



Alagnak

Aniakchak

Katmai

Kenai Fjords

Lake Clark

Sea Otters

Importance

Sea otters (*Enhydra lutris*) are known as a keystone species. A keystone species dramatically affects the structure and complexity of their environment. For example, when sea otters are present in rocky habitats, they eat sea urchins and urchin density decreases as a result. Lower urchin density reduces grazing pressure on kelps, resulting in a more diverse nearshore ecosystem¹. In 2005, sea otter populations in the southwest Alaska population segment (which includes coastal habitat of Katmai National Park and Preserve) were listed as threatened under the Endangered Species Act. Further, the U.S. Fish and Wildlife Service designated almost 6,000 miles of coastline in southwest Alaska as critical habitat for the northern sea otter. Critical habitat is habitat that is deemed essential for the conservation of a threatened (or endangered) species. Monitoring sea otter populations, as well as other components related to sea otter status, in nearshore ecosystems will result in important information to better understand population trajectories.

Methods

There are three different ways sea otter data are collected: fly aerial surveys to estimate abundance, conduct foraging observations to estimate energy recovery rates, and collect carcasses to estimate the age-class distribution of the dying otters.

Aerial surveys are conducted in order to calculate sea otter abundance. Surveys were flown in Katmai National Park and Preserve (NPP) in 2008, 2012, and 2015; Kenai Fjords National Park (NP) in 2007 and 2010; and western Prince William Sound annually from 1993 through 2005, 2007 through 2009, and 2011 through 2013.

Sea otter foraging data are collected annually in these areas to estimate energy recovery rates (kcal/min). These rates are used to indicate population status relative to a food-limited carrying capacity. In biology, carrying capacity is the maximum population size of a particular species that the environment can sustain indefinitely given the food, habitat, and other necessary environmental resources.

Carcass surveys also occur annually. To date, very few carcasses have been found in Kenai Fjord NP, presumably because of the relatively low density of sea otters in the area and the lack of low sloping beaches that could act as repositories for carcasses. Carcasses are collected every year from Katmai NPP and western Prince William Sound.



A biologist observes feeding behavior of sea otters in Kenai Fjords NP. Collected data include the type, size, and numbers of species consumed by otters, as well as how much time sea otters spend diving and at the surface. This data helps biologists calculate energy recovery rates of sea otters. NPS photo.



Sea otter feeding on an octopus (left) and grooming (right). NPS photos.

Findings to date

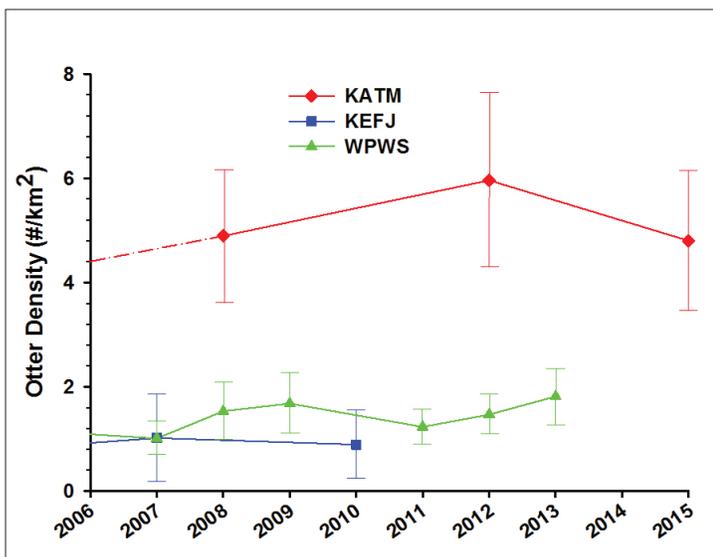
In Katmai NPP, our data suggest that sea otter numbers increased substantially since the early 1990's and have been at high and stable densities in recent years (see Figure 1). This corresponds with declining energy recovery rates, suggesting that otters have reached a food-limited state (see Figure 2).

Densities of otters in Kenai Fjords NP, while relatively low, have been stable since 2002 (see Figure 1) with stable energy recovery rates (see Figure 2), indicating a population at carrying capacity with low food availability in comparison to Katmai NPP. Unlike Katmai NPP, which has extensive shallow soft-sediment habitats ideal for clams, Kenai Fjords NP is predominately a glacial fjord ecosystem. Its "steep and deep" characteristics can be unfavorable for clams. The low availability of clams likely contributes to the lower density of otters in Kenai Fjords NP.

Initially, in western Prince William Sound, food was not a limiting factor in sea otter recovery from the *Exxon Valdez* oil spill. More recently we have observed a moderate increase in sea otter population density, with a subsequent decline in energy recovery rates. This indicates that the population may be reaching its carrying capacity for this region (see Figures 1 and 2)².

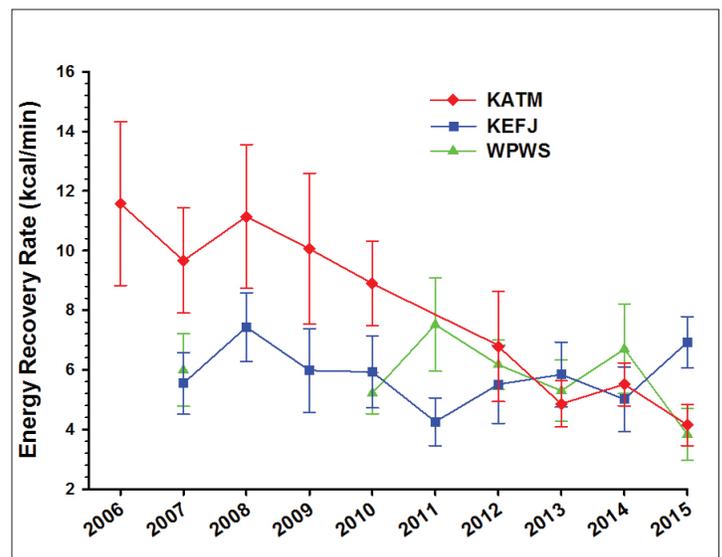
The design and coordination of our monitoring program allows the National Park Service to infer potential causes and spatial extent of the observed changes in abundance that have occurred through time.

Figure 1



Estimated mean density of sea otters occupying suitable habitat in Katmai NPP (KATM), Kenai Fjords NP (KEFJ), and western Prince William Sound (WPWS). Error bars represent 95% confidence intervals.

Figure 2



Energy recovery rates (measured as kilocalories gained per minute, kcal/m) for sea otters foraging in Katmai NPP (KATM), Kenai Fjords NP (KEFJ), and western Prince William Sound (WPWS). Error bars represent 95% confidence intervals.

For more information:

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1. Estes, J.A. and D.O. Duggins. 1995. Sea otters and kelp forests in Alaska: generality and variation in a community ecology paradigm. *Ecological Monographs*. 65: 75-100.

2. Coletti, H.A., J.L. Bodkin, D.H. Monson, B.E. Ballachey and T.A. Dean. *Ecosphere*. Detecting and inferring cause of change in an Alaska nearshore marine ecosystem. *In review*.