Devil Facial Tumour Disease – The cancer that's raising hell in Tasmania

Philip Denbaum
Populärvetenskaplig sammanfattning av Självständigt arbete I biologi 2014
Institutionen för biologisk grundutbildning

Since 1996 a mysterious epidemic has been sweeping across the island of Tasmania, threatening the Tasmanian devil (Sarcophilus harrisii) with extinction. The species is endemic to the island which is part of Australia and lies south of Melbourne. Being endemic to the island the devils are of particular risk of extinction. Not only has the risk of losing the world's largest extant carnivorous marsupial aroused great interest, but also the disease itself, has received much attention from the world of oncology due to its unusual trait of being a contagious cancer.

Figure 1. Tasmanian devil with facial tumor's caused by DFTD.

The situation

In 1996 the first report of a devil with unusual lesions on the face, thought to be tumors, came in from the area around mount William in Tasmania's northeast. In 1997 DFTD (Devil Facial Tumor Disease) was observed in a captured animal. The disease soon received attention from a variety of fields, ranging from conservationists to oncologists. In oncology there was big interest due to the unusual trait the disease had of being a seemingly contagious cancer and also the fact that the disease seemed to have appeared out of nowhere. Conservationists were interested due to the situation of having a possible epidemic of a terminal disease in an endemic species. Also with the devil being an apex predator, the possible extinction could have serious repercussions on the rest of the island's ecosystem.

Since the discovery of the disease, it has become an epidemic on the island. In estimates made through spotlighting, trapping censuses made each year and reports of sightings, there has been a decline of the total population of over 50% since 1996. Also where the disease has entered a population, the population has on average declined around 80% and the disease has now spread to over 75% of Tasmania. In 2008 the IUCN classified the species as endangered, at the same time research about DFTD and conservational efforts have come a long way in a short time. This has led to a situation where we as humans have a better chance of conserving this species. It has also given us much knowledge about transmissible cancers and experience in conservation.

The Tasmanian devil

The Tasmanian devil is the largest extant marsupial carnivore; it is also an apex predator in Tasmania. They get up to 30cm high at the shoulders and weigh up to 12kg. Males tend to be slightly larger than females; the species is endemic to Tasmania which lies about 240km south of mainland Australia. After becoming extinct on the mainland around 400 years ago, according to most scientific estimates, the Tasmanian population has had ups and downs. They were hunted as a pest during early settlement but were protected by law in 1941 due to risk of extinction. At the time the Thylacine, more commonly known as Tasmanian tiger, had recently been hunted to extinction on the island.

Tasmanian devils are actually more of scavengers than hunters; this has led to another threat against them. As the devils scavenge for road kill, they often become what they are looking for.

”Jaw wrestling” is a common behavior amongst Tasmanian devils; it occurs during mating and general altercations often related to feeding. The devils are nocturnal and their name is believed to be derived from the noises they make during communal feeding on carcasses. As settlers and explorers would hear their devilish screams and growls in the night they would have been terrified and their imagination would have been running wild (see YouTube clip in references for the devils growl).

Conservational efforts

There are several different projects that are working with the conservation of the Tasmanian devil. Most of these projects are parts of the Save the Tasmanian Devil Program (STDP).

There are today over 20 zoos and wildlife parks that are keeping what is called insurance populations. An insurance population is a collection of devils that are kept in reserves where they get to live in an environment made to simulate their natural habitat as much as possible. These insurance populations are located on Tasmania and on the Australian mainland (Fig. 2).

Not only do these populations work as insurance if the devils were to become extinct in the wild. They also give the opportunity of controlling the breeding and thereby the genetic diversity of these populations. Also the possibility of gradually releasing these individuals into their natural habitat might increase the genetic diversity in the wild and keep population numbers up. The reason genetic diversity is important in this case is that the devils have been isolated on Tasmania for a long time and they have become inbred and genetically similar. This effect has been amplified through several population bottlenecks occurring through their time in isolation. This is the case for the immune system in particular, so higher genetic diversity increases the chance of some individuals being immune.

Figure 2. Tasmanian devil quarantine area.

Another project that has not yet entered the construction phase but is quite exciting is the Great Devil Walls Of Tasmania (GDWOP). GDWOP are the plan to build two large sanctuaries in the wild in Tasmania. One of these would separate the Freycinet peninsula from the mainland; the other would separate a part of north western Tasmania. This project is exciting because it would enable larger populations of devils to roam freely in their natural habitat safe from DFTD. Also, a project where a group of devils have been relocated from captivity to Maria Island just outside Tasmania has been put into action. This is another insurance population project which lets the population roam free on the island which is a national park. The population of 15 devils which were relocated to the island was chosen from hundreds of individuals in captivity. The process of choosing them included behavioral tests to make sure the devils acted like wild specimens.

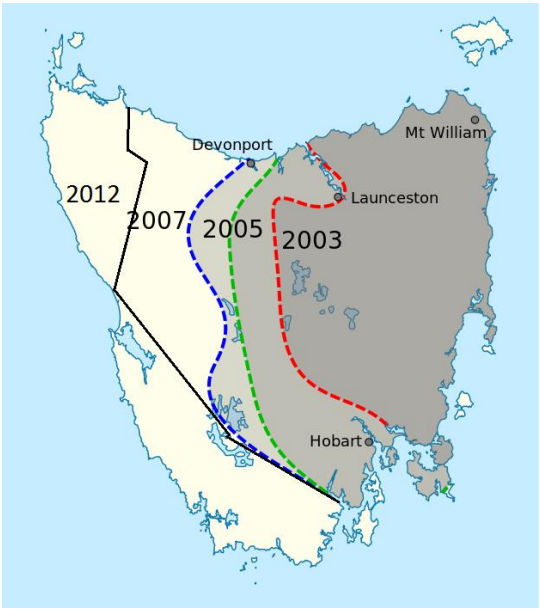

Figure 3. Approximate movement of the DFTD diseasefront from 2003 until 2012. Freycinet peninsula is the appendix-like peninsula halfway up the east coast.

The disease

Through extensive research over the last 10-15 years, scientists have discovered many things about DFTD but many things about it are still unclear. Most things about the diseases pathology points to it being a clonally transmissible cancer. That means that the tumors don't arise from the uncontrolled growth of the hosts own body cells due to mutation or other factors affecting the control of cellular growth.

Instead the tumors have their own karyotype, or chromosomal setup, which indicates a direct transfer of tumor cells from one individual to another (fig 4). It is hypothesized this happens mainly through the extensive "jaw wrestling" which is common among devils. So it seems the tumors are transferred from one individual to another, starts growing on the new host's facial area using energy and building blocks from the host.

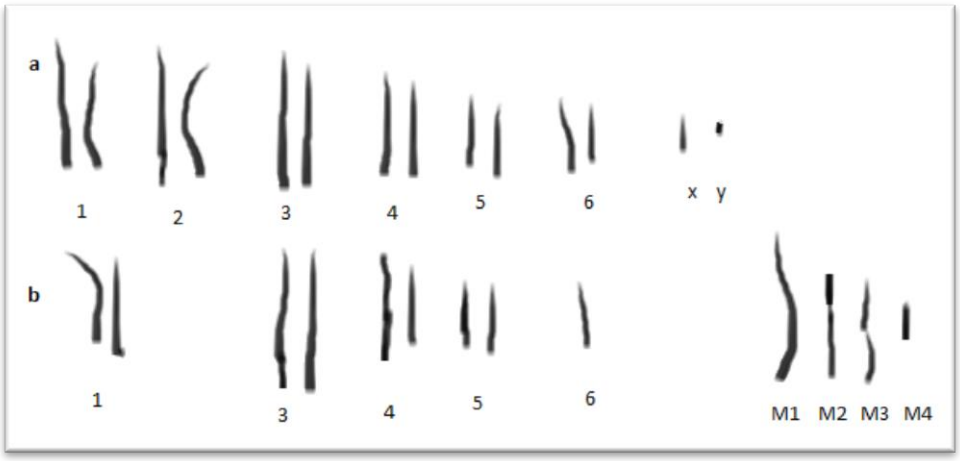

Figure 4. Karyotypes of **a**: male *S. harrisii* and **b**: tumor caused by DFTD. On these karyotypes it is visible that the tumors are chromosomally different from the devils. Chromosome-pair two, aswell as the Allosomes, or sex chromosomes are missing. Also on of the chromosomes in pair one is missing part of its long arm, one chromosome is missing from pair six and four marker chromosomes with unknown function have been added.

This is something which is highly unusual, in the wild it has only been seen in a tumor disease affecting the common dog (*Canis lupus familiaris*). This is a sexually transmitted disease known as CTVT (Canine Transmissible venereal tumor) which causes the dogs sickness but is usually not fatal.

Unlike CTVT, DFTD is almost always fatal. Only a few cases of devils recovering from DFTD after showing symptoms have been reported. In general the devils only have about 6 months to live after the tumors have started forming. Cause of death is usually attributed to starvation due to tumors obstructing feeding, infection in ulcerating tumors or metastasis of the cancer to vital body parts, or a combination of all three.

Concluding remarks

Through further studies of DFTD scientists have found certain so called markers which give clues to the diseases origin and also will help understanding the disease and diagnose it. It is also believed by many that studying this disease will lead to a greater understanding of other cancers, maybe even give insight into cancers which affect humans. Hopes are naturally that some discovery will lead to a cure or vaccine.

In the future a plan for similar situations as this should be put together. This would help organizations and governments work faster in understanding a threat towards endangered species.

More information

Denbaum P. 2014. Devil Facial Tumor Disease – den mystiska cancern som hotar en arts överlevnad.

http://www.tassiedevil.com.au/tasdevil.nsf
http://www.savethetasmaniandevil.org.au/
http://www.devilark.com.au/
http://www.iucn.org/
http://newswise.com/articles/view/546018/
http://www.youtube.com/watch?v=v2AU7AtY-js