Foraging Ecology of the California Sea Lion

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Summary

Marine biologists are enlisting marine mammals to probe the ocean. The foraging patterns of sea lions are providing insights into ocean warming and how it influences the distribution of fishes.

Using tagging data, Sea Grant biologists have an explanation for the exodus of sea lions from Monterey Bay in the winter of 2005. This explanation, besides being of scientific interest in its own right, illustrates the complexity of striving for truly ecosystem-based fisheries management.

Some of the tagging data has also been incorporated into sophisticated ocean climate models at the Jet Propulsion Laboratory in Pasadena to validate physical assumptions about flow dynamics and to improve climate forecasts.

Sea lions are being enlisted as mobile ocean-measuring devices. Photo Mike Weise, UCSC

Background

In the winter of 2005, the usually ubiquitous California sea lion all but vanished from Monterey Bay and did not return until the summer of 2005.

2005 was not an El Niño year. Coastal waters off California, Oregon and Washington, however, were unusually warm in the winter and spring, due to weaker than normal winds that drive upwelling of cold, nutrient-rich water from depth.

Without nutrients to support phytoplankton growth, the food chain was thrown out of whack. As a result, there was a noticeable, some would say profound, redistribution of prey species. The entire colony of nesting pairs of Cassin's auklets on California's Farallones Islands, for example, abandoned their nests, most likely because of shortages of krill, their main food.

Warming Causes Sea Lions to Forage Further

During the warm event, tracking data showed that some male sea lions were traveling as far as 300 miles from shore, swimming in giant loops that originated at the coast. They swam these loops repeatedly during the warm event, said Sea Grant Trainee Mike Weise, who is a doctoral student with biology professor Dan Costa of the University of California, Santa Cruz.

"Sea lions are described as a purely coastal species," Weise said. "That's why this offshore movement was so unexpected. It appears the warming pushed a lot of the sea lions' typical prey species out of the bay," he continued. "Things

Photo Jan Roletto, NOAA Sanctuaries digital archives

like squid disappeared. The fishery declined significantly. Sea lions left in search of food."

Sea lions, particularly adult males who do not help raise pups, have the biological luxury of being able to spend huge amounts of time foraging for food. In contrast, female sea lions tend to stay closer to shore to keep better tabs on their pups. Even females, however, were observed to migrate farther north along the coast than usual.

Not only did sea lions have to travel farther for food, analyses of sea lion scat collected at Año Nuevo Island shows the marine mammals were also eating more sardines and rockfishes. Usually, squid is a main prey item.

Links to Commercial Fishing

A sea lion's diet is comprised almost entirely of commercially harvested species, such as squid, sardines, and rockfish. One of the goals of the tagging project is to understand how oceanographic conditions influence sea lion foraging behaviors and what this means for commercial fisheries.

"If we want to manage commercially important fish species that are

primary prey species for large predators, we need to evaluate and incorporate into fisheries models how much, where, and when predators are taking the same fish," Weise said.

So far, sea lion behavior mirrors what commercial fishers experienced during the warm event, a fact that underscores the link between fishing prosperity and ecosystem health. Squid landings in California declined by approximately 80 percent in 2005; sardine landings declined almost 35 percent, and the sardines that were caught were smaller than usual. "We believe adult male sea lions left the bay to feed on schools of larger sardines," Weise said.

In 2006, researchers tagged 12 more male sea lions in Monterey Harbor. Some were equipped with a prototype tag that measures water temperature, salinity and depth and uses GPS to locate an animal's position to within 1-meter accuracy. Data from these animals will let researchers examine links between oceanic features (such as frontal boundaries) and sea floor bathym-

etry (such as submarine canyons) on sea lion foraging routes.

"We are getting an idea of where sea lions forage," Weise said. "The next step is to overlay this information with maps of the distribution of fishing effort along the coast. Ecosystem-based management is about understanding the resource requirements for marine mammals. We need to know where they go, what they feed on, and how these change when environmental conditions change."

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Sea lion with GPS tag.
Photo Mark Weise, UCSC

Tagging data are being incorporated into sophisticated ocean climate models. Image courtesy Y. Chao, Jet Propulsion Laboratory

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