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STELLER SEA LIONS
WHAT DOES SCIENCE SAY ABOUT THEIR DECLINE AND RECOVERY

What caused the decline of the endangered Steller sea lion (SSL) population in the North Pacific and why are some regional populations slower in their pace toward recovery?

SSL POPULATION STATUS

Steller sea lions (SSL) were listed under the ESA as threatened in 1990. In 1997, the population was divided into two segments: the eastern distinct population segment (EDPS) that includes southeast Alaska, British Columbia, and the Pacific coast to California; and the western distinct population segment WDPS) that includes U.S. waters of Prince William Sound, the Gulf of Alaska, Bering Sea and Aleutian Islands, and Russia/Asia. At this time the WDPS was listed as endangered. The EDPS remained listed as threatened. In March 2008 the *Recovery Plan for the Steller Sea Lion* (SSLRP) was released by NMFS that sets out criteria for downlisting and delisting these two segments.

In the late 1990's, NMFS reviewed and evaluated the potential impacts of federally managed groundfish fisheries in Alaska on SSLs under the ESA. Strict fishery regulations were first put in place in 1999-2000. Current fishery restrictions designed to protect SSL were put in final regulations in 2002.

Recent surveys of non-pups (juveniles and adults) and pups have been conducted over the past two years. What they have shown is that the Western Distinct Population Segment (WDPS) of SSLs is improving throughout much of its range. Current data put the U.S. population of the WDPS at around 50,000 animals[i], and the Russian population at approximately 25,000 animals[ii] for a total of roughly 75,000 for the entire WDPS.

In February, 2009 NMFS reported survey results from 2008 showing a fourteen percent (14%) increase for the period 2000-2008 for the WDPS adult and juvenile (non-pup) population[iii]. In the summer of 2009, NMFS conducted a partial survey of non-pups in the Gulf of Alaska to reassess the non-pup counts for that region. NMFS reported in December of 2009[iv] that it appeared that there may have been an overestimate in the 2008 non-pup count and therefore adjusted the non-pup count slightly downward to a twelve percent (12%) increase over the 2000-2008 period. This translates into a 1.4% to 1.7% per year increase in non-pups in the WDPS.

During the summer of 2009 NMFS also conducted surveys of pups throughout the SSL range, with the exception of the western Aleutian and Pribilof Islands. NMFS reported

the results in December 2009. Pup production increased by fourteen percent (14%) for the period 2001/2002 to 2009 which equates to a 1.7% per year increase over that time period.

The increasing trend for both pups and non-pups has not been consistent across the range of the WDPS. The Gulf of Alaska has been relatively stable or slightly increasing over this period. The eastern Aleutian Islands have shown consistent growth. This is the area adjacent to the most productive Bering Sea fishing grounds. The central Aleutian Islands have shown a stable trend in the eastern part of the subregion and a declining trend in the western portion of the subregion. The western Aleutian Islands have shown an ongoing decline in the population.

FACTORS AFFECTING RECOVERY

After $190 million in research money, much of it allocated by Congress, uncertainty remains about the cause of the SSL decline and identification of what might hinder its recovery and eventual removal from the Endangered Species list.

Several hypotheses attempt to explain the decline of the sea lions. These can be divided into two categories. The "bottom up" hypotheses include potential causes that would limit the amount or quality of food available to sea lions including 1) large scale fishery removals reducing the availability or quality of prey species; 2) climate/regime shift changing the abundance or distribution of prey; 3) non-lethal disease; and 4) pollutants contaminating fish eaten by sea lions.

"Top-down" hypotheses encompass factors that kill sea lions independently of the capacity of the environment to support the sea lion population. These include: 1) predator switching by killer whales (or sharks) to target sea lions; 2) increasing incidental take (or disturbance) through capture or entanglement in fishing gear; 3) subsistence harvesting of sea lions taking more than estimated; 4) underestimation of sea lion shooting; and 5) increasing mortality from pollution and disease, independent of nutrition.

Two federal panels were assigned to review the available science and, after years of review, no single culprit has been identified.

In 2003 the National Research Council was directed by Congress to review the data and determine the cause of the SSL decline. The NRC panel[v] concluded that existing data indicated that bottom-up hypotheses resulting in food limitation are unlikely to represent the primary threat to Steller sea lion recovery. Although no hypotheses can be excluded based on existing data, the NRC also concluded that top-down sources of mortality appear to pose the greatest threat to the current population.

The SSL Recovery Plan (2008)[vi] concluded there were probably many factors that contributed to the decline of the SSL but was unable to identify a specific culprit that may be impeding the recovery of the western segment of the population. Three hypotheses were identified by the SSL Recovery Team as "potentially high" threats to the recovery

of the species: 1) nutritional stress caused by adverse impacts environmental variability might have on SSL prey availability, 2) nutritional stress caused by adverse impacts commercial fishing might have on SSL prey availability, and 3) killer whale predation of SSL.

NUTRITIONAL STRESS AND REPRODUCTIVE RATES

Effects on Reproductive Rates. Extensive research efforts have been directed at gaining a better understanding of how decreased nutrient intake influences the physiology of SSL which may impact its survival and reproduction rate. Recent research shows there is now a high survival rate for juvenile and adult animals but concerns remain about whether or not the reproduction rate for SSLs is high enough to fuel a sustained recovery of the species.

Several studies of reproduction rates have come to two very different conclusions. One modeling study (Holmes et.al. 2007) found evidence of declining fecundity in the Central Gulf of Alaska and extrapolated those findings across the WDPS, showing possible continued declines in pup production. Recently published field studies in the neighboring Prince William Sound/Kenai Peninsula region (Maniscalco; Horning 2010[vii]) suggested that reproductive rates are at least as good as prior to the SSL decline. Additional modeling (Boyd in press, 2010[viii]) indicates that current pup productivity is close to the long term mean, and similar for both the WDPS and the Eastern DPS.

The SSL population survey completed in 2009 showed increased pup counts for the WDPS: a fourteen percent (14%) increase from 2000/2001 to 2009.

Nutritional stress caused by environmental variability and effects on SSL prey availability. Many studies have been done on the caloric needs of SSL and how that might be impacted by changing prey availability for SSL. One hypothesis is that the species of fish available to SSL has changed and that the less fatty fish available in recent years do not provide as many calories. Known as the "junk food" hypothesis, this potential cause is grounded in environmental change or "regime shifts" that cause shifts in the dominance of forage species and coincided with SSL population declines. Prey species for SSLs vary considerably in the habitat of the eastern and western segments of the population with fatty fish such as herring more prevalent in the east. Genetic testing of Steller sea lions in the eastern segment of the population located in SE Alaska found that as many as 60% of the animals on one rookery and 40% on another rookery originated from the western segment of the population causing some to speculate that there is an ongoing emigration of the endangered western population moving to the eastern region where the population trend is increasing at a faster pace. The eastern population is at a level such that it meets the SSL recovery criteria for delisting.

COMPETITION WITH FISHERIES

SSL are opportunistic foragers for prey. Studies of their scat identify many food sources that vary by time of year and region including pollock, Pacific cod, Atka mackerel,

salmon, herring, flounder, candlefish and other species. NMFS determined that pollock, cod and Atka mackerel were generally the most important SSL prey in federal waters in the western region. One hypothesis is that a phenomena known as "localized depletion" of fish schools caused by commercial fishing activity make capture of prey by SSL more energetically demanding. Field studies could find no significant evidence that localized depletion occurs but a modeling exercise did not concur with those studies.

Since 2000, commercial fisheries that take SSL prey species have been heavily regulated and fleets prohibited from fishing in most areas where the majority of foraging activity occurs. For example, fishing is heavily restricted in SSL critical habitat within zones ranging from 10 to 20 nautical miles of rookeries and haulouts. Based on those restrictions, NMFS determined in 2001 that commercial fishing did not jeopardize or adversely impact the critical habitat of the Steller sea lion. Recent telemetry data show that greater than seventy five percent (75%) of SSL dives occur within 10-20 nm of the rookery or haulout, suggesting that this habitat is more important for foraging.

KILLER WHALE PREDATION

Killer whales are abundant in Alaska but not all killer whales eat other marine mammals. "Transient killer whales" are the type that eats marine mammals such as sea otters, whales, fur seals and Seller sea lions. Killer whales have been tagged and their caloric needs measured. One study found that SSL predation losses to a single pod of five killer whales could prevent the present SSL population from recovery and that the energy demands of as few as 67 killer whales could account for an estimated loss of about 11,000 SSL per year at the height of the decline. Other studies conclude that SSL are a relatively small part of the killer whales diet and so are having only a minor effect on the recovery of the SSL.

Recent orca population surveys found that there are roughly 350 transient killer whales in the Gulf of Alaska/Aleutian Island region. Scientists estimate that they could account for roughly 40-80% of SSL natural mortality[ix]. A recent study that monitored the mortality of SSL concluded that seven of eight recent electronically monitored mortalities likely represent acute deaths at sea, probably due to predation by killer whales.[x] Most scientists seem to agree that killer whale predation has an increased impact on SSL populations when SSL numbers are smaller.

SUMMARY

Though the science remains inconclusive, Steller sea lions populations are stable or increasing in all regions but the remote western Aleutians where they continue to decline. The question now is, are Steller sea lion numbers recovering fast enough in the western segment of the population and, if not, why not.

[i] NMFS Alaska Region letter of January 22, 2010
[ii] AFSC/NMML Russian Steller Sea Lion Research Update (Jan-Mar 2009)
[iii] NMFS-AFSC Memorandum of February 4, 2009
[iv] NMFS-AFSC Memorandum of December 2, 2009
[v] T*he Decline of the Steller Sea Lion in Alaskan Waters: Untangling Food Webs and Fishing Nets* (National Academy Press, 2003)
[vi] *Recovery Plan for Eastern and Western Distinct Population Segments of Steller Sea lion (Eumetopias jubatus)* (NOAA Office of Protected Resources, March 2008)
http://www.fakr.noaa.gov/protectedresources/stellers/recovery/sslrpfinalrev030408.pdf
[vii] Presentations to Steller Sea Lion Mitigation Committee, Jan 26-28, 2010
http://www.fakr.noaa.gov/npfmc/current_issues/ssl/ssl.htm
[viii] Ian Boyd Presentation to Steller Sea Lion Mitigation Committee, Jan 27, 2010; *The viability of Steller sea lion populations* (In press)
http://www.fakr.noaa.gov/npfmc/current_issues/ssl/JanuarySSL_mtg2010/BoydViability.pdf
[ix] Paul Wade Presentation to Steller Sea Lion Mitigation Committee Jan 26-28, 2010
http://www.fakr.noaa.gov/npfmc/current_issues/ssl/JanuarySSL_mtg2010/WadeKillerwhales.pdf
[x] Markus Horning Presentation to Steller Sea Lion Mitigation Committee, Jan 26-28, 2010
http://www.fakr.noaa.gov/npfmc/current_issues/ssl/JanuarySSL_mtg2010/HorningKillerwhales.pdf