Tasmanian devils: Will rare infectious cancer lead to their extinction?

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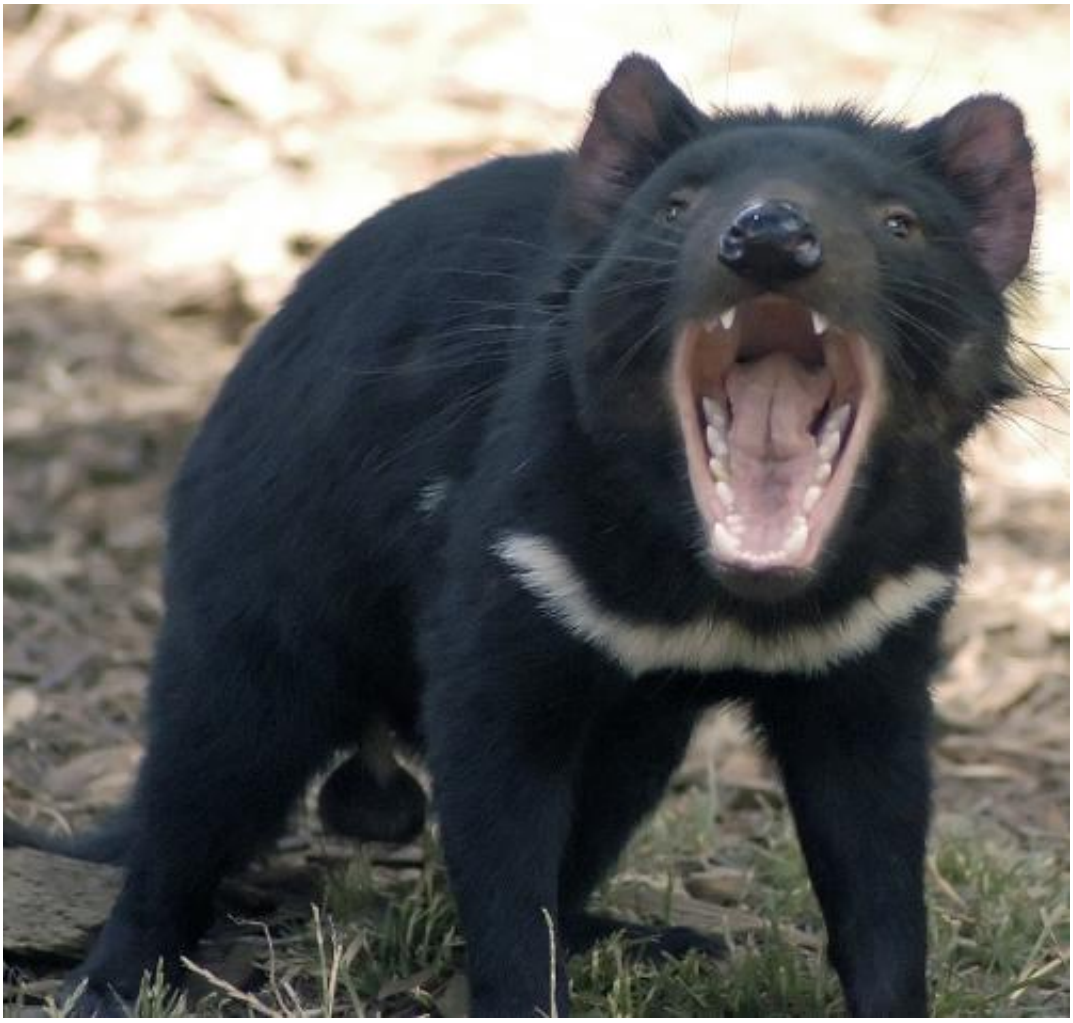

Not all Tasmanian devils are docile; many share traits with the cartoon character "Taz." Credit: Government of Tasmania

Taz was his name, the Tasmanian devil of Warner Bros. cartoon fame. A scrappy omnivore who ate anything and everything, he spun in a vortex and bit through everything in his path.

The devil was short-lived, however, making television appearances for a few years in the late 1950s and early 1960s before disappearing from view. In 1991, Taz got a reprieve: his own show, *Taz-Mania*, which ran for three seasons. Then he was gone for good.

From the screen to the wild

Tasmanian devils in the wild are no less imperiled. Carnivorous marsupials, they're found only on the Australian island of Tasmania. With a stocky build, black fur, keen sense of smell and ferocity when feeding, "real-life" Tasmanian devils and their cartoon namesake have much in common.

The size of small dogs, Tasmanian devils became the largest carnivorous marsupials in the world following the 1936 extinction of thylacines (Thylacinus cynocephalus), known as Tasmanian tigers or Tasmanian wolves. Thylacines lived on continental Australia, Tasmania and New Guinea.

Will the fate of Sarcophilus harrisii, the scientific name for the Tasmanian devil, mimic that of the thylacine?

"If a way isn't found to stop devil facial tumor disease, or DFTD," says disease ecologist Andrew Storfer of Washington State University, "models predict that Tasmanian devils could be extinct in as few as ten years."

And vanishing with them, valuable clues to diseases in other species, including humans.

DTFD is an aggressive, non-viral, transmissible parasitic cancer that is 100 percent lethal, says Storfer. "In short," he says, "it's bad news."

Can we save the Tasmanian devil?

To study DTFD and find ways of understanding its emergence and spread, Storfer has received a grant from the National Science Foundation- (NSF) National Institutes of Health (NIH) Ecology and Evolution of Infectious Diseases (EEID) Program.

Collaborators include Paul Hohenlohe of the University of Idaho, Hamish McCallum of Griffith University, Menna Jones of the University of Tasmania and Elizabeth Murchison of the Wellcome Trust Sanger Institute.

The NSF-NIH EEID Program supports efforts to understand the ecological and biological mechanisms that link environmental changes and the emergence and transmission of infectious diseases.

Projects funded through the program allow scientists to study how large-scale environmental events—such as habitat destruction, invasions of non-native species and pollution—alter the risks of emergence of viral, parasitic and bacterial diseases.

Devil facial tumor disease, an infectious cancer, is decimating populations of Tasmanian devils. Credit: Government of Australia

Storfer's research may lead to new insights about the spread of flu in humans. It also may help scientists understand other infectious diseases in animals such as bats, and how certain cancers progress.

"This study provides an excellent test-bed for understanding the spread of infectious diseases," says Sam Scheiner, EEID program director at NSF. "The results may help us control the spread of seasonal flu in people, West Nile virus in birds and white-nose syndrome in bats, among many other diseases."

Tasmanian devils: extinction on the horizon

The first official case of devil tumor facial disease was reported in 1996.

Since then, Tasmania's devil population has declined by 70 percent. Findings reported in 2010 show that 80 percent of the remaining devils are affected.

"Tasmanian devils that live in high-density populations may suffer drastic reductions a few years after emergence of the disease," Storfer says.

DTFD has been slowly moving from east to west across Tasmania for the last 17 years; it's now approaching the west coast. "Soon there may be no known uninfected devils," says Storfer.

The disease is spread when Tasmanian devils bite each other's heads while fighting over food, during territorial interactions and when they spar during mating season.

Devils that contract the disease develop lesions around their mouths that become cancerous tumors. The tumors may spread from their faces to their entire bodies. Devils almost always die within six to nine months.

Devil facial tumor disease likely began in what are called Schwann cells. Schwann cells are found in the peripheral nervous system; they produce myelin and other proteins essential for the functions of nerve cells.

In response to DTFD, Tasmanian devils have changed their reproductive habits. Before the outbreak, females started breeding at two years old. Now they breed by the end of their first year—and often die of DTFD soon afterward.

There's a ray of light, however, in this dark day for devils. Some devils have been found with partial immunity to the disease. Breeding in captivity is underway to try to save the species.

"Emerging infectious diseases like DTFD are one of the great scientific challenges of the 21st century," says Storfer. "Infectious diseases are now the sixth leading cause of species extinctions."

Answers in Tasmanian devils' genomes?

Extensive research by Storfer and others, including thousands of samples taken before and after devil die-offs, has given scientists a rare opportunity to study the genomic interactions of an infectious disease and its host—the devils—across an entire species' range.

"The research will tell us about the genetic basis of Tasmanian devils' susceptibility to the tumors," says Storfer, "providing environmental managers with information about which particular devils would be best suited for captive breeding programs."

Knowledge of the rates and direction of past tumor spread will enable scientists to uncover the likely locations of future infections.

Although only a few infectious cancers have been documented, Storfer says, "this disease shares properties with human cancers.

"Our research, especially genetic studies, may reveal the underlying reasons why DTFD is so prevalent and can hold on for so long in a population, perhaps providing information on cancer recurrence in humans."

To test predictions of the course of the epidemic, he and colleagues plan to meld what they call "devil contact network modeling" with genomic studies of Tasmanian devil populations expected to become infected.

"The answers will help in developing responses to this and other disease

outbreaks in Tasmanian devils—and potentially in people," says Storfer.

Taz may be gone, but, says Storfer, "Hopefully it's not too late for the real Tasmanian devil."

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