

# What the (Tasmanian) devil is going on?

Kevin O'Dell

The arrival of Aborigines, Europeans and their animals, coupled with changes in the local climate, has had a catastrophic effect on Australian wildlife. One animal that is under very real threat of extinction is the Tasmanian devil — the largest carnivorous marsupial in Australia. Geneticist Kevin O'Dell investigates why

**T**asmanian devils used to be widespread on mainland Australia. However, by about 3000 years ago, their population was restricted to the island of Tasmania (see Box 1). The reason for this is unclear, but it coincided with the expansion of indigenous Australians and their dingoes across mainland Australia. Was the sudden Tasmanian devil population decline due to direct hunting by humans, competition with dingoes, or indirect effects of a rapidly expanding human population? Or was it some combination of the three? Devils had co-existed with indigenous Australians and their dingoes for over

## Key words ↓

Cancer  
Extinction  
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Inbreeding  
Tasmanian devil

3000 years, so another possibility is that climate change, especially the increasingly arid nature of the Australian mainland, put devil populations under pressure. This would explain why devils survived in Tasmania, as it was largely unaffected by climate change and remained cool and damp.

## The arrival of Europeans in Tasmania

In 1803 the first European population arrived and settled in Tasmania. This British settlement was close to the modern day capital, Hobart. The settlers





Dingoes

brought their livestock with them, and immediately came into conflict with the local carnivores. There are reports of early settlers eating Tasmanian devils, which they described as tasting like veal. In 1830, a bounty scheme to remove Tasmanian devils from rural properties was introduced, as these carnivorous marsupials were blamed for killing and eating livestock.

Over the next hundred years, trapping and poisoning brought the Tasmanian devil population

### Terms explained



**Dingoes** Semi-wild dogs that may have originated in southern China and arrived in mainland Australia somewhere between 5000 and 20 000 years ago.

**Inbred** Organisms with very low levels of genetic diversity, normally due to a small population size that encourages mating between related individuals.

**Indigenous** A population or species originating in, or characteristic of, a particular country or region.

**Invasive** A species introduced to an environment or geographical region from which it was previously absent. In recent history most invasive species have been introduced by humans.

**Marsupial** A subset of mammals, the distinctive characteristic of which is that their young are born in a relatively immature state and are carried in a pouch.

**Relict** A relict population is one that currently occurs in a restricted geographical area, but its original range was far wider.

### Box 1 12 000 to 3 000 years ago



Tasmanian devils (*Sarcophilus harrisii*) were widespread on mainland Australia in the Pleistocene period. But by 12 000 years ago, devils were only found in three relict populations, a northern population centered on Darwin, a western population around Augusta and a southeastern population that may have stretched from the mouth of the Murray River eastwards to Port Phillip and south to Tasmania. At that time, Tasmania was connected by land to the Australian mainland. By about 3 000 years ago, only the Tasmanian population survived.

to the brink of extinction. In 1936 the Tasmanian government fully recognised the catastrophe befalling their unique wildlife and introduced laws protecting the Tasmanian devil.

However, it is not just direct human interference that has threatened the Tasmanian devil with extinction. The Tasmanian population of devils first became isolated from the relict mainland Australian population around 10 000 years ago. This time marks the end of the last ice age, when the sea level rose, isolating Tasmania as an island. So the entire Tasmanian population of devils has been living on a single island for 10 000 years. As a consequence, they are highly **inbred**, and have relatively little genetic variation. This means the immune systems of individual Tasmanian devils are very similar, so most of them are susceptible to the same infectious diseases. Since the arrival of Europeans, there have been at least two sudden and major declines in the Tasmanian devil populations, in 1909 and 1950, and these are both thought to have been due to disease epidemics.

### Catastrophic recent population decline

Due to the nocturnal, shy nature of Tasmanian devils, it has been difficult to estimate the size of their population. However, extensive studies in the mid-1990s estimated the Tasmanian devil population to be around 140 000, though the researchers conceded this was a very rough estimate.

By 2008, it became clear that the wild population of Tasmanian devils had plummeted. Experts estimated there had been at least an 80% decline in numbers since the 1990s and maybe as few as 10 000 devils remained in the wild. As a result, the Tasmanian government concluded there was a real chance

Koala



Opossum



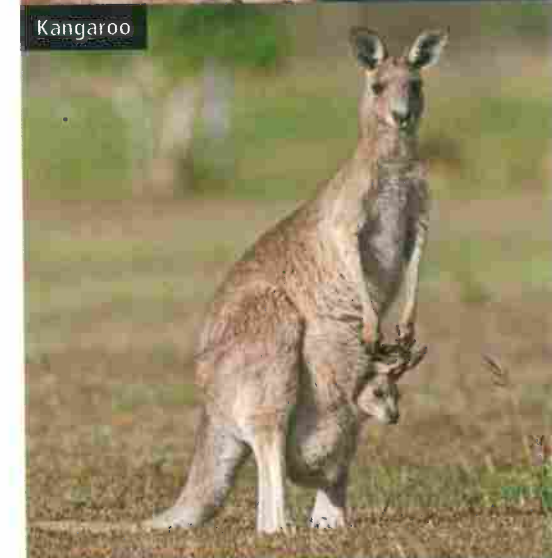
Wombat



Bandicoot



Kangaroo



Marsupials are mammals characterised by having a pouch to carry their young. They live primarily in Australasia and the Americas

of the Tasmanian devil becoming extinct within 20 years. But why had the population suffered such a catastrophic decline and what could they do?

There were several possible reasons for the population decline. For example, like many Australasian **marsupials**, many Tasmanian devils were killed in collisions with cars. Their dark colour and habit of lying flat on the ground eating roadkill makes them particularly susceptible to being run over. However, their decline is particularly severe in rural areas where roads and cars are infrequent.

Some ecologists initially suspected that the illegal introduction of the red fox to Tasmania, around the year 2000, might be responsible. Elsewhere on mainland Australia, **invasive** red foxes have devastated the indigenous wildlife. But research has revealed that Tasmanian devils eat fox cubs and can outcompete foxes, so this was unlikely to be the reason.

The real reason for the catastrophic decline in Tasmanian devil numbers since the 1990s was completely unexpected. All the evidence pointed to a cancer that first appeared in 1996 in a Tasmanian devil population in the northeast of the island. Visible signs of the cancer start with lumps around the mouth. These develop into more substantial tumours that interfere with feeding. Affected devils usually die of starvation within 6 months of symptoms first appearing. However, cancers aren't normally infectious, so what the devil is going on?

As comical as it is, the familiar Looney Tunes portrayal of a Tasmanian devil as a seething, snarling, insatiable lunatic is, at times, not all that far from the truth. The early European settlers first encountered Tasmanian devils by hearing their extensive vocalisations at night. As a result, the panicked settlers referred to these new animals as 'Beelzebub's pup', with suggested Latin names including *Sarcophilus satanicus* (Satanic meatlover) and *Diabolus ursinus* (Devil Bear), before settling on 'Tasmanian devil'. While risks to humans and their livestock were hugely exaggerated, the behaviour of Tasmanian devils during feeding and mating can be quite violent, with frequent fighting and biting.

The combination of biting behaviour, coupled with the fact that Tasmanian devils are highly inbred, has led to their catastrophic decline. Genetic analysis of the cancer cells from hundreds of dead or dying devils reveals that the cancers all have remarkably similar DNA sequences — suggesting that they have a single origin. The evidence points to a single cancer arising in the mouth of one Tasmanian devil in the northeast of Tasmania and being passed to other individuals by biting. Under normal circumstances the immune system of the bitten individual would recognise the cancerous cells from the biter as foreign, and these invading cells would be destroyed. However, Tasmanian devils are so

inbred that the immune system of one animal does not recognise that the cancerous cells of another are foreign. The cancer survives, thrives and ultimately starves its new host. To date there is no clear evidence that any wild Tasmanian devil can survive being infected by the cancer.

### Changes in Tasmanian devil reproductive behaviour

The cancer is no longer restricted to northeast Tasmania, where it originated. It is now found across most of the island except the extreme west and northwest coasts. In affected areas, population decline has been catastrophic, and this has had a profound effect on the reproductive behaviour of surviving populations.

Studies of unaffected wild populations suggest Tasmanian devils live for about 6 years. Most females reach sexual maturity in their second year and give birth once a year to as many as 30 young, or 'joeys'. Like other marsupials, these joeys are tiny, weighing just 0.2g at birth. They then make their way to their mother's pouch where competition for survival is fierce. Ultimately only three or four joeys survive to leave the pouch around 4 months later. As females mate in most of their four seasons of maturity, each unaffected adult female has around 12 surviving offspring over her lifetime.

In areas affected by the cancer, many females now reach sexual maturity in their first year, again having about three surviving offspring. Having been bitten during eating or mating, however, most females contract the cancer and few survive long enough to have a second batch of offspring. As a result population decline is inevitable.

Attempts to control the spread of the cancer by culling affected individuals has failed to stem the spread of the disease. This is presumably because once the cancer becomes obvious to us, the affected animals have already bitten other animals and passed on the cancer.

### Into the future

As the wild Tasmanian devil continues to decline at an alarming rate, there are three main hopes for Tasmanian devil survival.

**1** Sufficient genetic variation remains in the wild population that the cancer is recognised by some individuals as being non-self. In early 2010, scientists found that Tasmanian devils from the northwest of Tasmania may be sufficiently genetically different for their bodies to recognise the cancer as foreign. This is currently a disease-free area of Tasmania. It is unclear whether these individuals will be resistant when the cancer reaches the northwest populations.

**2** Researchers can find a treatment or cure for the cancer, or perhaps immunise the wild population. Several strategies have been tried but without

### Further reading

The *Save the Tasmanian Devil Program* is the official response of the Australian and Tasmanian governments to saving the Tasmanian devil.

See [www.tassiedevil.com.au/tasdevil.nsf](http://www.tassiedevil.com.au/tasdevil.nsf)

Devil Ark is a Tasmanian devil breeding facility at Barrington Tops, New South Wales.

See [www.devilark.com.au](http://www.devilark.com.au)

Fighting the presence of the European red fox in Tasmania:

<http://tinyurl.com/zcc9wq8>

success. This includes the use of drugs that have been successful in curing facial tumours in cats, dogs and horses, vaccination with irradiated cancer cells and the use of chemotherapy agents. In 2015, researchers found that mixing dead cancer cells with an inflammatory substance induced an immune response in five of six devils injected with the mixture. However, it is not clear whether this causes the devils to be immune to the cancer, or could even be a realistic option in wild populations.

**3** A captive population can be maintained to replace the wild animals once the disease has destroyed the entire wild population. The Devil Ark scheme at Barrington Tops, New South Wales, which was established in 2010 to provide a mainland breeding sanctuary, is the most ambitious project of this type. Conservationists collected 47 disease-free Tasmanian devils from across Tasmania, most of which were taken to Devil Ark, which provides the perfect breeding environment for the species. Ultimately, the Devil Ark project hopes to create a stable population of 1000 genetically representative devils that can be released into disease-free areas of Tasmania. The first release of devils born at Barrington Tops took place in Tasmania in November 2015, but it is too early to measure its success. A planned release in mainland Australia is also being considered. This may also have the added potential advantage of being a way of mitigating and managing the invasive red fox population.

### Points for discussion

- Why are inbred populations particularly susceptible to infectious disease?
- Why is it so difficult to estimate the size of the wild population of some animals, such as Tasmanian devils, but not others?
- Are there any other strategies that conservationists could use to help the Tasmanian devil survive?
- Invasive species, such as the red fox, often devastate the indigenous wildlife. Is it ethically acceptable to destroy the invasive species population and, if so, what might be the most efficient way of culling red foxes without killing the Tasmanian devils — the animals you wish to protect?

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### Key points

- Tasmanian devils are the largest surviving carnivorous marsupial in the world.
- Tasmanian devils are only found naturally on the island of Tasmania.
- Since the 1990s, the wild population of Tasmanian devils has fallen by around 90%.
- The decline in the wild Tasmanian devil population has been caused by the spread of an infectious facial cancer.
- Researchers are using a variety of strategies to try to prevent the Tasmanian devil from becoming extinct.