

# Decline in Alaskan sea otters affects bald eagles' diet

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Sea otters are known as a keystone species, filling such an important niche in ocean communities that without them, entire ecosystems can collapse. Scientists are finding, however, that sea otters can have even farther-reaching effects that extend to terrestrial communities and alter the behavior of another top predator: the bald eagle.

In nearshore marine communities, towering kelp can reach heights of 250 feet and function much like trees in a forest, providing food, homes and protection for fish and invertebrates. The most important enemies of these giant algae are tiny sea urchins, only inches in diameter, which live on the kelp's holdfasts and eat its tissue. When urchin populations become too large, they can defoliate entire kelp forests, leaving only barren remains.

Enter the sea otter. Otters can eat the spiky urchins whole, making them the major urchin predator. The otters' presence keeps urchin populations in check and maintains the balance of the ecosystem.

Scientists have known about these kelp forest community interactions since the 1970s. But in the October issue of the journal *Ecology*, Robert Anthony and colleagues report that the presence or absence of otters can also affect the diet of bald eagles, a neighboring terrestrial predator. Anthony is an ecologist with the Oregon Cooperative Fish & Wildlife Research Unit of the U.S. Geological Survey and Oregon State University.

Bald eagles live in high densities along the Aleutian archipelago off the coast of Alaska and place their nests on islets, coastal cliffs and shoreline sea stacks. Historically, more than 90 percent of the eagles' food comes from the ocean. Sea otters once also occupied a large range of coastal marine environments near these islands, but in recent years, otter populations have declined in response to their own main predator.

"All of the available data point to increased numbers of killer whales as the direct cause of the sea otter decline in southwest Alaska," says coauthor Jim Estes of the U.S.G.S. and the University of California at Santa Cruz. "The otter decline has caused a phase shift in the coastal ecosystem from a kelp dominated phase state to a deforested phase state."

This shift means many fewer kelp forest fish for the eagles to eat. In response, the eagles have adjusted their foraging tactics. Anthony and his colleagues surveyed remains of bald eagle prey in their nests during 1993 and 1994, when otters were abundant and the kelp forests were healthy, and in 2000, 2001 and 2002, when otters were scarce and the kelp forests had collapsed. They found that when otters were abundant, eagle prey consisted of predominantly kelp-forest fish and sea otter pups. When the otters were rare, however, the proportion of marine birds in the eagles' diet was much higher.

Anthony explains that because the eagles defend territories in dense patches along the coastline and there are few terrestrial animals to eat, they must be flexible in what they hunt.

"These bald eagles are opportunistic foragers as a consequence of their evolutionary history," he says. "They've developed foraging territories they defend against members of the same species along these coastlines, and the terrestrial environment provides very little for them. So they forage over the open water."

Anthony and his colleagues also found that the eagles had more young on average during 2000-2002, a fact that Anthony believes might be a result of a high caloric content in the eagles' increasingly seabird-dominated diet.

"Across the range of this species, their diet can be quite varied, but here it appears as though the change in diet had either a neutral or positive effect," he says. The propensity of the eagles to adapt quickly to a changing environment may have allowed them to flourish, but Anthony also cautions that adapting to this scenario might be difficult for more specialized predators.

The results are the first to show that the presence or absence of otters influences a terrestrial animal, and that the complex food web linkages can reach as far as five different food chain levels: from sea otters to sea urchins, kelp, marine fish and finally bald eagles.

"Top-down linkages can be very distant from their origin," says Anthony. "The effects of top predators can ripple throughout the ecosystem in ways we're just beginning to understand."

Source: Ecological Society of America

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