

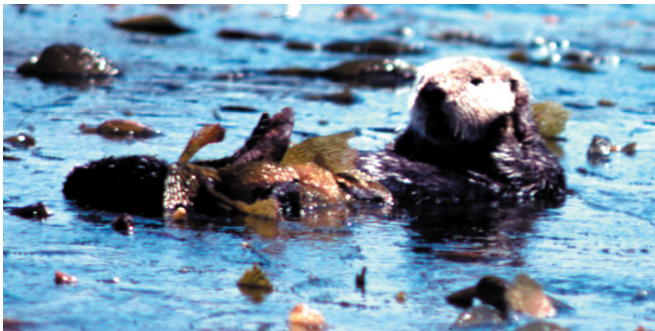
Sea Otter Studies

Sea otter research by the Western Ecological Research Center (WERC) focuses on this smallest marine mammal's population biology and its role as a keystone species in the near-shore marine community. WERC scientists conducting long-term research in Alaska and California seek to answer intricate ecological questions, such as what underlies the collapse of the kelp forest ecosystem in the Aleutian Islands, and why California's threatened sea otter population is growing so slowly. They work with state, federal, and local partners throughout the species' range.

Sea otters once ranged from the central Pacific coast of Baja California, Mexico, to northern Japan, probably in high densities more or less continuously throughout the region. The Pacific maritime fur trade, beginning with the discovery of Alaska and the Aleutian Islands by the Bering Expedition in the mid-1700s, brought sea otters to near extinction by the beginning of the 20th century. After 150 years of being intensively hunted for their valuable fur, sea otters had been extirpated from most of their range. Passage of the International Fur Seal Treaty in 1911 protected remaining sea otters from further hunting, but their distribution was severely fragmented, with remnant populations surviving in Alaska and along the rugged Big Sur coast of California. Later relocations of sea otters restored populations to some areas, including Washington and Southeast Alaska.

A Keystone Species

WERC's sea otter research program has used this fragmented distribution for large-scale studies, contrasting



Sea otter. Photo: Courtesy G. Jameson.

Research is still needed to:

- Determine the ultimate factors leading to increases in age-specific mortality in southern sea otters
- Understand how demographic shifts translate into changes in population trends
- Better understand the ultimate drivers of sea otter population collapse in western Alaska

similar habitats with and without sea otters and documenting changes through time as populations became reestablished and grew. Early work demonstrated that sea otters, by limiting populations of herbivorous invertebrates such as sea urchins and large gastropods, were an important factor in preventing kelp forests from being overgrazed. Subsequent research has focused on the broader influences of this interaction among otters, herbivorous invertebrates and kelp: both the indirect effects on other coastal species and ecosystem processes, and on the evolutionary influences over longer periods of time.

Decline in the Aleutians

Long-term research by WERC scientists has documented the extensive and precipitous decline of sea otters in southwest Alaska, particularly in the Aleutian Islands. Sea otter populations in the Aleutian archipelago have decreased by more than 90% since the 1980s. Untangling the chain of events that led to the collapse of this sea otter/kelp forest system, WERC scientists discovered that the collapse was driven by increased killer whale predation, and ultimately caused by events in the oceanic ecosystem. Their findings led the U.S. Fish and Wildlife Service (USFWS) to propose the sea otter in western Alaska as a candidate for listing under the Endangered Species Act. A fellowship from the Pew charitable trust funds a study on the historical ecology of the Bering Sea ecosystem.

Studies for Recovery in California

In California, efforts are currently directed toward understanding reasons for the depressed recovery rate of the threatened southern sea otter population. The

WERC monitoring program detected a significant decline between 1994 and 1999, the general cause being altered age-specific mortality rates. Since 1999 the population as a whole has resumed a slow rate of increase; however, this growth is primarily attributable to increases in male-dominated portions of the population, particularly near the range peripheries, while female-dominated portions of the population in the center of the range have either remained stable or continued to decline. Ongoing collection and analyses of demographic data by WERC scientists are aimed at understanding the underlying reasons for these variable population trends. This information has been important to the USFWS in its recovery planning process, to the California Department of Fish and Game (CDFG), the California Coastal Commission, the Monterey Bay Aquarium (MBA), a conglomerate of associated conservation nongovernmental organizations, and a diffuse group of fisheries organizations.

WERC researchers are involved in collaborative studies with scientists from the CDFG, the University of California at Santa Cruz, the University of California at Davis, the Smithsonian Institute, and the MBA. To learn more about the ecology of the southern sea otter, scientists have implanted VHF radio transmitters and time-depth recorders in sea otters at multiple sites throughout the range. These radio-tagged otters are then followed closely by fieldworkers for up to 5 years to monitor their survival, reproductive success, behavior and vital signs as they dive and forage for food. Their rates of energy acquisition are calculated based on observed prey capture success, in conjunction with detailed nutritional analyses of prey species. Their rates of energy expenditure are calculated from the data collected by the time-depth recorders, in conjunction with information on the metabolic costs of diving and swimming measured using captive study animals at UC Santa Cruz and the MBA. Combining all this information, the scientists can estimate the degree to which individual sea otters are meeting or exceeding their basic energetic requirements, and thereby resolve the question of whether sea otter population size is being limited by the abundance of food resources in some portions of the range. This research has also highlighted the extreme degree of individual dietary specialization in the southern sea otter, and the significance of such specialization for individual fitness and population dynamics.

Detailed health profiles are being developed for the radio-tagged study animals; additionally, beach-cast carcasses are being examined and tissues analyzed, in an effort to determine important causes of death in sea otters. Analyses of these data will help scientists to understand the status of this sea otter population and why its recovery has been so slow and inconsistent.

Comparing Sea Otter Populations

WERC scientists are learning how southern sea otters feed, live and die in central California, and contrasting this information with similar data collected in the 1980s when the population was still increasing. Comparisons are also being made between the populations at the center of the range and San Nicolas Island (located in the Santa Barbara channel), where sea otters were introduced in the late 1980s. In contrast with the stagnant growth seen in central California, the small population of sea otters at San Nicolas Island is increasing by about 9% per year. To discover why these rates vary so greatly, WERC scientists and their collaborators are comparing the behavior, diet, health profiles, and population biology of the San Nicolas population with that in central California. This comparative approach is being further expanded to include populations in Washington and Alaska: the scientists hope to determine the demographic mechanisms responsible for the different rates of population change, and to identify which behavioral and demographic characteristics are associated with rapidly growing populations and which are more typical of those that are either stable or in decline. Mathematical modeling approaches are being developed to predict future trends and to evaluate management alternatives.

To learn more about sea otter research at WERC, visit our web site at <http://www.werc.usgs.gov/otters/>.

For more information, contact:

Dr. James A. Estes
USGS Santa Cruz Field Station
100 Shaffer Road
Long Marine Laboratory, UCSC
Santa Cruz, CA 95060
Phone: 831.459.2357 Fax: 831.459.2249