Alaska Seas & Coasts
Marine Issues for Alaska's People
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alaska's steller sea lions

Boom to Bust—And Back?

In This Issue

Humans and Steller sea lions have both depended on Alaska's fish stocks for millennia. Both are opportunistic consumers, effectively foraging on fish species when and where they are most abundant. It is not surprising, then, that humans have interacted with Steller sea lions for decades in direct and indirect ways; sometimes directly in face-to-face battles for netted salmon, and more broadly and indirectly as coexisting consumers whose diets include many of the same fish species, e.g., salmon, pollock, cod, flatfish, and herring.

How has this relationship changed through the years? Drastic swings in social and economic values have inspired managers to shift from Steller sea lion reduction efforts, to protection efforts, in less than 30 years. In 1934 Secretary of Interior J.A. King declared "It has been determined that sea lions occur in excessive numbers in the waters of Alaska and are inflicting serious economic loss on the fisheries." [16 USC 659]. By the 1950s localized depletion of salmon by Steller sea lions was perceived as a threat to commercial fishermen, so the state sanctioned efforts to reduce sea lion numbers. After the mid-1970s, Steller sea lion numbers declined drastically. In the 1990s competition with commercial fishermen was perceived as a threat to sea lions; therefore fisheries have been managed to reduce the potential localized depletion of pollock, cod, and Atka mackerel.

Since the 1990s, Steller sea lions have been the subject of intensive conservation efforts, political and biological debate, and an unprecedented research initiative. In this issue of *Alaska Seas & Coasts* we explore some lessons learned in this process and ponder the role humans will play in the Steller sea lion's recovery.

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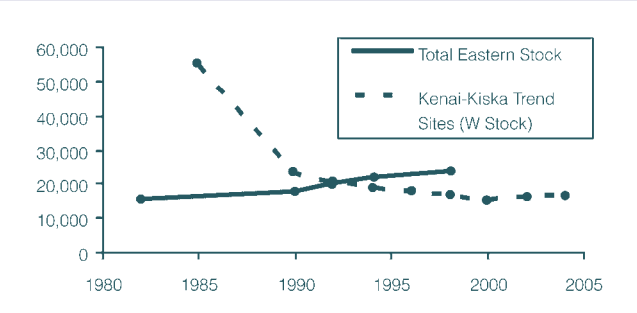
STELLER SEA LION STATUS

Monitoring Steller Sea Lion Numbers

By Lowell Fritz, NMFS Alaska Fisheries Science Center, National Marine Mammal Lab, Seattle



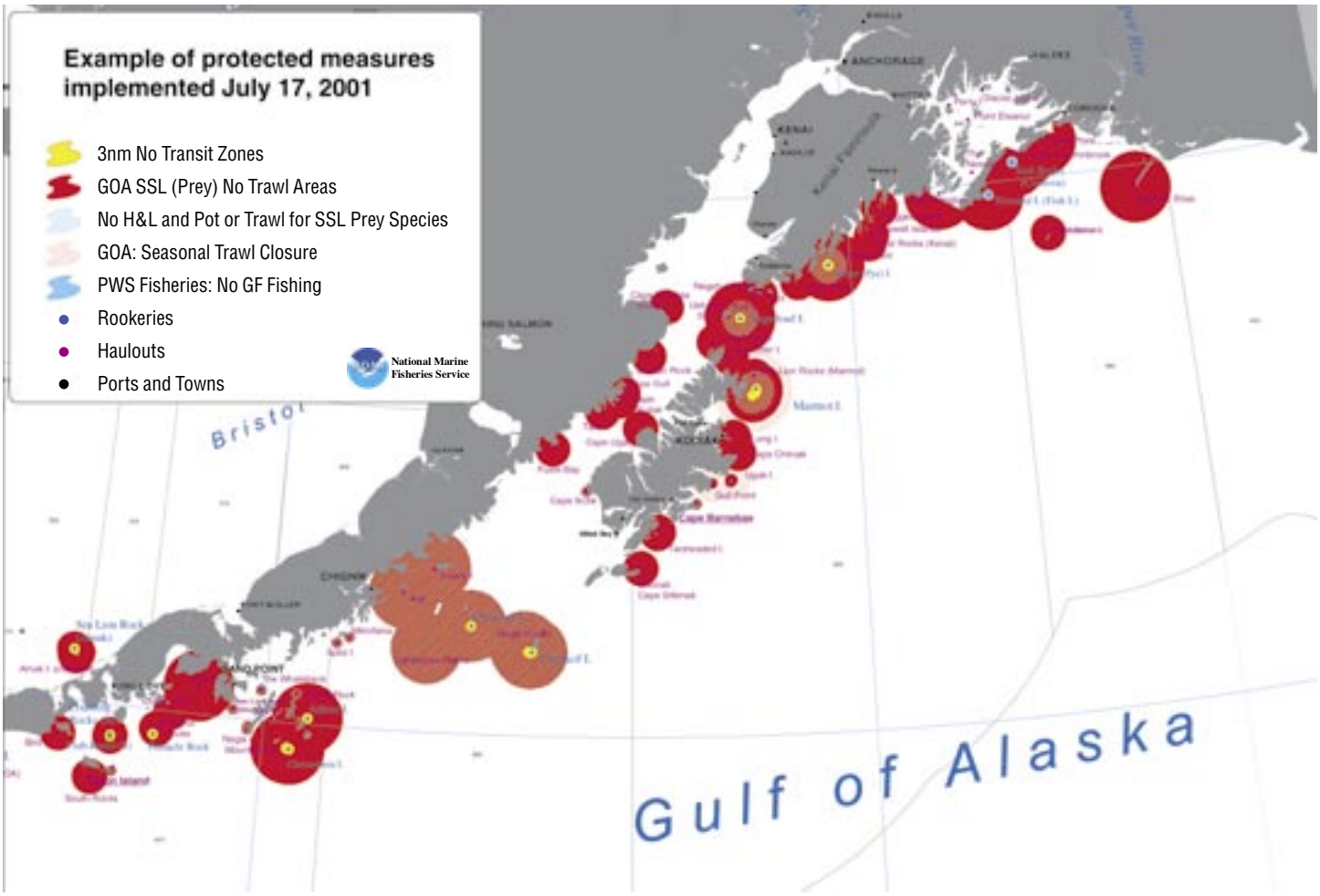
Steller sea lions range across the North Pacific Ocean, breeding on numerous rookeries from central California to the Kuril Islands and in the Sea of Okhotsk (see map below, NOAA/NMFS). Two distinct stocks of Steller sea lions are recognized based on differences in genetics as well as population trend. The eastern stock breeds in California, Oregon, British Columbia, and Southeast Alaska east of 144°W. The western stock breeds west of 144°W in the Gulf of Alaska, Aleutian Islands, and throughout Russia.

Scientists first noticed that the population of Steller sea lions was declining in the 1970s in the eastern Aleutian Islands. The decrease in numbers became very rapid in the late 1980s; in 1990 the species was listed as threatened under the Endangered Species Act (ESA) to help them recover. The stock structure became known in the mid-1990s and led, in 1997, to separate listings of threatened for the eastern stock and endangered for the western stock.

The National Marine Fisheries Service (NMFS) and the Alaska Department of Fish and Game (ADFG) conduct aerial surveys every two years during the breeding season (June-July) to assess the status and monitor the trend of the Steller sea lion population in Alaska. The survey conducted in June 2004 was the first complete survey using medium format, vertical photography.

Counts at a series of "trend" sites are used to monitor the trend in the population (see graph above, NOAA/NMFS). Trend sites are those that have been consistently surveyed since the mid-1980s. Counts at eastern stock trend sites increased at about 1-2% per year through the 1980s and 1990s, largely due to increases in Southeast Alaska and British Columbia. Counts at western stock trend sites declined rapidly in the late 1980s and continued to decline more slowly through the 1990s; trends between sub-areas differed considerably. It appears the western population may have begun to increase again in recent years with numbers on western trend sites increasing approximately 6% between 2000 and 2002 and again between 2002 and 2004. ♦

Steller Sea Lion Rookeries, Stock Locations



For some endangered species, it is relatively easy to identify factors that are limiting a population's survival. For the Steller sea lion, however, there was no definitive cause for their decline. When Steller sea lions were first listed under the ESA in 1990, the existing and potential threats to their population were identified and initial efforts were made to encourage recovery. Direct, human-induced mortality was reduced through a ban on illegal shooting. No-transit zones were established within 3 nautical miles (nm) around rookeries to eliminate vessel traffic and human disturbance on critical land sites (key rookeries west of 150°W). Aquatic habitat within 20 nm of those rookeries was designated as critical habitat in order to provide adequate prey for sea lions using these sites during biologically critical times of the year.

Steller sea lions are known to eat a variety of commercially harvested fish, and consequently human competition with Steller sea lions for certain fish species was identified as a potential threat—one that is difficult to either prove or disregard. In light of this uncertainty, a series of progressively more restrictive and complex commercial fishery management measures have been implemented since 1998 to minimize this potential for competitive interactions with Steller sea lions. Specifically, NMFS has imposed a series of catch limits, time, and/or area closures within "critical habitat" to minimize the potential for localized depletion of key prey species by humans, in times and areas assumed to be most critical to reproductive females and weaning pups (see map above).

Fishing Restrictions

There is currently no clear evidence linking commercial fisheries to Steller sea lion declines. Instead, these closures were taken as precautionary measures to reduce the potential for competitive conflicts, as mandated by the Endangered Species Act. Although direct benefits of these protective measures to the sea lions may be difficult to measure in a changing environment, their economic impacts were felt by many coastal fishermen and the communities they support. Fishing closures within Steller sea lion critical habitat forced small-vessel fishermen to travel farther in order to fish more than 20 nm from shore, increasing associated costs and hazards. The economic impacts of increased costs and reduced landings have trickled down through coastal community economies. In 2000, Congress responded to the socioeconomic ramifications of Steller sea lion protective measures by appropriating unprecedented research funding to examine factors contributing to the decline and slow recovery of Steller sea lions in western Alaska.

Students of Ms. Mary Downs' 4th grade class, Eagle's View Elementary, Unalaska

Steller sea lion protection measures…

"…have to be designed to allow the kind of experimentation and monitoring that will enable us to assess their performance." *—Nina M. Young, The Ocean Conservancy*

"…are affecting processors by affecting the quality of fish delivered. Increased distance and time affect the quality of fish and also make it hard to schedule the unloading of fishing vessels." *—Don Graves, Operations Development Manager, UniSea*

"…are costing local fishermen time and money based upon where and how they can fish. I don't think the protection measures for the under 60 foot boats are saving one single sea lion."*—Bobby Storrs, Vice President, Unalaska Native Fishermen's Association*

"…are one part of a suite of actions designed to aid in the recovery of this endangered species. Other regulations help reduce disturbance and the likelihood of direct mortality, but they all work together in the recovery effort."*—Lowell Fritz, NMFS Alaska Fisheries Science Center, National Marine Mammal Lab, Seattle*

"…do not directly affect small Native villages, but indirectly have a large effect on the cost of living in small rural areas."*—Julie Dirks, City Manager, Atka*

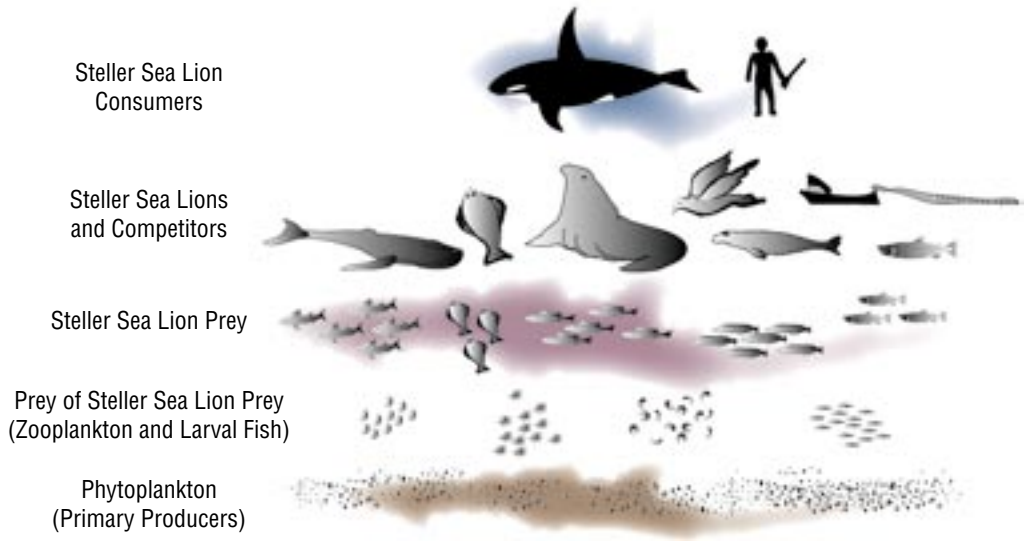
"…are there for a reason. As a community, Unalaska has adapted to the costs, and [we] are supportive of anything that will help the sea lions."*—Chris Hladick, City Manager, Unalaska*

"These rules … sometimes lead to the worst of all outcomes: higher cost, lower safety, and failure to catch fish in the outside waters open to fishing."*—Julie Bonney, Alaska Groundfish Database*

What Drives the Steller Sea Lion Population in Western Alaska?

A population will decline when the mortality rate exceeds survival. Factors affecting this balancing act are considered either "top-down" or "bottom-up" processes, referring to a species' relative position in the food web. "Top down" processes involve parasitism, predation, and other forms of direct mortality. For Steller sea lions they include predation by killer whales and sharks, disease and parasites, and killing by humans. "Bottom-up" factors are those that influence the availability of a species' food, including climatic and oceanographic effects on primary and secondary production, competition with other consumers, etc. Prey limitation can lead to acute or chronic starvation, reduced reproductive success, and increased susceptibility to disease, parasites, and predation.

What role these processes played in the Steller sea lion's catastrophic decline prior to 1990 will likely remain a mystery because the data needed for this assessment were not collected at the time. Researchers therefore have focused their efforts on assessing the slowly recovering western stock of Steller sea lions. Since 1999, more than $125 million has been dedicated to studying Steller sea lions and their environment, searching for key elements affecting their population health.



Researchers are studying Steller sea lions and their environment...


Briana Whiteveen UAF

Looking for changes in climate, oceanography, prey, predators such as this orca, or competitors that could negatively affect Steller sea lions.


Kate Wynne, NMFS permit 782-1532

Comparing Steller sea lions and their environment in areas of population decline (western stock) to areas of population stability (eastern stock).


Kate Wynne, NMFS permit 782-1532

Examining health and observing behavior of individual Steller sea lions to understand their critical needs and identify potential population threats.


Kate Wynne, NMFS permit 782-1532

Determining *how* these variables would affect individual Steller sea lions and how this would translate to population-level impacts on reproduction, growth, or survival.

Counts, Trends, and Habitat Needs

Steller sea lions were the target of three decades of predator control efforts, before the late 1950s–early 1960s when the first surveys counted about 140,000 on Alaska's shores. Decreasing counts in the late 1970s led to a more rigorous and consistent series of surveys starting in 1985, or one sea lion's lifetime ago. Since then, the downward trend in the western stock has varied regionally (see map below). Sea lion numbers dropped substantially in both the central Gulf of Alaska and central Aleutian Islands in the late 1980s but less dramatically in the other areas. The population remained relatively stable from 1990 to 2004 in some areas while continuing to decrease at varying rates into the 2000s in other regions.

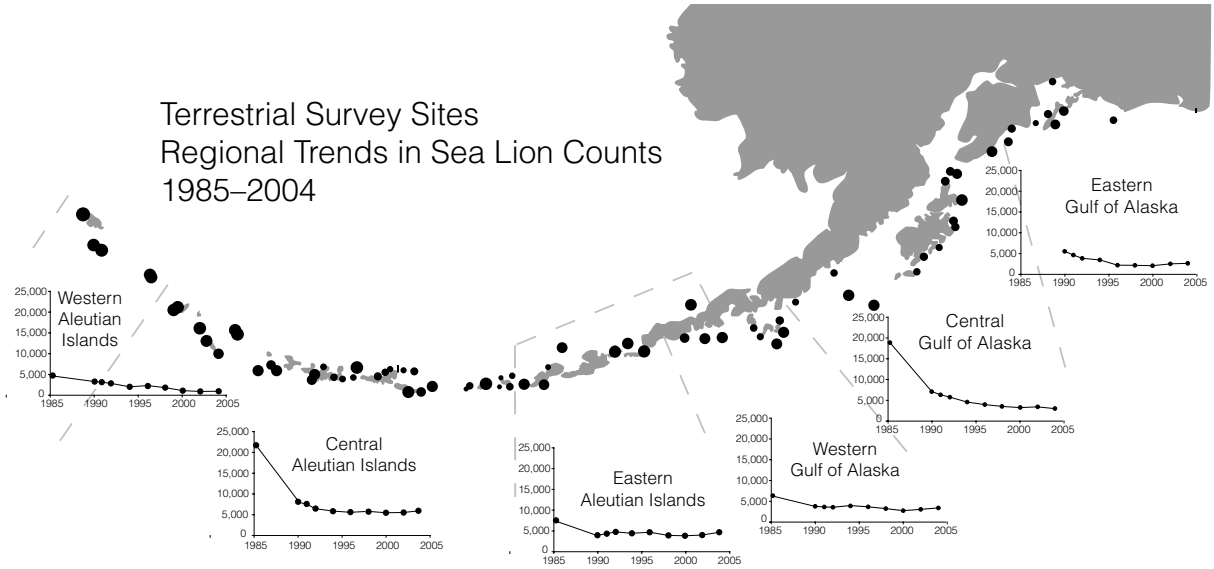
We are slowly refining our understanding of the seasons and ages during which specific habitats are most critical for Steller sea lions. Marking individual Steller sea lions with brands and tags has allowed the observation of individual pups as they wean, mature, travel through the North Pacific, and return to rookeries as breeding adults. Researchers have found that many but not all pups are weaned by spring, 10-12 months after their birth. Even as young pups, Steller sea lions may travel extensive distances between haul-outs but use primarily near-coastal habitats. After weaning they apparently forage farther from shore and may travel extensively throughout the North Pacific; several branded animals have been observed hundreds of miles from their birth site. (See p. 10 for How You Can Help with the brand re-sighting effort.)

Kate Wynne, NMFS permit 782-1532

Marked Steller sea lion, Long Island, Alaska (branded on Marmot Island as a pup).

Health

No "smoking gun" or single cause of the Steller sea lion decline has been identified after years of intensive research. No evidence of a mass die-off of Steller sea lions—large numbers of sick, starving, or dead animals onshore—was found along the vast Alaskan coast as would be expected when pinnipeds die due to acute starvation or disease. However, evidence consistent with chronic or long-term nutritional stress was found during



the peak of the decline when researchers examined individual Steller sea lions in western Alaska, and compared their condition to animals sampled earlier. They found Steller sea lions in the 1980s were smaller, grew slower, and had lower reproductive success than those examined in the mid-1970s. Biologists have hypothesized that the quality and/or quantity of prey available to Steller sea lions was reduced in the 1980s, which led to reduced juvenile and adult survival.

The few diet studies conducted since the 1940s show Steller sea lions eat a variety of marine species, including sandlance, herring, flatfish, pollock, salmon, cephalopods, sculpins, Pacific cod, rockfish, and smelts (including capelin). The relative importance of each prey species has varied seasonally, annually, and regionally suggesting Steller sea lions feed opportunistically on prey that is locally available. Most researchers believe Steller sea lions benefit from a diverse diet; some believe the dominance of pollock in western Alaska and availability for Steller sea lions to eat in the 1980s may have been nutritionally detrimental. But could this alone cause such a drastic decline in Steller sea lion numbers since the 1960s?

We also know thousands of Steller sea lions died in western Alaska prior to the 1970s due to natural and human-induced sources such as commercial harvest and pup killing, incidental and intentional mortality in commercial fisheries, predation, parasitism, and disease. But it was in the 1980s, after much of this known mortality was reduced, when the western population crashed. Individually, neither nutritional nor mortality factors would be expected to cause a large and healthy mammal population to decline so drastically. But many biologists believe Steller sea lions were hit by a "perfect storm"—the temporal convergence of several top-down and bottom-up factors whose cumulative impacts together reduced their survival in the 1970s and 1980s.

Briana Witteveen, NMFS permit 1049-1718

Numbers of humpback whales, which feed in the same areas on some of the same species as Steller sea lions, have been on the increase.

Hope on the Horizon?

Things appear to have changed since 1990 when the rate of population decline abruptly slowed. Steller sea lions examined since the mid-1990s have had a diverse diet and do not appear to be nutritionally stressed, yet their recovery has been slow and regionally variable. Why? If Steller sea lions were the only fish consumer in a system with abundant prey, we would expect their low-density population to benefit from relatively high per capita prey availability. As with their decline, though, the speed of the Steller sea lion's recovery is likely dictated by a combination of top-down and bottom-up pressures.

Steller sea lions are not the only consumers in the system: they share prey resources with humans and a multitude of other piscivores, many of which have increased in abundance since the mid-1980s. Fish are the dominant consumers of other fish in marine ecosystems. Since 1990, natural and anthropogenic conditions have favored the increase or recovery of many piscivorous species, including arrowtooth flounder, salmon, Pacific ocean perch, walleye pollock, and Pacific cod. Although Steller sea lions are known to eat these species, they may also compete with them for forage fish. In addition, piscivorous whales such as fins and humpbacks, whose stocks appear to be rebounding since whaling ended in the mid-1970s, are known to be significant consumers of forage fish eaten directly or indirectly by Steller sea lions. Harbor seals in the Gulf of Alaska, whose diet closely matches that of Steller sea lions, also have begun a slow but steady recovery from their severe decline in the 1970s.

In addition the relative impact of top-down pressures may be slowing recovery of the western stock of Steller sea lions. Although it is difficult to quantify, the per capita exposure of sea lions to killer whale predation, illegal killing, and other top-down pressures would be expected to have a greater relative impact on a small population of Steller sea lions than a larger one.

PROGNOSIS FOR RECOVERY

The focus of an enormous effort in research and management, since 1990, has been to encourage recovery from the Steller sea lion's catastrophic decline in the 1980s. But recovery to what level? The Marine Mammal Protection Act of 1972 (MMPA) declared the primary objective of marine mammal management "shall be to maintain the health and stability of the marine ecosystem. Whenever consistent with this primary objective, it should be the goal to obtain an Optimum Sustainable Population keeping in mind the carrying capacity of the habitat."[16 USC 1361 Sec 2(6)]. The National Marine Fisheries Service has interpreted Optimum Sustainable Population (OSP) to mean "a population size which falls within a range from the population level which is the largest supportable by the ecosystem to the population level which results in maximum net productivity" [50 CFR 216.3]. Carrying capacity is the maximum number of a species an environment can support.

What is the Optimum Sustainable Population?

It is possible that Steller sea lions were at an all-time high population level when first counted in the late 1950s–early 1960s. Many competitors had been removed by human harvesters early in the twentieth century through whale and pinniped harvests and nearshore fishing by U.S. and foreign fleets, freeing up prey resources for increased Steller sea lion population growth in the 1940s and 1950s. At the time Steller sea lions gained some protection with passage of the MMPA in 1972, many likely would have been sharing their prey base with a growing number of piscivorous consumers. If a reduction in the quantity or quality of prey also occurred at this time, it is easy to see how per capita prey availability would decrease and why Steller sea lions showed signs of nutritional stress when examined in the 1980s.

Given this scenario, the western stock of Steller sea lions may have been reaching their carrying capacity when 140,000 were counted in the late 1950s and the decline in the 1970s may have occurred in large part because it exceeded the "level which is the largest supportable by the ecosystem." Now consider that a species' carrying capacity is not a fixed value: both natural and anthropogenic influences favor some species (prey, predators, and competitors) over others in a given time period, affecting the total number of a given species that can be supported by the ecosystem. Given the continued recovery of piscivorous whales and increase of other potential competitors in the system, it is likely that the current carrying capacity of Steller sea lions is far lower and that the population may never approach its previous peak.

Steller sea lions in the western stock examined since 2000 look healthy. These adult female sea lions and their pups were photographed on Long Island, Alaska.

Kate Wynne, NMFS permit 782-1532

THE FUTURE

The challenge now is to determine what constitutes a recovered and sustainable Steller sea lion population. The MMPA established the goal of Optimum Sustainable Population for marine mammals within healthy ecosystems, setting the lower target of OSP as the population with maximum net productivity and the upper limit as the population's carrying capacity. Continued pup counts and observations of branded animals will be key to monitoring the net productivity of Steller sea lions in Alaska over time. Assessing the population size relative to carrying capacity is much more problematic and may rely on monitoring indices of individual Steller sea lion health and developing increasingly detailed ecosystem models.

Steller sea lion management efforts have swung from predator control to predator protection in less than 30 years but these conflicting attitudes and strategies share a common theme and weakness. Both management regimes are based on an assumption of simple, linear single-species ecological relationships. That is, both assume a decrease in fish consumed by one will directly benefit the other. Both ignore the potential involvement of other biological and environmental influences on the system.

If we have learned nothing else from the Steller sea lion "saga" we should have learned that their ecological relationships are not simple or linear. The marine environment that supports both humans and sea lions is dynamic and complex. It can shift to extremes within one sea lion life span. The conditions that supported 140,000 in the 1960s may never be duplicated, as the dominant species in the ecosystem have changed and will continue to change due to both natural and human-induced impacts. The causes of the Steller sea lion decline from 1975 to 1990 and apparent stabilization in the 2000s likely involve multiple factors and may never be understood. Although many details may remain enigmatic, lessons learned through this extensive research effort should lead to a more informed ecosystem-based approach to understanding Steller sea lions and their complex environment.

As their numbers increase, we can expect Steller sea lions to interact more frequently with humans who get between them and their food source.

Kathy Hough, NMML/NMFS

Most of the "scarecrows" built to deter sea lions, like this one in Kodiak, apparently don't do the job.

Kate Wynne, NMFS permit 782-1532

Steller sea lions look for fish in a salmon set gillnet, west of Kodiak.

HOW YOU CAN HELP

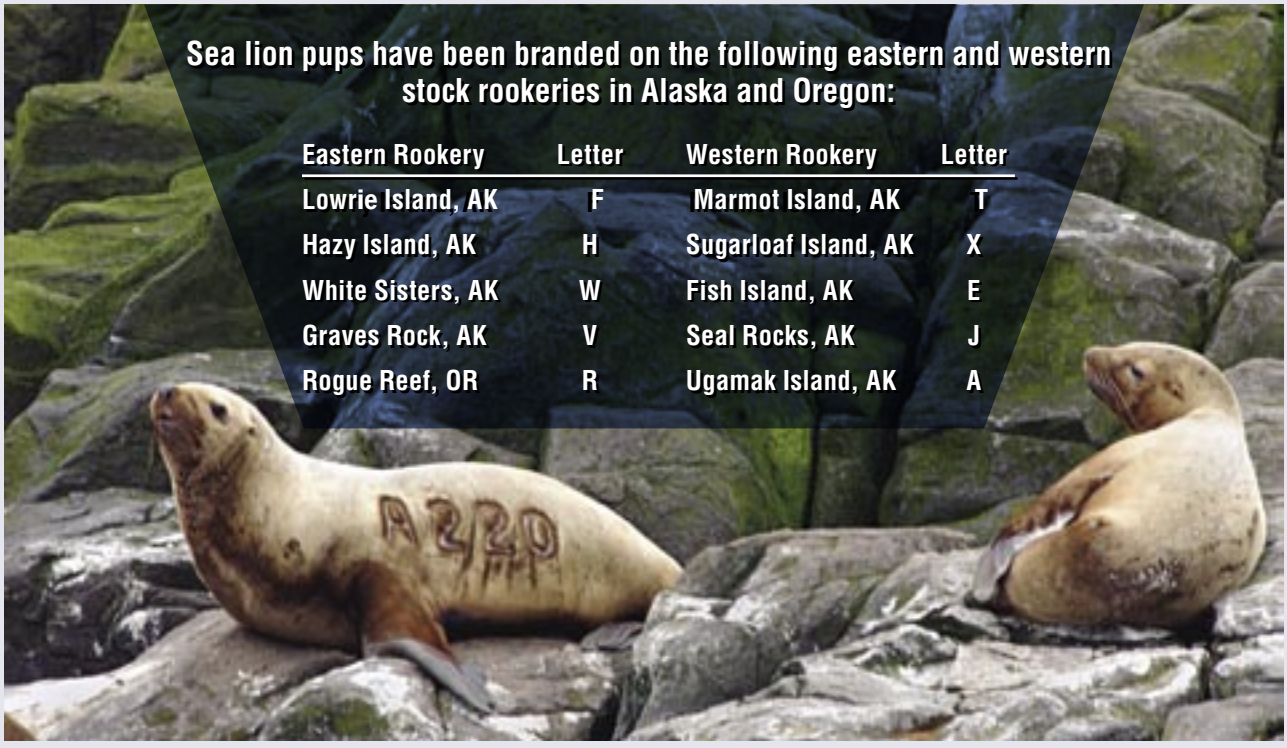
Get Involved!

Your observations can help ongoing research efforts

- **Report sick, injured, or dead Steller sea lions immediately to local enforcement officers.**
- **Submit video footage of killer whales attacking Steller sea lions.**
  Contact Kate Wynne at (907) 486-1517.
- **Report branded sea lion sightings.**

Between 1999 and 2004, NMFS and ADFG have individually marked over 3,000 sea lions as pups on their natal rookeries in Alaska and Oregon. This is done by hot branding a unique letter (corresponding to a particular rookery island) and a number onto the pup's left side after it has been sedated. By noting the time, place, and behavior of marked animals when they are seen again, scientists can determine survival and reproductive rates of sea lions, as well as describe their movement patterns.

If you see a marked Steller sea lion, please note date, time, and location of sighting and take a photograph if possible. Send to Lowell.fritz@noaa.gov or Lowell Fritz, Alaska Fisheries Science Center, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.



Sea lion pups have been branded on the following eastern and western stock rookeries in Alaska and Oregon:

Eastern Rookery	Letter	Western Rookery	Letter
Lowrie Island, AK	F	Marmot Island, AK	T
Hazy Island, AK	H	Sugarloaf Island, AK	X
White Sisters, AK	W	Fish Island, AK	E
Graves Rock, AK	V	Seal Rocks, AK	J
Rogue Reef, OR	R	Ugamak Island, AK	A

NMML/NMFS permit 782-1532

Do Not Feed Sea Lions!

Although you may think feeding an endangered species would be good for them, intentionally feeding sea lions is illegal. It is considered a "take" under the MMPA because it leads to a change in sea lion behavior, often resulting in their "habituation" to humans. Steller sea lions that lose their fear of humans and expect food handouts may aggressively approach humans in harbors, putting humans at risk of injury and requiring sea lions to be removed.

- **Use designated cleaning stations in harbors.**
- **Clean deck of all fish.**

Do Not Disturb Sea Lions!

- **Obey 3 nautical mile, no-transit zones around rookeries.**
- **If flying over Steller sea lions on land, maintain a minimum altitude of 1500 feet.**
- **When observing sea lions resting on haulout sites, maintain the sea lions' comfort zone: back away if animals become alert and agitated by your approach.**

Kate Wynne, NMFS permit 782-1532

For more information related to Steller sea lion research and management, check these Web sites.

RESEARCH UPDATES

NMFS Alaska Fisheries Science Center
www.afsc.noaa.gov

NMFS National Marine Mammal Lab,
Steller Sea Lion Program
nmml.afsc.noaa.gov/AlaskaEcosystems/akprog.htm

Alaska Department of Fish and Game, Marine Mammals
www.wildlife.alaska.gov/management/mm/mm_home.cfm

North Pacific Universities Marine Mammal Consortium
www.marinemammal.org

Alaska SeaLife Center
www.alaskasealife.org/site/research

REGULATION UPDATES

NMFS Alaska Region
www.fakr.noaa.gov

North Pacific Fishery Management Council
www.fakr.noaa.gov/npfmc

Alaska Seas & Coasts
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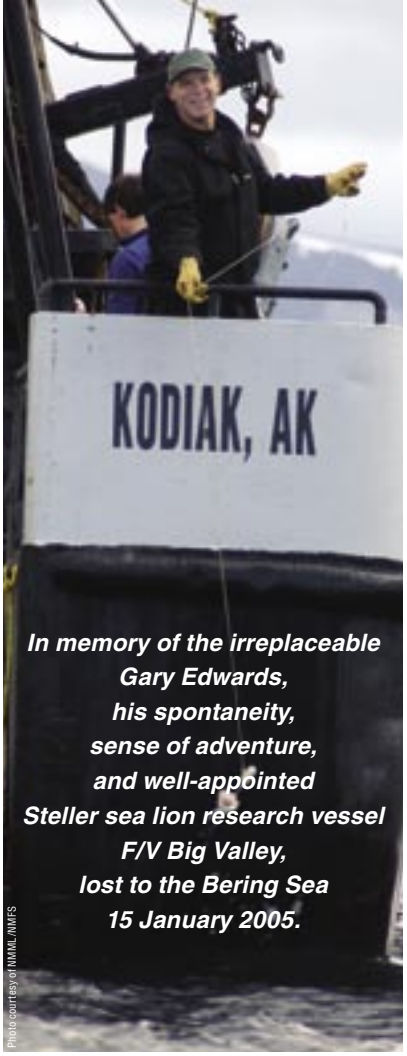
Kate Wynne is MAP's Marine Mammal Specialist, a position that allows her to study marine mammals and help mitigate their conflicts with humans through diverse research and outreach efforts. She has collaborated with agency and academic researchers in numerous pinniped and cetacean studies in the North Pacific and has produced a series of field guides to the marine mammals of U.S. waters.



In memory of the irreplaceable Gary Edwards, his spontaneity, sense of adventure, and well-appointed Steller sea lion research vessel F/V Big Valley, lost to the Bering Sea 15 January 2005.

Photo courtesy of NMML/NMFS

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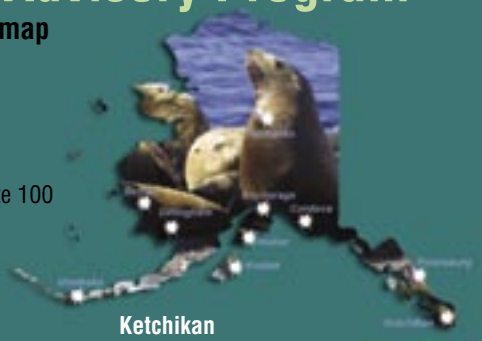

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