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## **Cougar predation key to ecosystem health**

CORVALLIS, Ore. -- The general disappearance of cougars from a portion of Zion National Park in the past 70 years has allowed deer populations to dramatically increase, leading to severe ecological damage, loss of cottonwood trees, eroding streambanks, and declining biodiversity.

This "trophic cascade" of environmental degradation, all linked to the decline of a major predator, has been shown in a new study to affect a broad range of terrestrial and aquatic species, according to scientists from Oregon State University.

The research was just published in the journal *Biological Conservation* – and, like recent studies outlining similar ecological ripple effects following the disappearance of wolves in the American West – may cause land managers to reconsider the importance of predatory species in how ecosystems function.

The findings are consistent, researchers say, with predictions made more than half a century ago by the famed naturalist Aldo Leopold, often considered the father of wildlife ecology.

"When park development caused cougar to begin leaving Zion Canyon in the 1930s, it allowed much higher levels of deer browsing," said Robert Beschta, an OSU professor emeritus of forest hydrology. "That set in motion a long cascade of changes that resulted in the loss of most cottonwoods along the streambanks and heavy bank erosion."

"But the end result isn't just loss of trees," he said. "It's the decline or disappearance of shrubs, wetland plants, amphibians, lizards, wildflowers, and even butterflies."

Until recently, ecologists had a poor understanding of how the loss of an important predator, such as wolves or cougar, could affect such a broad range of other plant and animal species. But the evidence is now accumulating that primary predators not only have direct effects in influencing the population sizes of native grazing animals such as deer and elk – they also have indirect effects in changing their foraging behavior, in what has been called "the ecology of fear."

That phenomenon, the scientists say, has been shown as vividly in Zion National Park as any other location they have ever studied.

In Zion Canyon, which since the early 1900s has been a popular tourist attraction, cougars are virtually absent, mostly just scared off by the huge influx of human visitors. With their natural enemy gone, growing and ravenous deer populations ate young cottonwood trees almost as quickly as they sprouted, robbing streambanks of shade and erosion protection.

As a result, floodplains began to erode away. Other types of vegetation and the animal species dependent on them suffered. And unless something is done, cottonwoods in Zion Canyon may ultimately disappear in areas accessible to deer, the researchers said.

By contrast, a nearby roadless watershed has similar native ecology but is sufficiently remote that it still has an intact cougar population and far fewer mule deer. In contrast to Zion Canyon, streambanks in this watershed have nearly 50 times more young cottonwood trees as well as thriving populations of flowers, lizards, butterflies, and several species of water-loving plants that help stabilize stream banks, provide food-web support, and protect floodplains for use by many other animal species.

"The documentation of species abundance that we have in this study is very compelling," said William Ripple, a professor in the OSU Department of Forest Resources and lead author on the study. Researchers did a systematic survey of channel dimensions, streambank condition, vegetation and species presence along each study site.

"These two canyons, almost side by side, have a similar climate and their ecosystems should be quite similar," Ripple said. "But instead they are very different, and we hypothesize that the long-term lack of cottonwood recruitment associated with stream-side areas in Zion Canyon indicates the effects of low cougar and high deer densities over many decades.

"It's a great research setting and a great opportunity to assess the potential importance of a key predator," he said. "We hope to conduct additional research in Zion National Park to further explore the findings of this initial study."

It's important to remember, the researchers said, that the ultimate driver behind all of these changes is humans – in the case of Zion

Canyon, simply by their presence. That canyon receives nearly three million human visitors a year, the adjacent North Creek a stray handful of hikers. Cougars in Zion Canyon were not intentionally killed or removed, they just left due to the increased presence of humans.

As findings such as this – the way cougars affect deer and wolves affect elk – continue to mount, land managers may have to acknowledge the potentially enormous impact of these grazing animals on other ecosystem processes, scientists say. This could open the way to new management options once the role of herbivory by deer, elk, or other grazing animals is more fully understood.

In systems with wild ungulates, the sustainability of riparian habitats and biodiversity may require both predation on these herbivores as well as the fear of predation to further affect their behavior, the researchers concluded.

Ripple and Beschta considered other factors that may have played a role in loss of cottonwood trees in Zion Canyon, such as climate fluctuations or human interventions to stream channels, but concluded that those impacts could not have caused the enormous loss of trees and associated impacts to other biota that were found in the canyon.

The findings of this study may be relevant to other ecosystems in the U.S. and around the world where key predators have been removed, the researchers said, and high populations of native herbivores such as deer or elk – or domestic grazers such as cattle or sheep – affect native biodiversity.

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