author, reanalysed some of the calculations in GIS (Lindqvist 2001). This time it was made for the entire island, 92 parishes, since data were available in digital format for the entire island. The calculations and creation of the resulting maps now only took a few hours to produce.
The main research question was to give a plausible answer to the debated issue of whether the formation of the parishes was a prolonged process, which some scholars advocate, or if it was a quite rapid process, which Lindquist believes. A secondary question was who took the initiative to erect the parish churches and decide where it should be placed. Was it a single man (a great man) or a joint decision of farmers who were all peers? The GIS analysis focused on the second question. The data used in the analysis was the position of the farmstead buildings in 1700 and the parish borders of that time. The usage of the farmstead lots from 1700 for a process that took place 700 years earlier was motivated by a retrogressive analysis. The hypothesis was that the physical location of the church was a joint decision by the farmers and it was placed as “fair” as possible, which means that it should have a central location in relation to all of the farmsteads. The first analysis was to compare the extension of the parishes around the churches, to the “optimal” one. The optimal extension was defined as the thiessen polygon around the church. The location of the farmsteads was then compared to the optimal parish and the actual parish it belonged to. Only around 8% of the farmsteads lay closer to another church than the church to which they belonged, which points towards strengthening the hypothesis (Figure 7a). If natural obstructions like bogs, etc. were to be taken into account, the number would probably decrease. As a further test of the hypothesis, the distance between the church and the point of minimum transport distance from the farmsteads was compared. The rationale for this is as follows: If the distance is short, it points to the fact that the positioning of the church is “fair”, and all farmers had a say in the decision. If the distance is long, it is interpreted as the decision around the placing of the church is not made in consensus. In the GIS-system the point of transport minimum was calculated as the centre of gravity, by taking the mean position along the X- and Y axis of all the farmsteads in each parish. The distance between this point and the church was calculated. This distance was then visualised with a circle, with the distance as radius, around each parish, as shown in Figure 7b.

The results strengthen the hypothesis further. The parishes that have long distances are all known to be anomalous and there were known explanations for these anomalies.

![Figure 7a](image1.png) The dark areas are the difference between the optimal parishes, represented by thiessen polygons around the churches and the existing parishes.

![Figure 7b](image2.png) The distance between the centre of gravity of the farmsteads and the church in each parish.

**Statistics and Calculations**

Statistical calculations and other quantitative methods have a long tradition in studies of past times with historical maps as source material, often combined with other sources. These calculations have, in the past, been very tedious. With a system like ours, they will be rapid and precise. Calculations can easily be made, both from tabular data from the text part and also from the geometrical properties of the mapped features on the map itself. A good example of a classical study of this kind is made by Hannerberg (1971) in which data from historical
maps are used in calculations of yield, consumption, etc. in the agricultural societies of the past to depict the development over a longer period. There are numerous examples of these kinds of studies.

Calculations and statistics will perhaps not give the answers to most problems formulated in the humanities, but it often makes a very good starting point and can help with the interpretation of many problems. It can be used to describe and give a good overview of a situation or state of affairs, which is a necessary foundation when reasoning about a problem. In a GIS system, it can also be presented in a graphically powerful way and displayed in the map. Here we will show some examples of how calculations and statistics can be used in the system presented.

Location of Iron-Age Settlements

The need and demand for the ways to predict and understand the reasons for the location of various archaeological sites is great, both for Cultural Resource Management (CRM) and for academic research in archaeology. A predictive model attempts to predict where archaeological sites or features are located, by looking for tendencies and patterns observed in a region or by theory and notions of the distribution of sites or features (Kvamme 1990). An example is a large Danish project called “Foranderlige landskaber” (Ringtved 2002) in which different techniques for predictive modelling were tested to identify archaeological sensitive areas. It was based on the methods developed and tested in another project (Ejstrud 2003).

![Figure 8. Prediction map for Iron Age house foundations which is based on independent variables from the GM1700 maps. The more cross-hatched an area is, the higher the odds for it to resemble an site where an Iron Age house foundation is found.]

The information used in the models is composed of two parts, the dependent and the independent variables. The dependent variables are the archaeological sites or features whose distribution is sought. The independent variable is the characteristics recorded at each site. These characteristics can be divided in four major themes, according to Kvamme (1990): Environmental variables, cultural and social factors, positional characteristic and radiometric characteristics. With the basis in retrogressive analysis, historical maps can be used in predictive modelling. The information from historical maps is a social factor, used in the same way as other ancient remains. In the agricultural district areas around Roma in the centre of Gotland there are relatively few ancient remains recorded in the national database of ancient remains (FMIS). The general belief is that there have been many
ancient remains, but the modern farming has wiped out most of the visible traces of past. With predictive modelling it can be possible to find the areas where it is most likely that some of these ancient remains once lay.

In Gotland there are several researchers who have noticed that there is a correlation between “Kämpegravar”, which are Iron Age house foundations with dating to approximately AD 200-600 and the land use found in GM1700 maps. The meadows and farmstead lots from the GM1700, and other variables were used in a predictive model to verify this theory and also try to predict areas where these house foundations had been located (Svedjemo 2005). The model performed very well with a high significance (Figure 8). Even if the areas picked out by the model are too large to be really useful in field archaeology, predictive modelling techniques can be very useful in finding patterns in data and also in finding archaeologically “sensitive” areas, with a higher likelihood to inhabit different types of ancient remains than others. Historical maps can be a very good source for variables, according to the methods in retrogressive analysis.

Distances were of great importance for many reasons in the old agricultural society (Carlsson 1979). The farmstead building lot was generally placed near the fields, which were of highest economic value and also most vulnerable. Distances were also costly for transportation and time reasons; the greater the distances between the land parcels, the more time had to be spent on transportation. Distances are not only important in studies concerning the contemporary society at the time of the creation of the maps, but also play a vital role in many other analyses. As an example of a study that would have been greatly helped by our system (in our opinion), is Östergren’s (1989) work concerning Viking Age silver hoards. In this study, distances between different features found in the GM1700 and the find locations of silver hoards is of paramount importance for the analysis. Using GIS, these distances are very easy to calculate with standard techniques.

As mentioned above, the scatteredness of a farmstead land parcels can reveal something of the age and older phases in the farmsteads history. It is hard to pinpoint exactly how this works, but generally a more scattered farm has been subjected to more changes in its history, thus indicating a longer history. Examples include inheritance.
of other farms, strategic marriage, a moved building lot or the requisitioning of abandoned farm land parcels, as shown above. As a tool to visualize this scatteredness in statistical terms we have created an index, which shows how far the farm is situated between different percentages of its land. The index is defined by for each farm summing the land parcel acreage and finding the median (i.e. the distance that separates the 50 % remotest areas of the farm's land). The median of these values is set at 100; thus values above or below 100 indicate a higher or lower degree of scatteredness. These calculations can, of course, also be done at other breakpoints, like quartiles (25 %, 50%, and 75 %) and others. The resulting numbers can then be visualized in different ways (Figure 9).

Discussions and Future Work

Swedish large-scale historical maps are a unique source for many types of historical analyses. It is not only used in historical research, but also in ecology, archaeology, geography, linguistics etc. They are also used in a very high degree in non-research, for example in CRM, social- and physical planning at all levels, etc. Prior projects concerning the digitalisation of historical maps have drawbacks in various ways, affecting the usefulness of the digitised maps, for purposes other than the original scope of the project. The project Digitala Historiska Kartor (DHK) (Frisk 2000) at Riksantikvarieämbetet had too general of an approach, not addressing all the map- or generation specific information found on different maps. It only handled the general information, found on any historical map. The project Nationalutgåva av de äldre geometriska kartorna at Riksarkivet (Riksarkivet 2006) mostly addressed the text part of the maps, leaving the map itself more or less unprocessed.

In our work the semantic analysis is made with the aim of capturing all concepts in each map series. To model all information on all types of maps, a very data-oriented view is needed. This approach leads to a model that is very map-dependent, not like the DHK-model, which is very general. With this approach we do not lose any (or at least very little) information from the maps in the modelling process. Of course both the modelling of a domain model of this kind and populating the resulting database, takes longer compared to using a more general model. We believe that in the long run it will save time, since different scholars and agencies do not have to redo the process for their specific problem.

Most often when using historical maps in GIS, the GIS has been merely a tool to display the maps as “they are” and does not try to reveal or display any nested or hidden information. The analytic and statistical capabilities of modern GIS packages have seldom been used. In this paper we have presented some examples of usage of historical maps in which we take advantage of more of these capabilities. The graphical and display capabilities of GIS is also an essential part of our examples, but we have focused on using them to highlight and display the more deeply nested knowledge only visible after the information has been processed and analysed.

Some of these analyses are only possible to carry out if one has a domain model like ours that picks up the map-specific information and handles both the map and the text part. As an example, we used the notations about the owners and how they acquired the farm. Due to the lack of scanned maps, we could not fully demonstrate the analyses that can be performed. We only had access to scanned maps from one parish, Fröjel. Much of the map-specific information, present in other parts of the island, was not present here. Among these are the very interesting notations about disputes of land and co-ownership. With the full database these questions could be analysed. Interesting questions would be: Are there any special distributions of the farms and land disputed or co-owned? Can any characteristics of the farms involved be spotted? One working hypothesis could be that the disputed or co-owned land is land once belonging to now (around the year 1700) abandoned farms. Also the notations of what commodities the farmers used to pay taxes would be interesting to analyse, to see the spatial distribution.

With our model, essentially every piece of information from historical maps can be digitised and stored in a database. This will enable us to search for novel, and yet unknown patterns and correlations with advanced data mining techniques to gain new knowledge from the maps. One example was given around predictive modelling for Iron Age settlements in which information from the GM1700 was used. In our example logistic regression analysis was used, but other data mining techniques can probably be used for a great variety of problems and theories. This is, however, a largely undiscovered field of research and further research is needed to explore all the possibilities.

Historical maps are often used in retrogressive studies. In these analyses the depicted state of affairs found in the maps are traced back in time to reveal the situation several hundred, or even thousands of years prior the creation of the maps. As an example we executed a fairly elementary, but very powerful, graphical analysis that revealed
the location of abandoned farmsteads. In some areas the maps reveal very unusual situations, like in the parish of När. Farms from many surrounding parishes own land by the coast at a place called Hammaren. We believe that a method like the one presented here could help clarify and reveal the true nature of this situation and would probably be a good starting point for a deeper analysis. There are probably several more locations, not so obvious, that can be found with this method.

We hope that we with this paper have given some relevant examples about how a GIS database, based on a proper conceptual model of historical maps, can be used in a variety of different applications and problems. The examples we have given do, not of course, correspond to a comprehensive set of analyses. This field is largely an undiscovered area of research and we hope many others will follow in our steps and try to reveal more deeply nested knowledge from historical maps using advanced data processing.

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References
Hannerberg, D. 1971. Svenskt agrarsamhälle under 1200 år., Läromedelsförlagen, Stockholm


Unprinted references:

Lantmäteriverket i Visby:
Akt 2 Rone socken
Akt 2 Kräklingbo socken
Landscapes of Complexity: Data Visualization and Spatial Analysis of Prehistoric Shell Works Sites, Ten Thousand Islands, FL.

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Abstract - The Ten Thousand Islands are a remote archipelago of semi-tropical mangrove islands stretching for some 50 miles along southwest Florida’s coast. Located within this maze of islands is a complex seascape of prehistoric shell midden mounds and massive, human-engineered shell work sites constructed by non-agricultural coastal foragers. Shell work sites appear to have similar spatial patterns, ranging from small, simple, architecturally non-complex sites, to massive sites containing complex, monumental architecture. More elaborate shell works may include features such as canals, fish ponds, water courts, public plazas, and ceremonial or residential mounds. Is it possible that some of these features may have functioned to support corporate labor activities needed to maintain an increasing population dependent on a coastal foraging economy? This study aims to define the variety of shell work types and features, their spatial patterns, and what they indicate about site function, activities, population and social organization. GIS, data visualization, and spatial analysis of shell work features and site layouts are valuable tools to enhance interpretation of these unique island landscapes, as well as to help build regional settlement patterns and track social movements over time. By comparing various island settlement types and sizes, it is hypothesized that variations in the spatial patterns of shell works will reflect changes in social complexity over time.

Introduction

The archaeological study of islands, island landscapes and seascapes continues to grow as a viable and interesting subfield. Recent works by Fitzpatrick (2004), Broodbank (2000) and Patton (1996), as well as a growing network of researchers studying the archaeology of islands and archipelagos around the world have presented valuable case studies and have raised important methodological and theoretical issues central to island archaeology. Islands as landforms obviously present a different unit of study than others, being bounded and completely separated by water, and often viewed as insular. Access to, use and settlement of islands and their potentially different, limited and “bounded” environments required special adaptations, offering archaeologists a potentially unique framework in which to study human migration, colonization, interaction, insularity, socio-political organization, subsistence strategies, and landscape and ecosystem transformation on islands over time. This potential framework makes case studies of islands, no matter where their geographic location, relevant to all researchers interested in island archaeology.

As Fitzpatrick (2004:xiv) and other researchers have noted, there remains a paucity of island-to-island, and island-to-mainland comparisons, with most studies focusing on islands in continental areas, the Pacific and Mediterranean, and with little focus on other areas. In this paper, I present an introduction to the complex island landscapes of a little-studied archipelago of islands known as the Ten Thousand Islands, Florida, and show how geographic information systems (GIS) and data visualization are powerful tools to assist with the analysis and interpretation of complex island landscapes.

The Ten Thousand Islands are among some of the most significant examples of transformed island landscapes in the world, as the majority of sites remain pristine examples of a prehistoric seafaring culture who extensively constructed elaborate, complex shell works, terra-forming entire islands out of marine shell, earth and water to build functional and meaningful landscapes. This preliminary study suggests that shell works sites appear to have similar spatial patterns, ranging from small, simple, architecturally non-complex sites, to massive sites containing complex, monumental architecture. This study aims to begin defining the variety of shell work types and features, and what they potentially indicate about site function, activities, population and social organization.

The Ten Thousand Islands

Located in South Florida, the Ten Thousand Islands are a large, subtropical mosaic of marshes, swamps, rivers, and estuaries (Figure 1). The central feature of South Florida is the Everglades, a unique and vast wetland that
spans the entire southern half of Florida, and is the largest subtropical wetland in North America. The gulf coastal portion of the Everglades contains the Ten Thousand Islands, a maze of lagoons, mangrove swamps and marine meadows. Mangrove islands and swamps form a dense coastal forest several kilometers wide, where shallow, protected embayments permitted the development of extensive estuaries, providing abundant fish and shellfish to Native populations.

The Ten Thousand Islands region of south Florida contains numerous shell midden sites, which consist of midden piles, mounds, ridges, and sites with massive, intricate arrangements of shells called shell works. Shell works sites have been little studied, probably due to their remoteness, massive and bewildering complexity, and the extremely harsh environment and unpleasant working conditions within the humid, mosquito-infested shallow waters of the region.

The first archeological studies in south Florida were classificatory-descriptive in nature (Willey and Sabloff 1980:34), with a central interest in determining the origins and functions of mounds, which were viewed mostly as curiosities (Brinton 1872; Conklin 1875; Douglass 1885a, 1885b; Hallock 1875; Kenworthy 1883; Le Baron 1884; Simons 1884; Thomas 1891; Wyman 1875).
Prior ethnohistoric records from 16th century Spanish explorers in the Caloosahatchee area north of the Ten Thousand Islands had described the local Calusa Indians as a sedentary, socially stratified non-agricultural chiefdom with a marine-based subsistence. At the time of contact, all of south Florida was reportedly dominated by the Calusa, who had influence over some fifty to seventy towns, all of which were required to pay them tribute. It is not known if the Ten Thousand Islands groups were part of this chiefdom, or a separate tribe that were required to pay tribute to the Calusa.

More recently, several interdisciplinary investigations have provided significant regional data on shell mound complexes north of the Ten Thousand Islands, within the Calusa heartland. Works by Marquardt (1986, 1987, 1988, 1992, 1996, and 1999), Widmer (1988), Russo (1991) and Walker (1992) have provided major contributions for interpreting the evolution of these cultures. Further south, archaeological investigations have been much more limited. Hundreds of sites have been documented, mostly shell middens ranging from small, isolated accumulations, to massive complex shell works.

Three types of middens occur within the region: black earth middens, shell middens, and shell works. Middens can have a wide range of appearances depending on their formation process, degree of soil alteration, type of matrix and amount of cultural material incorporated into the midden. Black earth middens are composed of dark brown to black, organically stained soil intermixed with dense vertebrate faunal remains, ceramics, and other midden debris, with marine shell no more than a quarter of the matrix. Shell middens are accumulations of debris, composed primarily of marine shells, intermixed with other faunal remains and artifacts.

Some shell midden sites in the Everglades are extensive, and while a form of shell midden, are termed “shell works.” The term shell work is meant as a counterpart to the term “earthwork,” and describes sites that are purposefully composed of marine shell piled to form features such as high mounds, ridges, crescents, raised platforms, canals, and inundated courtyards (Goggin and Sturtevant 1964:194-195). Shell works sites in the Ten Thousand Islands are often located on remote and isolated islands, at the mouths of some rivers, and in some cases, were probably former islands that are now landlocked and completely surrounded by a thick forest of mangroves. Some shell work island sites appear to be completely anthropogenic, that is, the entire island was built or terra-formed by humans with shell.

These large, complex construction efforts suggest planned architectural features, and may reflect an organized level of leadership for the planning and building of such features. If shell works are purposeful social constructions, what were their functions, and how were these island landscapes transformed, and viewed by their makers? These remain questions central for interpreting shell works sites.

**GIS and Data Visualization: Methods**

Shell works sites are complex palimpsests, and understanding their individual construction histories, temporal and spatial patterns, and interpreting their meanings and functions is a difficult challenge. Not only are GIS and data visualization useful tools to conduct physical landscape analyses, they are also valuable tools for interpreting landscapes (Wheatley and Gillings 2000). GIS and data visualization can facilitate the archaeological exploration and interpretation of landscapes (Chapman 2006:14), helping to investigate themes such as the inter-relatedness of monuments and features, concepts of space and place, and elements of experience (Tuan 1977; Cosgrove 1989; Bender 1993; Thomas 1993; Tilley 1994).

In order to begin defining the geographic extent, archaeological characteristics and spatial patterns of Ten Thousand Islands shell works sites, a regional GIS was generated to incorporate a variety of data types and scales. First, a regional archaeological base map of the region was generated, incorporating various feature and raster datasets, including aerial imagery and environmental data. The regional-scale base map is used to analyze the geographic extent and distribution of shell works sites to begin building a regional settlement pattern.

Next, comprehensive archival and site data research were conducted for all sites within the region, to identify and copy all existing maps, sketches, photographs and data, for integration into the GIS. Using a variety of methods and software programs, existing site maps were either scanned, plotted, and digitized with a tablet in AutoCAD™, or scanned and digitized on screen in AutoCAD™. AutoCAD™ drawings were then converted in ESRI® ArcMAP™ 9.2 to feature and raster datasets, and using the Spatial Analyst extension, converted into Triangulated Irregular Network (TIN) files. AutoCAD™ drawings were also imported into Surfer™ and converted to generate a variety of 3-D surface and contour maps.
Results

Shell works occur along the southwest coast of Florida, but are concentrated in only two areas: the Charlotte Harbor area; and further south within the Ten Thousand Islands, where there are 17 known sites (Figure 2). The largest shell works in this region likely represent large, nucleated villages, or perhaps the political seats of local chiefdoms. These sites occur with a certain spatial frequency: 8 of the largest sites occur at every 3 to 4 miles within the northern part of the region, and become less frequent towards the southern end of the region. The largest sites often have smaller shell works sites and villages within 2 to 5 miles surrounding them, as well as other smaller sites thought to represent fishing hamlets or collection stations. Interestingly, there is a strong correlation between the location of large settlements opposite the mouths of major rivers, probably at the most highly productive estuarine zones. These settlements may have reflected a level of corporate control and access to more productive fishing grounds surrounding their sites, allowing their populations to grow and form organized leadership. This is only one possibility that may explain the larger size of these settlements.

A preliminary examination of shell works sites throughout the region suggest that sites may be arranged in spatially similar patterns. Sites range from small, simple, non-complex curvilinear mounded shell midden ridges, to massive, complete islands constructed with complex arrangements of shell. By comparing various site types and sizes over time, it is hypothesized that changes in social complexity among coastal foragers in the Ten Thousand Islands can be demonstrated. Using GIS, data visualization, and systematic archaeological testing to determine site structure, chronology and temporality, a variety of shell work site types and features are examined to determine whether they indicate diverse site functions, activities, populations and social organization over time. The following are examples of the use of GIS and data visualization for analysis and interpretation of shell works sites.
Key Marco

Discovered in 1896, the Key Marco site is the northernmost shell works island in the Ten Thousand Islands. Cushing (1897) excavated a submerged “muck pond” at the site, recovering many well-preserved carved and painted wooden ceremonial and utilitarian objects. Cushing thought that the muck pond represented a water court purposefully kept filled with water, and that numerous “shell benches” surrounding the water court functioned as canoe landings, docks, or structures supporting scaffold dwellings (Cushing 1897). Numerous wooden “piles” or piers were found around the shell benches, suggesting foundations for pile-supported quays or scaffolds for long, narrow, low thatched houses. Cushing recovered many household-type articles over and around these benches.

Unfortunately, the Key Marco site has since been destroyed. But spatial analysis and data visualization of the site is still possible using the site map produced by Cushing’s surveyor in the 1890s. A published copy of the Key Marco site map was scanned, plotted and then digitized in AutoCAD™ and plotted using Surfer™ mapping software, producing an impressive migration from flat paper-space document to a 3-D topographic map (Figure 3).

Visualization of the 3-D topographic map’s features demonstrate the magnitude in which the site’s occupants engineered the landscape and environment of the island with shell, creating features such as a series of protruding finger-like ridge projections, multiple basins and depressions, flat topped mounds and canals. Canals were probably constructed to access the site, as portage for canoes, and for control of water levels with other features in the site such as water courts. Several large depressions suggest the borrowing of shell, or were
features to hold water, perhaps for fish ponds or for aquaculture. The site also contains what appears to be a long, protective sea-wall built along the side of the site that faces the open sea. A group of the largest mounds toward the interior of the site suggests elite households, perhaps those of a chief or other person with high status and power among the community.

**Dismal Key**

The Dismal Key site is one of the largest and most complex of the Ten Thousand Islands shell works complexes, with monumental architecture covering up to 73 acres of the island. A contour map of the Dismal Key site produced by John Beriault (Beriault *et al.* 2003) was also scanned, plotted and then digitized into AutoCAD™, and then plotted in ArcGIS as a 3-D topographic map (Figure 4). Data displayed in 3-D is much more effective for viewing the complex features of the site, which include shell mound groupings, ridges, plazas, canals, water courts, and seawalls.

![Figure 4. The Dismal Key Site, Adapted from Beriault *et al.* 2003.](image)

The two tallest mounds measure 6 meters in height and are very steep sided, with flat platforms at their summit. These two mounds suggest the possibility of a chiefly residence, placed front and center to the entrance to the site, or that these were protective viewpoints. These two mounds are bisected by a long, canal that leads into the central portion of the site, suggesting a controlled entrance to the site, perhaps with a ceremonial or symbolic significance. Construction of this canal suggests a great amount of coordination and effort to build and maintain it.

The site also contains many protruding finger ridges, which may have served as house platforms, canoe docks or for other purposes. A possible shell ring is located in the interior of the site, measuring 200 by 300 meters with the open end facing the east towards a plaza. Several other features are possible ramps or expansions of the ring. The ring is consistent with other known shell rings in the Southeast, suggesting it could be an earlier Archaic period ceremonial construction, used for feasting and ceremonies. However, this remains to be determined by future testing.
Fakahatchee Key

GIS and data visualization of shell works sites also suggests that shell works were constructed to separate domestic from burial places, as demonstrated at Fakahatchee Key, an enormous 70 acre site mapped by Beriault (Beriault et al. 2003). An existing contour map was digitized and plotted in ArcGIS (Figure 5), and shows an enormous curvilinear shell midden ridge with distinct shell midden mounds, platforms, and radiating finger-ridges and canals. The curvilinear arrangement appears to be oriented towards the inside of the site, facing a low, central area of shell fields, and a large plaza or water court.

Figure 5. The Fakahatchee Key Site, Adapte from Beriault et al. 2003.
The domestic and social areas of the site are separated by a large linear midden ridge running north to southwest, which separates the site from an isolated burial mound to the west. A ramp or graded walkway leads up into an elevated area that contains a slightly sunken open plaza about 1 acre in diameter. It is flanked by two, 7-meter tall conical mounds, from which locals report that human remains were recovered. This mound complex is likely the village burial or ceremonial center, and its separation suggests a distinct cultural preference for separating domestic and sacred areas.

**Turner River**

The Turner River site, located at the mouth of the Turner River, covers an impressive 30 acres and consists of individual conical shell mounds extending linearly for a quarter-mile along the river. Smithsonian anthropologist Ales Hrdlička considered the Turner River Mounds to be “the most noteworthy group of shell heaps and mounds to be found in the entire region” (Hrdlička 1922), and considered the mounds to be structures.

Sears (1956) investigated the site in 1955, excavating five large test units and producing a contour map. Sears’ original contour map was digitized and integrated into ArcGIS®, which clearly demonstrates the effectiveness of viewing complicated topography in various views in 3-D mode (Figure 6). The site demonstrates a distinct pattern of multiple rows of massive shell midden mounds and ridges, which may have served as foundations for platform structures. The outer row closest to the river consists of 19 evenly spaced mounds, almost equally tall at 5 to 6 meters in height and 20 or so meters in diameter at their bases. Low depressions between them may have served as canoe approaches or small canals, or may also mark the locations of former elevated platform structures.

**Figure 6.** The Turner River Mound Complex, Adapted from Sears 1956.

Within the interior, central portion of the site are several of the largest and tallest mounds with distinct platforms overlooking open low plazas. This suggests the possibility that these mark the residence of the village leader or chief, or those who held special status in the community and whose houses were larger to display a message of wealth, power and prestige.

The outer row of mounds may have also served as a protective barrier for the inner mounds and public courtyards within the interior of the site. ArcScene™ and Surfer™ allow one to rotate a 3-D view to any angle,
and view the site as it may have looked unencumbered by the thick, overgrown vegetation that obscures the site today. Looking at the site as it would have been approached from the water by canoe, these tall mounds would have appeared as impressive, perhaps intimidating monuments, and certainly would have provided an increased view-shed above the very flat mangrove islands of the region.

Another possibility is that the site functioned as small village and tribute-based processing center focused on fishing or processing shellfish. Perhaps each mound represents a household work area, where shellfish were brought for processing or drying. If so, then these mounds may mark individual household shell dumps, with adjacent living areas nearby. As Sears noted, clean shell with little to no other artifacts, sediments or debris were found within the upper portions of the shell mounds. He found that occupational debris and artifacts were restricted to the black earth mounds, the basal portions of shell mounds, or to low spots in-between them. This does suggest that the upper portions of the mounds formed rapidly, were special activity areas used exclusively for processing and dumping shell, or the mounds were intentionally built as monuments or structures. Twelve radio-carbon dates taken from different areas of the site indicates that the site dates from about AD 430 to AD 1110. In one case, a 6 meter tall shell mound was found to have been constructed within a 190 year period.

Sears also noted that groundwater occurred at shallow levels, with midden extending well below the water table (Sears 1956). He concluded midden was therefore dropped into the water from an elevated structure above the water. I agree with this possibility, but argue that the best evidence for elevated structures is the very tall, steeply-sided conical arrangements of these mounds: this suggests that midden must have been deposited from a structure located above. These types of tall, steep-sided shell mounds separated by canals are common at most shell works sites, and suggest a similar architectural form.

**Russel Key**

Russell Key is another large shell work site that prior to this study had not been mapped nor tested. Systematically investigating a large shell work site like Russell Key is challenging, and it is very difficult to represent visually the variety and extent of the many types and sizes of features of the site. However, GIS and data visualization are shown to be important tools to begin analysis and interpretation of such a complex landscape (Figure 7).

At about 60 acres in extent, Russell Key is enormous. Several days of field walking and reconnaissance were used to produce a preliminary map of the site, and confirmed that the entire island is constructed with complex shell work features. Features include mounds, ridges, rings, plazas, canals and depressions. Archaeological mapping, testing and dating of a variety of features throughout different areas of the site included 10 excavation units and a total of 27 radiocarbon dates, and provide important temporal data for how Russell Key’s inhabitants may have engineered and terra-formed the island over time.

At the northern end of the site is a large, simple, open shell ring, which was dated at 390 BC to 170 BC and 300 BC to 10 BC, the earliest dated component of the site. This suggests that the first occupants of the site lived in a large, open ring-shaped formation, and shell was deposited as refuse, perhaps unintentionally marking the locations around a small settlement. Alternatively, the shell ring could mark the location where earlier visitors of the site held communal feasts, perhaps on a seasonal basis.

Separated from the shell ring by mangrove swamps is the main portion of the site. An interesting feature is its bilateral symmetry, with a very large, flat, central open interior area constructed of low shell scatters, possibly functioning as a central plaza, and dating from AD 420 to AD 710. The central plaza area of the site is flanked on both east, west and south sides with a series of radiating, protruding shell midden finger-ridges, which may represent a moiety or other clan residential zones or habitation areas.

Archaeological testing and dating of these features supports this idea, as the east and west finger ridges were built rapidly and are contemporaneous, with seven radiocarbon dates indicating these areas of the sites were constructed between AD 550 to AD 960.

Between these raised finger ridges are long, low depressions, which are similar to the ridges between mounds at Turner River. This series of ridges and depressions raises the question of whether they could have functioned as canoe portals, docks, or held platform structures on top of the ridges or within the lower depressions.
The finger ridges and features at the southern edge of the site were determined to date more recently, as indicated by five radiocarbon dates ranging from AD 900 to AD 1410. This suggests that Russell Key’s inhabitants continued to move in a southern direction along the site, perhaps building more island out of shell by continuing to build shell ridges towards the water.

One of the most intriguing features at Russell Key is an impressive series of basins and depressions found around the margins of the site. Collectively called water courts (Cushing 1897), it is not known yet what function these structures had. The size and shapes of the water courts range in size from small, low, tear-drop-shaped basins measuring from five by seven meters; to very large, steep-sided and deep, circular or oblong-shaped rings measuring up to 20 to 30 meters in diameter.

There are two distinct clusters of water courts at Russell Key, one on the east side of the site and the other on the west side, both adjacent to the series of finger ridges. In both areas there are six individual, very large water courts lined up in a curvilinear row, but separated by tall walls or ridges of shell. A sample was tested and found to be contemporaneous with the shell ridges and with each other, dating from AD 550 to AD 960. One excavation unit determined that Water Court 1 was built rapidly, as indicated by a date of AD 610 to AD 780 at the bottom of the shell ring, and at five meters above it at the top, a date of AD 720 to AD 960.
Water courts also occur around other margins of the site, but tend to be smaller, tear-dropped and shallow basin-type water courts. Some water courts currently hold water and are filled with small mangrove ponds, while others remain dry. All contain surface scatters of artifacts, including prehistoric ceramics, and a variety of shell tools such as hammers, cutting-edged tools, and vessels, such as scoops and cups.

Based on the variety of shapes, sizes, and their distribution around the site, it may be that water courts served a variety of purposes, with such possibilities as fish traps, impoundments, or ponds for aquaculture to capture, store and retrieve live marine food resources. It is also possible that some of the smaller water courts may mark the locations of former structures. Other possibilities are that the courts functioned as large shellfish roasting or steaming pits, shellfish production locales, tool manufacturing locales, or feasting pits. It is also possible that they served to store freshwater, however this remains problematic, since shell is permeable and could not have held freshwater without the addition of an impermeable barrier, such as a clay lining. Testing of one water court did not produce any lining or substrate, nor did it indicate any subsurface features such as floor layers, hearths or pits. Whatever their function, the presence of over a dozen of water courts suggests the possibility of large-scale organized labor, probably supporting their highly-specialized production of marine food resources.

At Water Court 6, a sluice was found on the edge of the water court facing the water. It appears that this water court probably functioned as a large fish trap, where fish would enter the water court through the open sluice during high tide, the sluice then was closed off, and fish could easily be collected. However, examination of all other water courts failed to identify any other sluces, and in fact, all the other water courts appear to have been built up taller against the side facing the sea.

In order to begin analysis and interpretation of these features and determine how they may have been constructed and what their purposes may have been, we have begun systematically mapping the features to elucidate their complex topography, relationship to sea level and water, and how they relate spatially and functionally to other features of the site. Using a Leica™ laser theodolite and transit, a total of three water courts have been mapped on a 1 to 2 meter grid (Figure 8). Though extremely time consuming to produce, these maps are invaluable for seeing complexities in their construction, which may not have been reproducible by other methods, such as the relationship of the water courts to the interior of the site and to that of the sea.

![Figure 8. Topographic Map of Russell Key Water Courts 1-3.](attachment:image)
Along the southern edge of the site is one single water court, the largest found on Russell Key, measuring fifteen by fifty meters. Two radiocarbon dates place the construction of this feature at AD 1030 to AD 1290, the last dated occupation of the site. The presence of one large water court at the later component of the site compared to the two groupings of six individual water courts at the earlier component of the site suggests a shift towards a centralization or control of resources. Not only is this the largest water court found on Russell Key, but several large *Busycon* shells were found inverted into the inside and outside walls of the water court, suggesting an added symbolic or artistic elaboration to the water court.

Russell Key includes two distinct mounds separated from the main part of the site. Their separation across water from the domestic area of the site indicates a possible cultural preference for separating the secular from the sacred. A large, flat-topped 4 meter tall mound with a ramp was tested and it was determined that it was built rapidly, between AD 610 and AD 850. Based on the existence of other flat-topped mounds in south Florida, this mound may have held a sacred temple or residence of a chief or religious leader.

Another interesting feature of shell works sites are called shell fields. These are low, slightly undulating open areas located in the interior of the site, which have far less elaboration than features like water courts, finger ridges and mounds. These are often overlooked because they appear almost flat, compared with the taller and more complex features typical along the margins of the sites. Shell fields contain concentrations of surface artifacts reflecting domestic activities, and it is hypothesized that shell fields may have been village activity areas associated with households. Systematic controlled surface collection of one shell field, along with systematic mapping of the area was conducted to see if there were any correlations between artifact type and the topography of the site.

Using a laser and transit, a one-meter interval grid over a 25 by 100 meter area of the shell field was established. The elevation points were plotted in ArcGIS™ as a TIN, showing an interesting terrain that includes several very low, shallow basins or depressions (Figure 9). These basins are small, oval-shaped features, measuring from seven by nine meters, to eleven by fifteen meters. The other features of this area are taller, protruding shell ridges. It is hypothesized that the shell ridges may have served as platforms for house structures, measuring from five by seven meters to eleven by fifteen meters. The shallow basins appear to be distinct activity areas, and may have served as some type of tool making or food processing locale.

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**Figure 9.** Density Distribution Map of Shell Tools, Shell Fields, Russell Key.
While plotting artifact densities for shell tool types, several interesting clusters are noted. The first is a high density cluster of clam shell choppers, found along the east edge of the shell field, within a series of depressions. The second two high-density clusters are of shell vessels and shell hammers, found along the southwest edge of the shell fields, within a flat, slightly depressed area. These patterns suggest the possibility that distinct activities were undertaken in various areas of the site, such as processing of shell fish and shell tool manufacturing (hammers and choppers), as well as cooking and eating (shell vessels).

The use of GIS and data visualization at Russell Key, though only in its early stages, has demonstrated its utility as a tool to help visualize and interpret the complex landscape of the site. Not only is it a functional tool to display artifact distributions and topographic features, but it can help visualize how the landscape was used, or how it may have appeared over time. While the function of the shell midden finger ridges and water court features are not fully understood yet, GIS and data visualization has assisted as a tool to test various theories, such as how the landscape may have appeared and how the finger ridges may have functioned during higher sea levels. With higher water levels in the past, it is easier to imagine pairs of finger ridges functioning as docks or jetties that people could walk out onto above the sea and use the ridges as piers to engage in group fish netting.

**West Pass**

West Pass is the closest site to Russell Key, at only a half mile. This site was also subjected to field-walking, reconnaissance, mapping, and archaeological testing. No elaborate or complex architectural features were found at West Pass, such as the rows of large mounds, radiating finger ridges, platform mounds or canals found at larger shell works sites. The shape of West Pass is reminiscent of the shell ring at Russell Key, suggesting a simple, large, open, almost crescent-shaped configuration. West Pass does contain a few examples of intentional

![Figure 10. The West Pass Site.](image)
constructions, including one very large, rectangular water court and two small depressions that may have served as small water courts. The site also contains a large, open central plaza area, which based on the presence of many artifacts on the surface, appears to have been a community activity area.

Results from five excavation units and eleven radiocarbon dates throughout the site indicate that the main occupation of West Pass occurred earlier than that of Russell Key, from about AD 100 to AD 690. It appears that the beginning of shell work elaboration at the site, with the building of the large water court, occurred towards the end of the site’s occupation, from about AD 430 to AD690. After AD 690, the site appears to have been completely abandoned.

It is not known how West Pass and Russell Key settlements interacted or if they were related, though at times, they may have had contemporaneous occupations. It is possible that the earlier shell ring population of Russell Key and the West Pass population eventually combined settlements at Russell Key around AD 690, after the abandonment of West Pass, and that perhaps they maintained distinct moiety or residential zones as seen on the contemporaneous constructions on the east and west sides of the site. While hypothetical, the possibility of West Pass and Russell Key settlements merging is supported by the abandonment date of AD690 at West Pass, and the contemporaneous bilateral east and west shell midden finger ridge constructions that begin at Russell Key around AD 600.

**Conclusion**

Ten Thousand Islands shell works sites are significant examples of island landscapes, and the extent to which humans have shaped and transformed their island environments. Shell works comprise complex prehistoric landscapes of distinctly arranged features, and represent a unique, prehistoric architectural tradition of landscape terra-forming using shell.

Shell works reflect an array of functions, such as to define domestic, public and sacred spaces; as burial places; walkways, canals and water courses; feasting locations, and as ceremonial constructions and monuments. Other shell work features are not as easily interpreted, and their purpose and meaning can only be surmised. For instance, basins and depressions, known collectively as water courts, may have served various purposes, such as for fresh water storage, cooking pits, feasting or processing areas, fish weirs, impoundments, or ponds for temporary storage of surplus live marine food resources.

This preliminary study suggests that shell works sites range from small, simple, non-complex curvilinear mounded shell midden ridges, such as West Pass, to massive, complete islands constructed with complex arrangements of shell, such as nearby Russell Key. It is hypothesized that similarity or diversity in site layouts, and the presence or absence of certain architectural features indicate continuity and or change in social organization over time, and by comparing various settlement types and sizes over time, changes in social complexity among the coastal foragers of south Florida can be demonstrated.

The goal of this paper was to introduce the significant and complex shell work island landscapes of the Ten Thousand Islands, and show how GIS and data visualization are important tools for landscape analysis and to facilitate ways of approaching interpreting complex landscapes. While much of this work is preliminary, and much of the graphics are basic in terms of GIS analysis, it is a starting point to expand on new ideas and approaches to looking at complex island landscape.

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References


Ancient DNA Preserved in 5000 Year Old Hedgehog Bones

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Abstract - The patterns of DNA degradation are partly known. Cold and dry environments with a neutral or slightly above neutral pH will preserve DNA better than hot, humid, or acidic conditions. But little is yet known on what types of material preserves DNA. So far, most of the genetic studies on ancient specimens have been conducted on mammals with large bones, few studies have been done on micro mammals. Here we investigate the possibility to retrieve DNA from small mammalian bones, from hedgehogs, from the Baltic island Gotland. We use bones from ancient hedgehogs from known archaeological sites. Of the 13 samples used in the study, all between 5000 and 1000 years old, 6 yielded reproducible DNA that could be assigned to hedgehog. We conclude that it is possible to retrieve DNA, and that this opens the possibility to study early migrations routes to the Baltic island Gotland.

Introduction

The possibility to retrieve DNA from ancient tissue relies on various factors, i.e. humidity, pH, and microbial activities. The two most important factors seems, however, to be age and temperature (Smith et al. 2001; Smith et al. 2003). DNA will survive for hundreds of thousands of years where the temperature is low and the geological conditions are favorable (Valdiosera et al. 2006; Willerslev et al. 2007), while it may vanish in less than thousand years in less favorable conditions (Gilbert et al. 2005). While the survival of ancient DNA is still not completely understood, the major factors behind degradation and preservation are being investigated (Gilbert et al. 2007; Malmstrom et al. 2007). Less is know about the type of material that preserves DNA in small bones. While there are numerous studies on large mammals that have yielded ancient DNA, relatively few have been carried out on micro mammals (Chan et al. 2006; Chan et al. 2005; Hadly et al. 2004; Matisoo-Smith et al. 1997). As several micro mammals have a fast generation time, and as several of them are restricted to either cold or warm climate, such animals would be ideal for testing hypothesis on migration, climate dependence, and bottlenecks.

In this study we investigate if it is possible to extract DNA from 4000 – 5000 year old bone samples of small mammals originating on the Baltic island Gotland. A study on extant hedgehogs from all over Europe where the two most common European species of hedgehog, the western (Erinaceus europaeus) and the eastern (Erinaceus concolor), had been separated through mtDNA control region sequences (Seddon et al. 2001), provided the possibility to design a suitable experiment. We use material from the Gotland due to the relatively cold environment in the area, the high pH in the soil, and the abundance or material from different time periods. Positive results would indicate the possibility for DNA retrieval under good conditions.

Materials and Methods

The material originated from two different sites, the Middle Neolithic Pitted Ware site, Ajvide and the Viking Age site, Fröjel. The middle Neolithic material was 5000-4000 years old, while the Viking Age material was ~1000 years old. In addition we used three medieval human bones as negative controls. Those three samples were not expected to contain ancient hedgehog DNA.

None of the bone samples had been washed or cleaned at the time of excavation. The Ajvide samples had been stored in plastic bags in boxes together with other animal bones from the mass material separated by year of excavation, and were removed specifically for this investigation. The Fröjel bone samples had been removed and
stored in separate plastic bags at the time of excavation and were without specific context. A minimum of approximately 100 mg was drilled from each bone.

DNA Extraction and Amplification

The extraction technique used for the DNA purification of the bone powder is based on silica binding and decalcifying of the bone with EDTA (Bouwman and Brown 2002; Yang et al. 1998) modified by using 1 M UREA instead of SDS in the extraction buffer [15]. Approximately 100 mg of bone powder and one millilitre of extraction buffer (0.5M EDTA pH8, 1M UREA, 100mg/ml Proteinase K) were mixed and incubated with constant agitation at 55°C for 24 h.

The primers were designed using E. concolor and E. europaeus control region reference sequences AF481501-AF481515, AF379854, AF379858, AF379703, AF379704, AF379706, and AF379712. DNA was amplified in two overlapping fragments by using primer pairs: Hedgehog 2; 5’ - ACT CTA TAA TTA CAT AAA ACA TTA A - 3’ and 5’ - GGA GGT GAT ATG CGG GTG G - 3’, and Hedgehog 3; 5’ - CAT CCT ATT AAT AAA CTT TAT CT - 3’ and 5’ - GGT AAA TGG GCC CGG GGC - 3’.

The PCR mix contained 2.5U HotStar Taq (Qiagen), BSA 0.1µg/µl. The PCR parameters were as follows: 10 min at 95°C, 55 cycles of 30 sec at 94°C, 30 sec at the annealing temperature, 30 sec at 72°C, 7 min at 72°C. Annealing temperatures were set at 50°C, 52°C, and 55°C.

Products were examined by electrophoresis at 80V for 40 min in 2% agarose gels, with 2 µl blue dye, 4 µl DNA PCR product and DNA ladder (G210A 19832903, 100 bp). All positive products were purified using Exosap-IT™ and sequenced using the MegaBACE 1000™.

Authenticity of DNA Sequences

All of the drilling, extraction, and prePCR work were preformed in a separate laboratory specifically used for aDNA extractions. There had been no extractions done on hedgehog in this laboratory prior to this work. Full body suits, facemasks with visors, and double gloves were used. All work surfaces were cleaned with bleach.
distilled water, and alcohol both before and after usage. All extraction and prePCR set-up benches were UV-irradiated for 24 hours. All tools and material used that was not supposed to contain DNA, were UV-irradiated. As, all of the bones were small and thin, the outer layer was not removed or cleaned with bleach, instead they were UV-irradiated with 1 Joul/cm². Each bone was then ground down separately to a powder by using a hand-held drill with a new burr for each sample. The PCR master mix consisted of 10X buffer, MgCl₂, dNTPs, BSA, primers and water and prepared in bulk. Extraction blanks were prepared in parallel with the extractions, and PCR blanks were set up with each batch of PCRs.

Results and Discussion

Out of the 13 bones, 6 yielded DNA that could be identified as hedgehog sequences. Of these, 4 were reproducible. Thus, in this minor sample set 30% were successfully extracted, amplified, and sequenced. We were also able to assign all sequences to (E. europaeus). There have previously been authenticated results from Scandinavia (Svensson et al. 2007; Dalen et al. 2007; Vila et al. 2001), and also from the Baltic states (Vila et al. 2001). These sequences are, however, the first authenticated from a Baltic island. The possibility to work with ancient DNA from Baltic islands will yield information on migration patterns for animals. Remains from harp seals (Phoca groenlandica) have been found on the island, and DNA analyses could help to resolve the old debate whether they were a Baltic population that went extinct, or just a part of a migrating population from the North Sea and the Atlantic that did not return when the conditions got less favorable (Storå 2001). Humans have also brought animals to the island. Among those is the domestic cow (Bos taurus), which appeared on the island already during the Neolithic. It could have originated from an eastern rout over Eastern Europe and what is today Ukraine and Russia, or via central Europe. The black rat (Rattus rattus) was also brought to Gotland with humans, although probably not purposely. A closer investigation on the black rats from the medieval layers may reveal if they were an isolated population, or if the abundant communications in the Baltic Sea in effect made all the black rats in the area behave like one large population. We have already retrieved some initial data from the hedgehogs, and they do seem to originate from Scandinavia. As they have a distinct place in the Baltic Neolithic (Burenhult 1997) studies on genetic variation in additional samples will reveal if the were purposely and continuously brought to the Island during the Neolithic.

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References


Article 55 Directions: Developing and Revising Tentative Lists and their Potential Influences

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Abstract - Experts to the World Heritage Committee have long acknowledged the significance of undertaking serious amendments to the Operational Guidelines to establish a representative, balanced and credible World Heritage List. Adopting a new section involved with the Global Strategy, which has been one of the key amendments carried out to the Guidelines of 2005, represents a response to the previous demands. Article 55, which prefaces the new section, depends on encouraging the preparation and submission of Tentative Lists in achieving the objectives of the Global Strategy. The purpose of the study was to evaluate the potential role that the submission of Tentative Lists might play in resolving the representativity gaps. It approached the issue by means of an empirical study. Developing and analyzing two groups of databases, involved with the experiences of inscribing properties and submitting Tentative Lists, was the key tool adopted to conduct the empirical study. The findings revealed the very limited potential influences of submitting Tentative Lists. They also indicated that the prosperous experiences in submitting Tentative Lists have been associated with the over-represented States Parties. The results suggest re-considering the maximum interval allowed before re-submitting Tentative Lists.

Preamble

In 1972, the UNESCO adopted the World Heritage Convention, which motivated the inscription of the properties that enjoy outstanding universal values on the list known as the World Heritage List, WHL (UNESCO 1972). During its early stages, the WHL seemed to be suffering from serious gaps. To resolve these gaps, the World Heritage Committee has launched the Global Strategy in 1994. The Glossary of World Heritage Terms provides the following definition of the Global Strategy: “The Global Strategy is a conceptual framework devised to ensure the representativeness and credibility of the World Heritage List. The Global Strategy was adopted by the World Heritage Committee at its eighteenth session in 1994” (UNESCO 1997a:21). The major aim of the Global Strategy is to guarantee that the WHL represents the variety of the world’s cultural and natural resources of outstanding universal values. The other aims include widening the definition of world heritage to represent the widest possible range of the world’s valuable cultural and natural resources. Encouraging non-States Parties to ratify the World Heritage Convention, and States Parties to submit Tentative Lists, TLs, are other objectives (World Heritage Centre-Global Strategy 2006).

The gaps of the WHL can be classified as geographical and typological ones. The concentration of the World Heritage Sites, WHSs, inside particular over-represented regions, such as Europe (Expert Meeting on the Global Strategy, June 1994, 2006), represents the geographical gaps. On the typological side, some types of the WHSs are under-represented, such as natural properties, in general (World Heritage Centre-Global Strategy 2006). “Wadi Al-Hitan (Whale Valley)” WHS is an example of the inscribed natural properties in Egypt. The site was inscribed in 2005 (World Heritage Centre-World Heritage List, 2006). Other types are over-represented; such as historic towns, religious buildings and elitist architecture; while 20th century and vernacular architecture are deemed under-represented types (Expert Meeting on the Global Strategy, June 1994, 2006). "Old and New Towns of Edinburgh” WHS (Figure 1), which was inscribed on the WHL in 1995 (Aplin 2002), is an example of the inscribed properties that represent the 20th century architectural heritage. The Bauhaus buildings in Dessau were designed by Walter Gropius in 1926 (Lupfer and Sigel 2004). The site has been inscribed in 1996 (Oers and Haraguchi 2003).
According to the study conducted by the ICOMOS (International Council on Monuments and Sites), the reasons for the gaps in the WHL can be classified as either structural or qualitative reasons. The former reasons, which relate to the properties nomination process, include the lack of the technical experiences that allow the preparation of the nomination documents. They also include the lack of the efficient assessment of the heritage properties, and the lack of the convenient legislative and management frameworks. On the other hand, the qualitative reasons relate to the identification and evaluation of the properties. The study also cites other reasons, such as the lack of the adequate legislation that provide protection for the nominated properties, and the lack of the national statutory inventories of cultural properties (UNESCO, 2004). Saouma-Forero (2006) discusses other reasons for the under-representativity of Africa, such as the limited resources of the African countries and the serious challenges concerning the education and health services that they face. She also indicates that further restrictions expressed in the latest versions of the Guidelines might have had negative impacts on the gaps in the WHL.

Resolving the gaps of the WHL has required exerting many efforts, which include holding conferences, thematic studies and meetings, such as the "Expert Meeting on the 'Global Strategy' and thematic studies for a representative World Heritage List", that held in the UNESCO Headquarters in June 1994. Another important meeting, was the "First Global Strategy Meeting", entitled "African Cultural Heritage and the World Heritage Convention", held in Harare in October 1995 (World Heritage Centre-Global Strategy 2006). In addition to these meetings, there were earlier contributions, such as the Secretariat's efforts of 1984 to propose initial thematic thoughts centered on architecture. In 1992, the ICOMOS has proposed an idea of "cultural provinces" that accompanied the American and the Greek proposal of a "time-culture-human achievement" grid, which are other early contributions (Expert Meeting on the Global Strategy, June 1994, 2006).

During the previous meetings, many recommendations were put forward. These mainly focused on three subjects "the criteria-integrity / authenticity", "outstanding universal value" and "credibility of the World Heritage Convention and the World Heritage List". These subjects were discussed thoroughly during the "World Heritage Global Strategy Natural and Cultural Heritage Expert Meeting" (UNESCO 1998a). The amendments carried out to the Operational Guidelines of 2005 can be considered one of the key outcomes of the previous efforts. Adding a new section to the Guidelines that is involved with the Global Strategy, section "II. B." (UNESCO 2005), is the most significant amendment. The latest TLs submissions can be considered another significant outcome of these efforts.

Figure 1. Edinburgh Castle inside the "Old and New Towns of Edinburgh" World Heritage Site. Source: The author.
Preliminary Studies

The Operational Guidelines

The Glossary of World Heritage Terms provides the following purposes of the Guidelines:

The Operational Guidelines for the Implementation of the World Heritage Convention ... were prepared by the World Heritage Committee for the purpose of informing States Parties to the Convention of the principles which guide the work of the World Heritage Committee in establishing the World Heritage List, the List of World Heritage in Danger and in granting international assistance under the World Heritage Fund ... The Operational Guidelines also provide details on other questions, mainly of a procedural nature, which relate to the implementation of the Convention. (UNESCO 1997a, p. 38)


Article 55 Directions

To remedy the gaps in the WHL, the Guidelines of 2005 have adopted section "II. B.", which is entitled "A Representative, Balanced and Credible World Heritage List". Articles 54–61 in this section have adopted the following tools that seem to have considerable influences on the representativity, balance and credibility of the WHL:

- The further ratification of the Convention
- The further submission of TLs (by the States Parties lately ratified the Convention)
- The further nominations of properties for inscription on the WHL (by the States Parties lately joined the Convention)
- Controlling the total number of inscribed properties
- The under-represented States Parties' preparation of TLs
- The participation of under-represented States Parties in the sessions of the World Heritage Committee
- Controlling the nomination rates and the total annual limit
- Giving priority to the nominations of the nil-site States Parties (UNESCO 2005).

Article 55 of the Guidelines of 2005, which adopts the first three tools, states that: 'The Global Strategy for a Representative, Balanced and Credible World Heritage List is designed to identify and fill the major gaps in the World Heritage List. It does this by encouraging more countries to become States Parties to the Convention and to develop Tentative Lists as defined in paragraph 62 and nominations of properties for inscription on the World...
Heritage List' (UNESCO 2005:15). The previous Article reveals the dependence on three key tools, which include encouraging more non-State Parties to ratify the Convention, encouraging more States Parties to develop TLs, and encouraging the States Parties who recently joined the Convention to nominate properties for inscription on the WHL. The coinage of Article 55 reflects some earlier recommendations. These recommendations encouraged States Parties to submit TLs, and stimulate more countries to become States Parties. The previous recommendations were adopted during the "Expert Meeting on the 'Global Strategy' and thematic studies for a representative World Heritage List", which was held in 1994 (Expert Meeting on the Global Strategy, June 1994, 2006). The progress report of 1998 (UNESCO 1998b), as well as the progress report of 1999 (UNESCO 1999b), adopted similar recommendations.

The preparation and submission of TLs had earlier origins in the previous versions of the Guidelines. Section "II. B.", in the Guidelines of 2005, addressed the significance of preparing TLs. The earliest Guidelines that have included relevant sections are those of 1980, 1983, 1984, 1987, 1988, 1992, 1994, 1996, 1997 and 1999. The title of this section is “BALANCE BETWEEN THE CULTURAL AND THE NATURAL HERITAGE IN THE IMPLEMENTATION OF THE CONVENTION”. The previous section emphasizes the Committee's recommendation to adopt particular measures to enhance the balance of the WHL. These measures include granting preparatory assistance to States Parties according to a priority system that gives the maximum priority to preparing TLs. The Article that hosts the previous recommendation has changed from one version to the other, yet the title of the relevant section has remained unchanged (UNESCO 1980; UNESCO 1983; UNESCO 1984; UNESCO 1987; UNESCO 1988; UNESCO 1992; UNESCO 1994; UNESCO 1996; UNESCO 1997b; UNESCO 1999a).

Tentative Lists

Tentative Lists, which have been established in the Guidelines, are originally the inventories that the World Heritage Convention has introduced. Article 11-1 in the Convention, which establishes the concept of submitting inventories, states that: 'Every State Party to the Convention shall, in so far as possible, submit to the World Heritage Committee an inventory of property forming part of the cultural and natural heritage, situated in its territory and suitable for inclusion in the list provided for in paragraph 2 of this Article. This inventory, which shall not be considered exhaustive, shall include documentation about the location of the property in question and its significance' (UNESCO 1972:6). Article 70 in the Guidelines of 2005 provides the following definition of Tentative Lists: 'Tentative Lists are a useful and important planning tool for States Parties, the World Heritage Committee, the Secretariat, and the Advisory Bodies, as they provide an indication of future nominations' (UNESCO 2005:18). The purpose of TLs is to assist the World Heritage Committee with evaluating the outstanding universal value of each nominated property, within the broadest possible context (UNESCO 1997a).

The Guidelines of 2005 guide and control the various aspects of TLs management; including the preparation, revision and harmonization of TLs; and provide the format used to submit TLs. Article 65 of the Guidelines points out that it is preferred that States Parties submit TLs at least one year prior to nominating any property, which is listed in the TL, for inscription on the WHL. It also encourages States Parties to revise and re-submit their TLs at least once every 10 years. Article 73, which urges States Parties to harmonize their TLs, provides the definition of "harmonization" as the process through which States Parties evaluate their TLs to check the existing gaps and to recognize widespread themes. The Guidelines identify the information required to submit TLs; such as the name and the geographical location of each property, a description of it, and an explanation of its outstanding universal value. Annex 2 of the Guidelines provides the TLs submission format (UNESCO 2005). The earliest versions of 1980, 1983, 1984, 1987, 1988, 1992, 1994, 1996, 1997 and 1999 were involved with some aspects of TLs management (UNESCO 1980; UNESCO 1983; UNESCO 1984; UNESCO 1987; UNESCO 1988; UNESCO 1992; UNESCO 1994; UNESCO 1996; UNESCO 1997b; UNESCO 1999a). These Guidelines have addressed the level of compulsion to submit TLs, the influences of TLs submission on the nomination process, and the allowed interval before revising and re-submitting TLs. They also include the provision of a submission format and the information required to submit TLs.

The course of the development of TLs management can be divided into four stages associated with certain versions of the Guidelines. The first stage is associated with the Guidelines of 1980; while the second is associated with the versions of 1983, 1984 and 1987. The third stage is associated with the versions of 1988, 1992, 1994, 1996, 1997 and 1999, while the fourth is associated with the Guidelines of 2005.
Table 1. The Development of the Management of Tentative Lists through the Various Versions of the Guidelines.

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<tr>
<th>Date</th>
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<th>The Key Relevant Materials</th>
<th>Level of Compulsion to Submit TLs</th>
<th>Influences on Nominations</th>
<th>Allowed Interval Before TLs Review</th>
<th>Submission Format</th>
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<td>(and CC. 80/CONF.016/06)</td>
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<td>.96/</td>
<td></td>
<td>7</td>
<td>Cultural nominations will not be considered, unless they are listed on the submitted TLs (Natural nominations will be given the priority if they are listed on the submitted TLs)</td>
<td>Provided (Annex 1 in the Guidelines)</td>
<td>N/P</td>
<td>N/P</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>.97/</td>
<td></td>
<td>7</td>
<td>Cultural nominations are not considered, unless they are listed on the submitted TLs</td>
<td>Provided (Annex 2 in the Guidelines)</td>
<td>N/P</td>
<td>N/P</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>.99/</td>
<td></td>
<td>7</td>
<td>Cultural nominations will not be considered, unless they are listed on the submitted TLs (Natural nominations will be given the priority if they are listed on the submitted TLs)</td>
<td>Provided (Annex 1 in the Guidelines)</td>
<td>N/P</td>
<td>N/P</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>WHC/2005/WS/1</td>
<td>Section II. &quot;THE WORLD HERITAGE LIST&quot; Subsection II. C &quot;Tentative Lists&quot;</td>
<td>62 - 76</td>
<td>Cultural and natural nominations are not considered, unless they are listed on the submitted TLs</td>
<td>10 years (TLs are recommended to be re-examined and re-submitted at least every 10 years)</td>
<td>Provided (Annex 2 in the Guidelines)</td>
<td>Provided (Annex 2 in the Guidelines)</td>
<td>Time limit 4</td>
</tr>
</tbody>
</table>

During the first stage, the Guidelines asked the States Parties to submit TLs as far as possible. Submitting TLs has not had any influences on the nomination process. The interval before reviewing TLs has been from 5 to 10 years. The Guidelines provided neither the format nor the information required to submit TLs (UNESCO 1980). The only change that occurred during the second stage was the listing of the information required to submit TLs; the name and the geographical location of each property, and a brief description of it, and a brief justification of its outstanding value (UNESCO 1983; UNESCO 1984; UNESCO 1987). During the third stage, many significant changes occurred. In a further compulsory tone, the Guidelines requested States Parties to submit TLs of cultural and natural properties and have renounced the phrase "as far as possible". Submitting TLs has had strong influences on the nomination process, since considering cultural nominations has become impossible unless they have been previously listed on the submitted TLs. The Guidelines have provided a standard format used to prepare and submit TLs (UNESCO 1988; UNESCO 1992; UNESCO 1994; UNESCO 1996; UNESCO 1997b; UNESCO 1999a). Other significant changes have occurred during the fourth stage. According to the Guidelines of 2005, cultural and natural nominations will not be considered unless they are listed on the submitted TLs. The allowed interval, prior to examining and re-submitting TLs, has become 10 years (UNESCO 2005).

The earlier preview reveals the features of the stages of the development of TLs management (Table 1). The first, second and third stages; which end by adopting the Guidelines of 1980, 1988 and 2005, respectively; can be called the "pre-TLs directions inscriptions", the "TLs-independent inscriptions" and the "partial TLs-based inscriptions". Adopting the Guidelines of 2005 marks the outset of the last stage, which can be called the "entirely TLs-based inscriptions".

### The Calendar for Nominations Processing

The significance of the calendar for nominations processing stems from its role in identifying the earliest inscriptions that reflect the new directions of the Guidelines, which have been previously reviewed. Subsequently, these inscriptions will indicate the time limits that should be adopted to conduct the empirical study. The calendar, presented in Article 168 in the Guidelines of 2005, comprises 14 stages (UNESCO 2005). The relevant stages are the deadline for the receipt of nominations, the decision making stage, and the notification of the States Parties of the adopted decisions.

<table>
<thead>
<tr>
<th>The relevant (900) Guidance</th>
<th>The key relevant stages in the calendar</th>
<th>The earliest (900) inscriptions that reflect the directions of the guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Guidelines of 1980</strong></td>
<td>1 January - - September- (the same year) - October - November (the same year) - December - Inscriptions of 1981</td>
<td></td>
</tr>
<tr>
<td><strong>The Guidelines of 1988</strong></td>
<td>1 October - - December (the following year) - - January (2 years later) - - Inscriptions of 1990</td>
<td></td>
</tr>
<tr>
<td><strong>The Guidelines of 2005</strong></td>
<td>30 September (before year 1) - - June (year 2) - July - June (immediately following the annual session) - July - Inscriptions of 2007</td>
<td></td>
</tr>
<tr>
<td>The relevant time limits:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978 (the first inscriptions)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1981 (inscriptions reflecting the Guidelines of 1980)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990 (inscriptions reflecting the Guidelines of 1988)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 (inscriptions reflecting the Guidelines of 2005)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The calendar has undergone an ongoing development process that has accompanied the development of the various versions of the Guidelines. The three versions of the Guidelines of 1980, 1988 and 2005 identify three key stages of the course of the development of the calendar. The Guidelines of 1980 assigned the 1st of January as the deadline for the receipt of nominations, and the period (September-October), in the same year, for decision making. They allocated the period (November-December), in the same year, for notifying the States Parties of
the adopted decisions (UNESCO 1980). The Guidelines of 1988 assigned the 1st of October as the deadline for the receipt of nominations; and December, in the following year, for decision making. They assigned January, two years later, for notifying the States Parties of the adopted decisions (UNESCO 1988). The Guidelines of 2005 assigned the 13th of September, before year one, as the deadline for the receipt of nominations; and the period (June-July), during year two, for decision making. They assigned the period (June-July), immediately following the annual session, for notifying the States Parties of the adopted decisions (UNESCO 2005). The previous preview indicates that the earliest inscriptions that reflect the directions of the Guidelines of 1980, 1988 and 2005 are those of 1981, 1990 and 2007, respectively (Table 2).

The Aims and the Hypotheses of the Study

The main aim of the study was to investigate the potential influences of TLs submission on the gaps of the WHL. The study also aimed at evaluating the validity of the following hypotheses:

- Despite its crucial role to the nomination process, submitting Tentative Lists per se is not expected to contribute towards the enhancement of the representativity, balance or credibility of the World Heritage List.
- The prosperous experiences in submitting Tentative Lists have been associated with the over-represented States Parties.

The Method of the Study

Conducting an empirical study, which was confined to the period (1972-2005), was the key tool adopted to achieve the previous aims. The former limit of the study period, 1972, represented the date of adopting the World Heritage Convention, while the latter was the time of the latest available inscriptions. The empirical study, conducted in May 2006, entailed carrying out bivariate analyses that required adopting a sample of States Parties. Therefore, a non-probability convenience sample, which implied selecting all the available convenient sampling units, was adopted.

To conduct the empirical study, a group of databases incorporating the relevant data was developed. This required adopting an official list of all the existing countries and classifying them according to their status. The list of countries provided within the UN publication “Standard Country or Area Codes for Statistical Use, Revision 4” was adopted for this purpose (United Nations Statistics Division-Country and Region Codes a, 2006). The adopted list was classified into the UNESCO's regions, which were Africa, Arab States, Asia and the Pacific, Europe and North America, and Latin America and the Caribbean (UNESCO.ORG | UNESCO Worldwide 2006). It was also classified according to the countries' statuses, which were the "State Party" status, the "non-State Party" status, and "not applicable" status that was assigned to the countries that ceased to exist.

The political changes that occurred during the span of the study represented a significant factor that was taken in account. During this period, many countries ceased to exist in certain instances, while others dissolved into independent countries. The political change that occurred to the Union of Soviet Socialist Republic, USSR, in 1991 might explain the influences of this factor. (USSR), which became a State Party in 1988 and inscribed five properties in 1990, dissolved into 15 independent countries in 1991 (United Nations Statistics Division-Country and Region Codes b 2006). The inscribed five properties had to be re-located within the seceding countries, in case that they ratified the Convention. Because of its efficient trace of such political changes, the previous UN publication was adopted as a major source of these changes.

Two groups of databases, which were associated with the "inscription experience" and the "TLs preparation and submission experience", were developed. The databases associated with the former experience were "the database of inscriptions on the WHL (including extended properties)", "the database of extensions" and "the database of transboundary properties". The indicators adopted to describe the features of this experience were "the number of inscribed properties" and "the size of the representativity gap". To calculate the total number of properties inscribed by each time limit, the following equation was adopted: \[ \text{the total number of properties inscribed by any time limit} = \text{the total number of inscriptions (excluding extensions)} - \text{the total number of inscriptions of transboundary properties (excluding extensions)} + \text{the total number of transboundary properties (excluding extensions) inscribed by the same time limit}. \] The total number of properties that each State Party has inscribed was calculated depending on the following equation: \[ \text{the total number of properties that any State} \]
Party has inscribed (by any time limit) = $\sum$ inscriptions (including extensions) - $\sum$ extended properties, by the same time limit.

The databases associated with the "TLs preparation and submission experience" were "the database of the submitted TLs" and "the database of the properties on these TLs". Amongst other aspects, the previous databases have been involved with the assessment of the submitted TLs. These TLs were assessed as either "TL meets the requirements of the Guidelines" or "TL does not meet the requirements of the Guidelines", regarding that the assessment of some TLs were not available. The adopted indicators of this experience were "the TLs submission frequency (the successful and available TLs)" and "the average number of properties on TLs".

Conducting the empirical study entailed determining the time limits by which the indicators of both experiences should be measured. To determine these time limits, the previously previewed stages of the development of TLs management were adopted. The earliest inscriptions that reflect the directions of the Guidelines (Table 2) were considered while determining the limits of each stage. Therefore, the first, second and third stages were assigned the limits (1978, 1980), (1981, 1989) and (1990, 2006), respectively; while the fourth was assigned the limit 2007 that marks its beginning. The previous limits indicated that the first stage included the years 1978, 1979 and 1980; the second included the years 1981… 1989, while the third included the years 1990… 2006. To determine the adopted time limits, the following equation was used: the number of WHSs inscribed by 1980 – the number of WHSs inscribed by 1977 = the number of WHSs inscribed in 1980 + the number of WHSs inscribed in 1979 + the number of WHSs inscribed in 1978. Taking this equation in account, the year 1977 was adopted as the beginning time limit of the first stage. In a similar way, the years 1980, 1989 and 2006 were adopted as the beginning time limits of the second, third and fourth stages, respectively. Because the earliest inscriptions took place in 1978, and because of the unavailability of the inscriptions of 2006, the adopted time limits were determined to be 1977, 1978, 1980, 1989 and 2005.

On the States Parties' level, the following equation, which represents the equal quota approach, was adopted to calculate the size of the representativity gaps:

$$\text{The size of the gap (site)} = \frac{\text{the State Party's actual number of inscribed properties} - \text{the total number of inscribed properties}}{1} \times \frac{1}{\text{the total number of States Parties}}$$

The following equation, which embodies the area-based quota approach, was adopted to calculate the size of the gaps on the regional level:

$$\text{The size of the gap (site)} = \frac{\text{the region's actual number of inscribed properties} - \text{the total number of inscribed properties}}{\text{the region's area}} \times \frac{1}{\text{total regions' area}}$$

The following were some of the limitations of the study:

- The empirical study was conducted on the geographical level only.
- Some countries were neither States Parties to the Convention nor Member States to the UNESCO. These countries were assigned potential UNESCO regions.
- The official documents involved with the submitted TLs were incomplete. Some TLs, as well as some of their classifications and assessments, were missing.
- Some of the documents of the World Heritage Centre were inconsistent. Obvious contradictions between corresponding documents could be easily realized. Document (SC-89/CONF.003/INF.2) reflected the Bureau of the World Heritage Committee's recognition of the Egyptian and Saudi TLs submitted in 1988 (UNESCO 1989). On the other hand, the document (WHC-93/CONF.002/7) provided three tables of the States Parties that had successfully submitted TLs, the States Parties whose submitted TLs had been unsuccessful, and the States Parties that had not submit TLs by 1993. Egypt and Saudi Arabia were listed in neither of the previous tables (UNESCO 1993).
- The calculated number of properties inscribed by 2005 was inaccurate. Depending on the adopted method, the calculated number was 813, despite that the actual number was 812 WHSs. The location of the transboundary property "Uvs Nuur Basin" within two UNESCO's regions might be the reason for this discrepancy.
- TLs that the countries, which ceased to exist, have submitted were not re-located.
The Findings and the Discussion

The Key Features

The results, concerning the earliest inscriptions and TLs submissions, showed that the earliest inscriptions are those of 1978, when seven States Parties have inscribed 12 properties. These States Parties are Canada, Ecuador, Ethiopia, The Federal Republic of Germany, Poland, Senegal and The United States of America; who have inscribed two properties for each, apart from The Federal Republic of Germany and Senegal that have inscribed one property for each. The findings showed that the earliest TLs submissions have been the Canadian and the Jamaican of 1980. Neither the previous TLs nor the classification of the properties that they included is available. The Canadian TL has met the requirements of the then Guidelines, yet the Jamaican failed to do so. The earliest TL submission that is available and meets the requirements of the Guidelines is the Bulgarian submission of 1984.

Table 3. The key features of the experience of submitting Tentative Lists. Note: TLs= Tentative Lists. Data source: The databases.

<table>
<thead>
<tr>
<th>The time limits</th>
<th>The UNESCO’s regions</th>
<th>The number of the States Parties that have submitted TLs</th>
<th>The area of the States Parties that have submitted TLs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of the States Parties that have submitted TLs</td>
<td>% (to the number of all the States Parties that have submitted TLs)</td>
<td>Area of the States Parties that have submitted TLs (sq km)</td>
</tr>
<tr>
<td>1977</td>
<td>Africa</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1978</td>
<td>Africa</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1980</td>
<td>Africa</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1989</td>
<td>Africa</td>
<td>1.00</td>
<td>16.67</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>4.00</td>
<td>66.67</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>1.00</td>
<td>16.67</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>6.00</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6.00</td>
<td>100.00</td>
</tr>
<tr>
<td>2005</td>
<td>Africa</td>
<td>28.00</td>
<td>19.44</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>13.00</td>
<td>9.03</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>30.00</td>
<td>20.83</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>48.00</td>
<td>33.33</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>25.00</td>
<td>17.36</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>144.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

The results (Table 3), concerning the key features of the TLs submission experience, indicated the possibility to divide the course of TLs submission into three stages. The first stage, which includes the time limits 1977, 1978 and 1980, can be called the “nil-submission” stage. During this stage, not a single TL has been submitted. The second stage, which embraces the time limit 1989, can be called the “limited submission” stage. During this
stage, very few TLs have been submitted. The third stage, which includes the time limit 2005, can be called the "vigorous submission" stage. During this stage, the majority of the States Parties have submitted TLs. The findings also indicated that Europe and North America have predominated the other regions' experiences in TLs submission, by 1989. Four of the six States Parties that have submitted TLs by 1989 (66.67%) are located in Europe and North America. Europe and North America have maintained their predominance in TLs submission, by 2005. Forty-eight of the 144 States Parties that have submitted TLs by 2005 (33.33%), including the previous six States Parties, are located in Europe and North America, representing the maximum ration of any region.

The previous results revealed a vigorous TLs submission during the period (1989-2005). They seem to indicate that this vigorous submission might be attributed to the amendments carried out to the Guidelines of 1988, concerning TLs management. They also revealed a recession in the supremacy of Europe and North America, in terms of the number of States Parties that have submitted TLs, by 2005. This result might be ascribed to the active efforts of the Global Strategy, which led to greater participation of the other regions in the process of preparing and submitting TLs.

### The Size of the Representativity Gaps

The results (Table 4), concerning the size of the gaps on the regional level, revealed the nil gap size of all the regions by 1977, because of the lack of any inscriptions in 1977. The results also indicated that the over-represented regions by 1978 were Europe and North America, Africa, and Latin America and the Caribbean; while the Arab States, and Asia and the Pacific were under-represented. Europe and North America were the most over-represented region, while Asia and the Pacific were the most under-represented region. By 1980, the over-represented regions were Europe and North America, the Arab States, and Africa; while Asia and the Pacific, and Latin America and the Caribbean have been under-represented. Europe and North America had the largest over-representivity gap, while Asia and the Pacific had the largest under-represented gap. The results showed that Europe and North America, and the Arab States were over-represented by 1989; while the other regions were under-represented. Europe and North America was the most over-represented regions, while Asia and the Pacific had the largest under-representativity gap. By 2005, Europe and North America was the only over-represented regions, while the other regions were under-represented. Africa had the largest under-representativity gap. The previous results seem to indicate that, by all the time limits, Asia and the Pacific were under-represented, while Europe and North America were over-represented.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inscribed properties</td>
<td>Gap size (site)</td>
<td>%</td>
<td>Number of inscribed properties</td>
<td>Gap size (site)</td>
<td>%</td>
</tr>
<tr>
<td>Africa</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>3.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Arab States</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-1.00</td>
</tr>
<tr>
<td>Asia and the Pacific</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-3.00</td>
</tr>
<tr>
<td>Europe and North America</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>7.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>12.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

On the States Parties' level, the results (Table 5) revealed the continuous decline in the percentage of the number of under-represented States Parties, to the total number of States Parties, throughout the time limits of 1977, 1978, 1980 and 1989; and the sudden expansion in this percentage that has occurred by 2005. They also revealed the continuous growth in the percentage of the number of over-represented States Parties, to the total number of States Parties, throughout the first four time limits, and the sudden fall in this percentage that has occurred by 2005. The results achieved on the regional and the States Parties' levels seem to support each other. They emphasize the remarkable drop in the percentage of the number of over-represented States Parties, to the total
number of States Parties; and the sudden fall of all the regions, except for Europe and North America, into the under-representativity zone; which occurred during the period from 1989-2005. The directions of the Guidelines of 1988 seem to be responsible for this phenomenon.

Table 5: The size of the representativity gaps on the States Parties’ level. Data source: The databases.1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of under-represented States Parties</td>
<td>0.00</td>
<td>36.00</td>
<td>36.00</td>
<td>64.00</td>
<td>123.00</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>0.00</td>
<td>83.72</td>
<td>64.29</td>
<td>58.72</td>
<td>67.96</td>
</tr>
<tr>
<td>Total number of balanced States Parties</td>
<td>35.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>100.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total number of over-represented States Parties</td>
<td>0.00</td>
<td>7.00</td>
<td>20.00</td>
<td>45.00</td>
<td>58.00</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>0.00</td>
<td>16.28</td>
<td>35.71</td>
<td>41.28</td>
<td>32.04</td>
</tr>
<tr>
<td>Total number of States Parties</td>
<td>35.00</td>
<td>43.00</td>
<td>56.00</td>
<td>109.00</td>
<td>181.00</td>
</tr>
</tbody>
</table>

The Bivariate Analyses

The bivariate analyses were conducted on the States Parties’ and the regional levels. The analyses conducted on the States Parties’ level were concerned with concluding the relationship between the States Parties’ indicators of both the properties inscription and the TLs submission experiences. The correlation coefficient (r) was adopted to describe the relationship between these indicators. The results (Table 6) revealed an insignificant relationship between the number of inscribed properties and the TLs submission frequency in 1989 (r = 0.23), and a significant relationship between the same variables in 2005 (r = 0.73). The relationship between the number of inscribed properties and the average number of properties on TLs in 1989 was deemed insignificant (r = 0.31), while the relationship between the same variables in 2005 was considered significant (r = 0.74). The relationship between the TLs submission frequency and the size of the representativity gap can be considered insignificant in 1989 (r = 0.23), and significant in 2005 (r = 0.73). The findings revealed an insignificant relationship between the average number of properties on TLs and the size of the representativity gap in 1989 (r = 0.31). They also emphasized the significant relationship between the previous variables in 2005 (r = 0.74).

Table 6: The correlation coefficients that have existed between the States Parties’ indicators of the properties inscription and the Tentative Lists submission experiences. Note: TLs = Tentative Lists. Data source: The databases.1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of inscribed properties</td>
<td>TLs submission frequency</td>
<td>N/P</td>
<td>N/P</td>
<td>N/P</td>
<td>0.23</td>
<td>0.73</td>
</tr>
<tr>
<td>The number of inscribed properties</td>
<td>The average number of properties on TLs</td>
<td>N/P</td>
<td>N/P</td>
<td>N/P</td>
<td>0.31</td>
<td>0.74</td>
</tr>
<tr>
<td>TLs submission frequency</td>
<td>The size of the representativity gap</td>
<td>N/P</td>
<td>N/P</td>
<td>N/P</td>
<td>0.23</td>
<td>0.73</td>
</tr>
<tr>
<td>The average number of properties on TLs</td>
<td>The size of the representativity gap</td>
<td>N/P</td>
<td>N/P</td>
<td>N/P</td>
<td>0.31</td>
<td>0.74</td>
</tr>
</tbody>
</table>

The results reveal the null relationship that has existed between the States Parties’ indicators of both experiences by 1977, 1978 and 1980. They indicate that this relationship has been negligible by 1989, and has become significant by 2005. The results unveil a growing relationship between the States Parties’ indicators of both experiences that is getting well established as time elapses. They indicate that the over-represented States Parties and those who have substantial numbers of WHSs are the most active States Parties in submitting TLs, and are the States Parties that submit the richest TLs. The results indicate that the directions of the Guidelines of 1988 concerning the submission of TLs have been responsible for this significant relationship.
The bivariate analyses conducted on the regional level were concerned with concluding the relationship between "the size of the representativity gap of each region" and "the relevant number of the States Parties that have submitted TLs". The findings (Figure 2 and Figure 3), concerning the bivariate analyses conducted on the regional level during the period from 1989-2005, indicated the huge expansion of the size of the representativity gap of Europe and North America. The size of the gaps of Africa, the Arab States, and Asia and the Pacific has considerably declined; while the gap size of Latin America and the Caribbean has remained almost unchanged. The results also revealed the huge growth of the number of the States Parties that have submitted TLs in all the UNESCO regions. The growth in the number of the States Parties that have submitted TLs in Europe and North America has been larger than that in the other regions.

The results reveal the well-established relationship between the remarkable growth in Europe's submission of TLs and the remarkable expansion in its gap size, which has coincided with the decline in the size of the gaps of the other regions, during the period from 1989-2005. The bivariate analyses conducted on the regional level were repeated using other indicators. "The number of inscribed properties in each region" was adopted instead of "the size of the representativity gap of each region", and "the area of the States Parties that have submitted TLs" was adopted instead of "the number of the States Parties that have submitted TLs". The results achieved when adopting the alternative indicators seem to conform to those achieved when adopting the original indicators.

**Figure 2.** The size of the representativity gaps on the regional level. *Source:* The author, based on the databases.¹
The number of States Parties (State Party)

Africa
Arab States
Asia and the Pacific
Europe and North America
Latin America and the Caribbean

The number of States Parties that have submitted Tentative Lists in each region. Source: The author, based on the databases.

Figure 3

The Targets

The directions of the Guidelines of 1988 and 2005 concerning the submission of TLs have aimed at encouraging the States Parties that have not submitted TLs to do so. The study aimed at measuring the size of the target of the Guidelines of 1988 and 2005 concerning the submission of TLs. Calculating the number and area of the States Parties and non-State Parties that have not yet submitted TLs by the time limits of 1989 and 2005 was the method adopted to measure the size of the target of the Guidelines of 1988 and 2005. The results (Table 7) (Figure 4 and Figure 5) showed that the directions of the Guidelines of 1988 have targeted 205 countries representing 97.16% of the existing countries by 1989. This target has represented 76.73% of the area of all the then existing countries. The directions of the Guidelines of 2005 have targeted 90 countries representing 38.46% of the existing countries by 2005. This target has represented 8.44% of the area of all the then existing countries. These results seem to reveal the obvious recession of the size of the target that has occurred by 2005. The relatively limited target of the Guidelines of 2005 might stimulate more doubts about the influences of submitting TLs on the representativity gaps.

The study also aimed at evaluating the success of the directions of the Guidelines of 1988 in achieving their targets. The findings (Figure 4 and Table 7) showed that, during the period from 1989-2005, 138 States Parties out of the targeted 205 countries have submitted TLs. This result indicated achieving 67.32% of the target of the Guidelines of 1988, when considering the number of the submitting States Parties. These 138 States Parties have represented 89.01% of the area of the targeted countries, indicating achieving 89.01% of the target of the Guidelines of 1988, when considering the area of the submitting States Parties. The percentages 67.32% and 89.01% were adopted as indicators of the success of the Guidelines of 1988, emphasizing the considerable influences and the satisfactory success of the Guidelines of 1988 in achieving their target.

<table>
<thead>
<tr>
<th>The time limits</th>
<th>The UNESCO’s regions</th>
<th>The target of the Guidelines, in terms of the number of countries</th>
<th>The target of the Guidelines, in terms of the area of countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number of the States Parties that have not submitted TLs and non-State Parties</td>
<td>% (of the total number of countries in the region)</td>
<td>Total area of the States Parties that have not submitted TLs and non-State Parties (sq km)</td>
</tr>
<tr>
<td>1989</td>
<td>Africa</td>
<td>48.00</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>19.00</td>
<td>95.00</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>49.00</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>44.00</td>
<td>91.67</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>45.00</td>
<td>97.83</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>205.00</td>
<td>97.16</td>
</tr>
<tr>
<td>2005</td>
<td>Africa</td>
<td>21.00</td>
<td>42.86</td>
</tr>
<tr>
<td></td>
<td>Arab States</td>
<td>7.00</td>
<td>35.00</td>
</tr>
<tr>
<td></td>
<td>Asia and the Pacific</td>
<td>27.00</td>
<td>47.37</td>
</tr>
<tr>
<td></td>
<td>Europe and North America</td>
<td>14.00</td>
<td>22.58</td>
</tr>
<tr>
<td></td>
<td>Latin America and the Caribbean</td>
<td>21.00</td>
<td>45.65</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>90.00</td>
<td>38.46</td>
</tr>
</tbody>
</table>

Figure 4. The size of the targets of the Guidelines of 1988 and 2005, in terms of the number of the States Parties and non-State Parties that have not submitted Tentative Lists. Source: The author, based on the databases.¹
The results (Figure 2) showed that the period from 1989-2005 has witnessed a remarkable relapse of the representativity gaps. During this period, the size of the over-representativity gap of Europe and North America has enormously grown, while the size of the gaps of the other regions has remarkably declined. By 2005, all the UNESCO regions, except for Europe and North America, have fallen within the under-representativity zone. These results contradict the arguments about the success of the directions of the Guidelines of 1988 in achieving most of their targets. This contradiction seems to undermine any potential positive influences of TLs submission on the gaps of the WHL. The previous arguments seem to support the validity of the first hypothesis, which implies that submitting TLs is not expected to play any future role in enhancing the gaps of the WHL.

Searching for an explanation for the previous contradiction, the key features of the States Parties that have submitted TLs were analyzed. The aim of the analysis was to examine the validity of the hypothesis that "the majority of the States Parties that have submitted TLs during the period from 1989-2005 had no inscribed properties", and the hypothesis that "the majority of the States Parties that have submitted TLs during this period have been under-represented". The validity of these hypotheses might explain the association of the growth of TLs submission with the expansion of the under-representativity gaps. The results (Table 8) showed that 12.5% of the States Parties that submitted TLs by 2005 have not had any inscribed properties, indicating the limited and ineffective participation of the nil-site States Parties in TLs submission during the period from 1989-2005. This result seems to contradict the first hypothesis. Eighty-seven of the States Parties that have submitted TLs by 2005 (60.42%) have been under-represented. Since the percentage 60.42% proves neither an absolute dominance of the under-represented States Parties, nor their negligible participation; the second hypothesis was ruled out. These results seem to indicate that the contradiction between the remarkable growth in TLs submission and the remarkable drop of the representativity gaps, during the period from 1989-2005, cannot be explained as a consequence of the dominance of the nil-site States Parties' submissions of TLs.

The previous preview attempted to explain the contradiction between the remarkable growth in TLs submission and the remarkable relapse of the representativity gaps witnessed during the period from 1989-2005. The hypothesis that "the prolific submission of TLs during this period has been associated with the nil-site and the under-represented States Parties” failed to explain this contradiction. The significant relationship between the States Parties’ indicators of both experiences might provide a rational explanation. The results revealed significant relationships between the size of the gaps, and both the TLs submission frequency and the average number of properties on the submitted TLs by 2005. They indicated that the vigorous submission of TLs, during
the period from 1989-2005, has been associated with the over-represented States Parties, which are mainly located in Europe and North America, and that is why the growth in TLs submission has been associated with the relapse of the representativity gaps.

Table 8. The key features of the States Parties that have submitted Tentative Lists.\textit{Note:} TLs= Tentative Lists.
\textit{Data source:} The databases.\

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of the States Parties that have submitted TLs</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>6.00</td>
<td>144.00</td>
</tr>
<tr>
<td>Number of the States Parties that have submitted TLs and do not have any inscribed properties</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>18.00</td>
</tr>
<tr>
<td>% (of all the States Parties that have submitted TLs)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>16.67</td>
<td>12.50</td>
</tr>
<tr>
<td>Number of the States Parties that have submitted TLs and are under-represented</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>87.00</td>
</tr>
<tr>
<td>% (of all the States Parties that have submitted TLs)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>33.33</td>
<td>60.42</td>
</tr>
<tr>
<td>Number of the States Parties that have submitted TLs and are over-represented</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>4.00</td>
<td>57.00</td>
</tr>
<tr>
<td>% (of all the States Parties that have submitted TLs)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>66.67</td>
<td>39.58</td>
</tr>
</tbody>
</table>

Conclusions

The findings reveal the success of the directions of the Guidelines of 1988, regarding the submission of Tentative Lists, in achieving their targets. The period from 1989-2005 has witnessed a vigorous submission of Tentative Lists accompanied by a remarkable relapse in the representativity gaps. The gap size of Europe and North America has undergone a remarkable growth that has been associated with a remarkable fall of the other UNESCO regions inside the under-representativity zone. These results indicate that the active submission of Tentative Lists witnessed during the 90s has not had any positive influences on the gaps in the World Heritage List. Subsequently, the potential influences of the further submission of Tentative Lists in the future seem to be very limited. Therefore, these findings support the validity of the first hypothesis, which implies that submitting Tentative Lists per se is not expected to play a significant role in enhancing the representativity and balance of the World Heritage List, despite their crucial role to the nomination process. The results unveil the association of the vigorous and affluent submission of Tentative Lists, witnessed during the 90s, with the over-represented States Parties. The previous result confirm the validity of the second hypothesis, which implies that the prosperous experiences in submitting Tentative Lists have been associated with the over-represented States Parties. This result explain the invalidity of the first hypothesis.

The previous arguments reveal the significance of Article 55 directions and the significance of submitting Tentative Lists. The directions are expected to help in putting the under-represented States Parties on the right track. The preparation and submission of Tentative Lists will also assist the World Heritage Committee with evaluating the outstanding universal value of each nominated property within the broadest possible context. Nevertheless, the directions of Article 55, concerning the preparation and submission of Tentative Lists, do not appear to have any potential role in enhancing the representativity of the World Heritage List. The continuous preparation, revision and submission of affluent Tentative Lists appears to be the most influential tool. The previous findings seem to suggest re-considering the maximum period allowed prior to the revision and re-submission of Tentative Lists. They also suggest adopting further policies aiming at developing the States Parties' capacities in preparing and revising Tentative Lists.

Notes

\footnote{The databases have been compiled by the author from the following references:}


The following key Web Sites were also used to develop the databases:


References


