What's killing sea otters? Scientists pinpoint parasite strain

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A southern sea otter and its baby swim off the coast of Moss Landing in California. Credit: Trina Wood/UC Davis

Many wild southern sea otters in California are infected with the parasite Toxoplasma gondii, yet the infection is fatal for only a fraction of sea otters, which has long puzzled the scientific community. A study from the University of California, Davis, identifies the parasite's specific strains that are killing southern sea otters, tracing them back to a bobcat and feral domestic cats from nearby watersheds.

The study, published this week in the journal *Proceedings of the Royal Society B*, marks the first time a genetic link has been clearly established between the Toxoplasma strains in felid hosts and parasites causing fatal disease in marine wildlife.

The study builds on years of work by a consortium of researchers led by the UC Davis School of Veterinary Medicine's Karen C. Drayer Wildlife Health Center and the California Department of Fish and Wildlife (CDFW). The scientists were called upon in the late 1990s to help decipher the mystery when Toxoplasma caused deaths in sea otters along the California coast.

"This is decades in the making," said corresponding author Karen Shapiro, an associate professor with the UC Davis School of Veterinary Medicine and its One Health Institute. "We now have a significant link between specific types of the parasite and the outcome for fatal toxoplasmosis in sea otters. We are actually able to link deaths in sea otters with wild and feral cats on land."

From land to sea

Wild and domestic cats are the only known hosts of Toxoplasma, in which the parasite forms egglike stages, called oocysts, in their feces. Shapiro led the initial effort to show how oocysts accumulate in kelp forests and are taken up by snails, which are eaten by sea otters.

For this study, the authors characterized Toxoplasma strains for more than 100 stranded southern sea otters examined by the CDFW between 1998 and 2015. CDFW Veterinary Pathologist Melissa Miller assessed the otters for Toxoplasma as a primary or contributing cause of death. The scientists compared pathology data with the parasite strains found in sea otters and nearby wild and domestic cats to identify connections between the disease-causing pathogen and its hosts.

The study's results highlight how infectious agents like Toxoplasma can spread from cat feces on land to the sea, leading to detrimental impacts on marine wildlife.

A southern sea otter swims off the coast of Moss Landing in California. Credit: Trina Wood/UC Davis

Closely watched

Southern sea otters are among the most intensely studied marine mammals in California because they are a threatened species and an iconic animal for the state. They live within just a few hundred meters of the coastline, allowing for close observation that enables a wealth of scientific data.

Previous research showed that up to 70 percent of stranded southern sea otters were infected with Toxoplasma, yet the infection becomes fatal for only a fraction of them. Decades of detailed investigations by CDFW and UC Davis have confirmed that infection by land-based protozoan parasites such as Toxoplasma and the related parasite Sarcocystis neurona are common causes of illness and death for southern sea otters.

Shapiro notes that Toxoplasma can also affect other wildlife species, but there is more robust data for the otters.

"Toxoplasma is one heavily studied pathogen that we care about, but there are many other viruses and bacteria that are on land and being flushed to the ocean that we probably aren't aware of yet," Shapiro said.

What can be done?

People can help reduce the spread of Toxoplasma by keeping their cats inside and disposing of cat feces in a bag in the trash, not outdoors or in the toilet because wastewater treatment is not effective in killing oocysts.

Outdoor cats that feed on wild rodents and birds are likely to become infected with Toxoplasma because the parasite is commonly present in the tissues of these prey animals.

Oocysts shed in cat feces on land get washed into waterways with rainfall, and prior research identified freshwater outflow as a key source of Toxoplasma exposure for southern sea otters.

Wetlands, forests and grasslands naturally serve to shield watersheds and oceans from pollutants, including oocysts. Preserving and restoring wetlands and natural areas, managing stormwater runoff, and replacing pavement with permeable surfaces can reduce contamination and minimize pathogens entering the water.

More information: Karen Shapiro et al, Type X strains of Toxoplasma gondii are virulent for southern sea otters (Enhydra lutris nereis) and present in felids from nearby watersheds, *Proceedings of the Royal Society B: Biological Sciences* (2019). DOI: 10.1098/rspb.2019.1334

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