BOX 1-1

Of Orcas and Otters

Nature is full of surprises, one of the latest being the near-disappearance of sea otters from Alaska's western coastline. Equally surprising is the identity of the agent responsible for the unexpected population crash and the demonstration that only a few members of a transient species can have a profound impact in linking interactions across ecosystems.

Playful marine mammals once hunted almost to extinction by fur traders, sea otters (*Enhydra lutris*) experienced a dramatic comeback following adoption in 1911 of an international treaty which prohibited killing of these animals. By the 1970s sea otter populations had recovered to pre-hunting levels in many parts of their historic range, giving conservationists reason to assume that their long-term survival was assured. Rebounding sea otter populations were regarded as good news for coastal marine ecosystems; as a "keystone species" of its biotic community, the sea otter plays a pivotal role in maintaining the health of the near-shore kelp "forests" on which a diverse assemblage of plant and animal species depend. As voracious predators of kelp-eating sea urchins, the otters prevent overgrazing of the giant algae, thereby contributing to overall ecosystem stability.

Until the late 1980s, sea otter populations along Alaska's Aleutian archipelago appeared healthy and thriving, but by 1990 the picture there suddenly and inexplicably began to change. Along a 500-mile stretch of western Alaska, the number of sea otters, which had been estimated at 53,000 in the 1970s, plummeted to just 6,000 in 1997—a 90% decline in population size. Scientists who had been studying the ecology of the area for several decades were initially at a loss to explain what was happening. They knew the animals weren't experiencing reproductive failure because studies of radio-tagged otters showed that birth and survival rates of otter pups remained at normal levels. Aerial surveys conducted by the U.S. Fish and Wildlife Service in 1965 and again in 1992 confirmed that the recent decline in the otter population was widespread throughout the island chain—the otters weren't simply relocating from one area to another. Consequently, the only explanation for the animals' drastic decline was increased mortality—but why? If otters were falling victim to disease or toxic pollutants, then researchers should have observed carcasses washing up onshore, but not even one had been sighted. Starvation was an unlikely explanation, since sea urchins, the otters' favorite food, were in plentiful supply. That left predation as the only plausible cause for rising otter death rates.

In 1991 when one member of the research team observed an otter being attacked and eaten by an orca, or killer whale (*Orcinus orca*), the sighting was regarded as an anomaly; orcas and sea otters had always shared the same waters and no one had ever seen the whales preying on their small, furry neighbors. However, over the next several years more such attacks were documented and gradually the scientists became convinced that a fundamental change in orca behavior was responsible for the dwindling number of otters. Gradually the case against the whales grew more persuasive; on Adak Island, observations revealed that 65% of the otters in easily accessible Kulak Bay disappeared over

the course of one year, while in Clam Lagoon, whose entrance from the sea was too shallow and narrow for the orcas to enter, the otter population decline was only 12%. Finally, statistical analyses of what the rate of observed orca attacks was likely to be if killer whales were responsible for the 90% observed decrease in otter numbers yielded a figure almost identical to the number of attacks actually witnessed. The verdict now was beyond doubt—orca predation was the cause of the otter population crash.

Again, however, the question was why? Why would orcas, whose preferred food had always been the much larger, more nutritious harbor seals and sea lions, suddenly begin eating sea otters? As one ecologist studying the phenomenon remarked, it's like "eating popcorn instead of steaks."

The answer to the riddle demonstrates how truly complex are the workings of nature. Since the late 1970s, populations of sea lions and seals have collapsed across the western North Pacific. While the cause of this event remains controversial, the most likely explanation is overfishing by commercial trawlers in the Bering Sea. The decline in perch and herring led directly to the crash in seal and sea lion populations which, in turn, forced killer whales to resort to a diet of otters. Considering the large energy requirements of orcas and the minimal caloric value of an otter, researchers calculate that a single killer whale may consume 1,825 otters per year, a figure which suggests that as few as four orcas may be responsible for the observed otter depopulation along more than 2,000 miles of shoreline!

Unfortunately, the ecological implications of this sad story don't end with the near-disappearance of Alaskan sea otters. With populations of their main predator so depleted, sea urchins in the affected areas are now experiencing a population explosion; hordes of hungry urchins are gobbling up the kelp beds, reducing the density of these underwater "forests" 12-fold in just ten years. If the kelp forest ecosystem collapses, as it is likely to do now that its keystone species (i.e. the sea otters) has been removed, many other components of this biotic community will be affected. Populations of rockfishes, sculpins, and greenlings—fish that live within the kelp beds—are likely to decline as their habitat vanishes; starfish, living in the open ocean beyond the kelp but also preyed upon by otters, will probably increase in numbers; seagull populations may remain stable, since those birds can turn to a diet of invertebrates as their preferred fish species dwindle; but less versatile bald eagles—totally dependent on fish—will either starve or go elsewhere as their food supply disappears.

It requires quite a stretch of the imagination to comprehend how catching too many herring in the North Pacific could result in the destruction of kelp forests and the loss of eagles along the Alaskan coast. Nevertheless, the fact that just such a scenario is now unfolding vividly demonstrates the complexity and interconnectedness of biotic communities and illustrates how human activities can set in motion a series of cascading events, culminating in the demise of species we never intended to harm.

References

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