SEA OTTER CONSERVATION WORKSHOP V 2007

SEATTLE AQUARIUM

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Seattle Aquarium - Seattle, Washington

March 16 - 18

SEATTLE AQUARIUM

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Workshop Agenda

Friday March 16

1:30-1:45	Welcome: *John Braden, Seattle Aquarium Director; CJ Casson; Traci Belting; Shawn Larson*
1:45-2:15	Sea otter sedation/anesthesia for captive animals: *Mike Murray*
2:15-2:45	Torsion events in captive sea otters: *Kelly Helmick*
2:45-3:15	Improving the way we wash sea otters: *Dave Jessup*
3:15-3:30	Break
3:30-4:00	Sea otter research in the Commander Islands: *Pam Tuomi*
4:00-4:30	Linking individual behavior and population health: Tracking protozoal pathogen exposure in southern sea otters: *Tim Tinker*
4:30-4:45	Update on the Southern Sea Otter Recovery Implementation Team: *Lilian Carswell*
4:45-5:00	Roundtable discussion: Major veterinary issues: *Kelly Helmick, Pam Tuomi, Dave Jessup, and Mike Murray*
6:30-9:00	Ice breaker on Argosy Cruises, dessert provided with a no host bar. Boat departs Pier 55 at 7 p.m. Returns about 8:45 p.m.

Saturday March 17

9:00-9:30	Keynote: *James Estes*
9:30-9:50	Northern sea otter status: *Angie Doroff*
9:50-10:10	PAH exposure to nearshore vertebrates through 2005 resulting from the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska: *Jim Bodkin and Brenda Ballachey*
10:10-10:30	Evaluating body condition in more than 2,000 sea otters sampled throughout much of the species range over the past 50 years: *Dan Monson*
10:30-10:45	Break
10:45-11:05	Update on Canada's sea otter research: *Linda Nichol*
11:05-11:25	Washington sea otter status: *Steve Jeffries*
11:25-11:45	Washington sea otter stranding: *Deanna Lynch*
11:45-Noon	Captive sea otter permitting issues: *Melanie F. Goddard Brose*
Noon-1:30	Lunch
1:30-1:45	Southern sea otter status: a summary of recent population surveys and strandings: *Brian Hatfield*
1:45-2:05	Predicted sea otter density and distribution based on habitat attributes within Prince William Sound: *Heather Coletti*
2:05-2:25	Update from the Alaska Sea Otter and Steller Sea Lion Commission: *Lianna Jack*

Saturday March 17 (cont.)

2:25-2:35	Sea otter genetics update: *Shawn Larson*
2:35-2:45	Sea otter studbook: *CJ Casson*
2:45-3:00	The latest on permit issues and captive sea otters: *Andy Johnson*
3:00-3:15	Break
3:15-3:35	Update from Russia: *Nadezhda Zimenko*
3:35-3:45	Research on sea otters in 2005-2006: *Sergei Kornev*
3:45-3:55	Marine mammals and coastal fishery on Kuril islands: *Sergei Kornev*
3:55-4:15	Sea otter ecology: *Glenn VanBlaricom*
4:15-4:35	Respiration physiology of diving mammals: *Margot Monti*
4:35-4:55	Preparation for sea otter husbandry at the National Museum of Marine Biology and Aquarium in Taiwan: *Fung-Chi Ko*
4:55-5:15	Monterey Bay Aquarium exhibit otter update: *Christine DeAngelo*
5:15-5:35	SORAC update: *Andy Johnson*
5:35-6:00	Roundtable discussion: Captive sea otter management issues: *Andy Johnson and CJ Casson*
6:30-10:00	Adjourn to reception and dinner in the aquarium exhibit spaces.

Sunday March 18

9:00-9:20	Web-based resource for captive sea otter management: *Andy Johnson*
9:20-9:40	Surrogate rearing program: *Karl Mayer*
9:40-9:55	Oregon Zoo's update: *Karen Rifenbury*
9:55-10:10	Oregon Coast Aquarium's update: *Judy Tuttle*
10:10- 10:25	Minnesota Zoo update: *Melanie Oerter*
10:25-10:40	Break
10:40-10:55	Point Defiance Zoo and Aquarium facility update: *Lisa Triggs*
10:55-11:10	Seattle Aquarium update: *Traci Belting*
11:10-11:25	Educational outreach at the Seattle Aquarium: *Cherie Williams*
11:25-11:40	Rotterdam update: *Dennis Blomjous*
11:40-11:55	Georgia Aquarium update: *Gina Fisher*
11:55-12:05	Shedd Aquarium update: *Lisa Takaki and Maris Muzzy*
12:05-1:30	Lunch
1:30-1:50	Sea otters: Defenders of Wildlife's efforts in conservation, advocacy and education: *Jim Curland*
1:50-2:10	Conservation action for the southern sea otter: *Steve Shimek*

2:10-2:30 Field research at Monterey Bay Aquarium: *Michelle Staedler*

2:30-2:50 Captive sea otter endocrinology: *Shawn Larson and Angela Smith*

2:50-3:10 Workshop summary: Where are we going as a group? *Andy Johnson, CJ Casson, Shawn Larson, Traci Belting, Doug Burn, Angie Doroff, James Bodkin, Daniel Monson and Jim Estes*

3:10 Meeting adjourned

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Sedation and Anesthesia in Captive Sea Otters

Michael J. Murray DVM
Monterey Bay Aquarium

Chemical sedation and anesthesia of the sea otter, particularly those managed within zoos and aquariums, is often approached with a great deal of trepidation. Within the venue of this meeting, an intramuscular protocol combining fentanyl citrate and midazolam followed by reversal with naltrexone is presented. While this protocol seems relatively novel, it is, in fact, based upon the work published by Monson ("Chemical Anesthesia of Northern Sea Otters (*Enhydra lutris*): Results of Past Field Studies", J Zoo Wildlife Med 32(2): 2001, pp 181-189). The difference between the previously published study and this work is that the diazepam is replaced by midazolam.

The use of midazolam provides several significant advantages as a result of its water solubility. Midazolam is more reliably absorbed from an intra-muscular injection site. This results in less muscle rigidity, fewer intra-anesthetic seizures, better respiration, and smoother inductions and recoveries. In addition, in humans there is less pain associated with intra-muscular injection, and there appears to be a post-use amnesia reported. The primary disadvantage to its use is simply one of economics, however, over time; the availability of generic forms of midazolam has significantly reduced expense.

Fentanyl, an opioid analgesic, has approximately 80-times the potency of morphine. It is relatively rapidly absorbed from the intramuscular injection site. It may cause variable degrees of respiratory depression. Fentanyl is classified as a schedule II controlled drug, which therefore requires use of a DEA -222 form to order the drug, which is typically a compounded formulation.

The opioid receptor antagonist, naltrexone, can be used to reverse the effects of fentanyl. It acts as a competitive antagonist, and is rarely associated with re-narcotization of the sea otter.

This presentation reports on the evaluation of fentanyl/midazolam/naltrexone sedation/anesthesia in over 500 events involving sea ot r several hours, typically overnight for morning procedures, although the need to fast these animals is subject to some dispute. The otter can be removed from the exhibit with a dip net, and while contained within the net basket manually restrained for the administration of fentanyl/midazolam intra-muscularly. The otter can then be transferred into an iced holding box for a time period of 8-10 minutes giving the drugs ample time to take effect. Once the appropriate degree of sedation is achieved, the animal can be placed on the examination or surgical table. It is often recommended that supplemental oxygen be supplied via a loosely fitting face mask.

Anesthetic monitoring involves evaluation of several physiologic parameters, body temperature, heart rate, respiratory rate, oxygen saturation, end tidal CO_2, blood pressure, and ECG. Tracheal intubation, when indicated, is generally accomplished with a 4.5-7.0 mm

endotracheal tube. Use of a laryngoscope facilitates the procedure.

Reversal with naltrexone follows the procedure. With the sea otter back in the "box", naltrexone is administered intra-muscularly. In most cases, the first response to the drug occurs within 2 minutes. Within 10 minutes, the sea otter can be returned to the water. In most cases, a small meal can be offered 30 minutes following reversal, and otters are generally returned to exhibit within 2 hours.

Sea Otter Research in the Commander Islands 2004 – 2007

Pam Tuomi
Seward Sealife Center

In the early 1900's, the Commander Islands off the eastern coast of Russia were home to one of only about a dozen remnant sea otter populations. The international treaty banning hunting of sea otters was successful in allowing sea otters populations to recover to near historic levels in many parts of Alaska by the 1980's but the numbers since then have been in severe decline.

Population trends in the Commander Islands have been quite different. Sea otter hunting was banned n the Commander Islands in 1924 when the population was estimated at between 105 and 130 individuals. By 2002, surveys counted 5,583 sea otters on Bering and Medney Islands and numbers appeared stable at or near equilibrium density with an apparent increase in birth rate (percent pup in counts). The region is thus of extreme interest for two reasons. 1) This site lies immediately west of the westernmost distribution of the sea otter decline in southwest Alaska (sea otter numbers at Attu Island, the next island to the east, have declined precipitously). If the geographical extent of the decline should spread west from Attu, studies in the Commander Islands would be of great interest and value in documenting the change. 2) Additionally, the Commander Islands offer what is perhaps the last remaining opportunity in the North Pacific to study the dynamics of a coastal ecosystem with an intact sea otter population. Data on body condition, life history patterns and behavior can be contrasted with comparable data from a variety of other sites where sea otter populations are below equilibrium density or extremely low. This will provide insight into how life history and behavior vary with population status, and how these variables change with cessation of population growth as resources become limiting.

The Alaska SeaLife Center, with assistance from the US Fish and Wildlife Service, US Geological Service, California Department of Fish and Game and the Kamchatka Branch of the Pacific Institute of Geography and others, has conducted studies in the Commander Islands since 2004 using, to the extent possible, the methods used in similar studies on sea otters in Alaska and California. The study included the live capture, sedation, examination and tagging of a total of 58 animals in March of 2004 and 2005 and 32 animals in June of 2006. The summer effort included intra-abdominal implantation of radio-telemetry and archival time depth recorders which will record data for up to 2 years. Follow-up field studies focusing on these tagged animals will continue for 2-3 years (depending on battery life) and will end with recapture and removal of the instruments. Implanted animals will provide data on reproduction, weaning success and adult mortality in addition to foraging and diving behavior. Skiff based surveys will continue to document population levels and resights of all tagged animals will assist in studying animal movements.

Morphometric measurements, blood, urine, whiskers, a premolar tooth, skin and fecal samples were collected from each live captured otter and are being assayed to establish body condition, health parameters, diet, age, exposure to toxins, and parasite loads. Collection of carcasses from natural mortalities has allowed additional morphometric and tissue collections and documented cause of death where possible.

While sample analysis is still underway, preliminary findings indicate that body size is slightly smaller than other northern sea otter populations but hematology and serum chemistries are similar to previously published data. Few serologic tests (other than protozoa) have been validated specifically for sea otters but results of assays to date indicate no titers to calicivirus or to canine and phocine distemper virus; low exposure to toxoplasmosis, sarcocystis and leptospirosis; and moderate exposure to phocine herpes virus and to brucella. The species of parasites identified are similar to those found in other northern sea otters. Acanthocephalid

perforation appeared to be the cause of death in one of the two fresh dead sea otters necropsied. Other gross necropsy findings (13 carcasses) were consistent with inanition, gastrointestinal stress, trauma, and dental wear but many bodies were too decomposed or scavenged to define cause of death. Tissue samples from these animals have been archived for future toxicological and histopathological examination.

Linking Individual Behavior and Population Health: Tracking Protozoal Pathogen Exposure in Southern Sea Otters

M. Tim Tinker[1], Chris Kreuder-Johnson[2], P. Conrad[2], M. Staedler[3], D. Jessup[4], J. Estes[5], M. Miller[4], and J. Mazet[2]

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Understanding factors that increase the risk of pathogen exposure in sea otters may have broad implications for overall ecosystem health and are likely to improve our understanding of the processes that promote disease in marine mammal populations. Linking individual animal behavior to disease risk in a wildlife population requires a large multidisciplinary research effort. As part of an ongoing collaborative program led by CDFG, USGS, and UC to monitor the recovery of sea otters, 155 otters were captured and radio-tagged. All otters were closely monitored over a 2-3 year period for movement, observation of prey preferences, feeding strategies, and behavior. Individual variation in prey selection was observed with each animal displaying specialization in preferred prey and micro-habitat use patterns. In addition, age- and sex-specific differences were detected in home range size and annual movement patterns. This cohort of intensely monitored sea otters provided an unusual opportunity to evaluate associations between individual animal behavior and pathogen exposure as determined at initial capture and subsequent recaptures. All otters underwent basic health screening at the time of capture and recapture. Blood samples collected at each capture were used to screen otters for exposure to protozoal pathogens, Toxoplasma gondii and Sarcocystis neurona that are known to be important causes of mortality in this population. Multivariate logistic regression techniques were used to measure associations between pathogen exposure and individual animal movement, home range location, micro-habitat use, and diet. Spatial analysis was used to identify clusters of pathogen exposure within sea otter habitat. Specific prey preferences and habitat use patterns significantly increased the risk of exposure to both T. gondii and S. neurona. Our results may be used to elucidate mechanisms promoting pathogen exposure in this ecosystem and inform coastal management conservation efforts for this protected species

Sea Otters And Coastal Marine Ecosystems In California: Research And Conservation

James A. Estes
U.S Geological Survey and University of California

After nearly a century of slow recovery from the ravages of the Pacific maritime fur trade, population growth in the California sea otter has stalled. Elevated mortality is almost unequivocally the responsible demographic process. To date, most of what is known about the causes and rates of mortality in California sea otters has been based on necropsies of stranded carcasses. These analyses have identified numerous causes of mortality, about 40 percent of which can be attributed to parasites and diseases. While life stage simulation analyses indicate that emaciation and infectious disease are the most important known sources of mortality, this conclusion is subject to considerable uncertainty because of difficulties in distinguishing between ultimate vs. proximate causes of mortality, and because of the high proportion of stranded carcasses (about 70%) for which cause of death cannot be undetermined. Longitudinal studies of living animals as they transition from life to death are needed to provide an independent and potentially less biased view of mortality. Our ongoing studies of the living population and its environment are beginning to indicate that food resource limitation is an important surrogate for exposure and susceptibility to disease. Food limitation apparently leads to extreme inter-individual variation in diet and foraging behavior, in turn potentially exposing animals with different prey preferences to different diseases. The overall analysis of data from living and dead animals indicates that survival rates decline from south to north across the California sea otter's range, and that survival rates have declined significantly during the past two decades.

PAH Exposure to Nearshore Vertebrates in Prince William Sound and Pathways of Exposure to Sea Otters

J.L. Bodkin and B.E. Ballachey
Alaska Science Center, US Geological Survey

Since 1996 the cytochrome P4501A biomarker of polycyclic aromatic hydrocarbons (PAH) has been used to compare potential exposure of birds, mammals, and fish to oil persisting in nearshore habitats from the 1989 *Exxon Valdez* oil spill. Species samples through 2003 include the harlequin duck, Barrow's goldeneye, pigeon guillemot, river otter, sea otter, masked greenling, and crescent gunnel, all occupants of nearshore marine habitats. Significantly higher biomarker values were obtained from oiled areas for each species over the period 1996-2003. A meta-analysis including all species and years was run to test standardized differences of P450 values between oiled and unoiled areas. The mean difference was significantly greater than zero ($p<0.0001$). Between 2002 and 2004 we instrumented sea otters with VHF radio transmitters and time-depth-recorders (TDRs') in an area heavily oiled in 1989 to evaluate potential pathways of exposure to oil. Home ranges based on telemetry locations of most sea otters included one or more known lingering oil locations, but these data did not demonstrate intertidal foraging. TDR data demonstrate that intertidal areas are used extensively by foraging sea otters and that use varies among individuals and seasons. Overall, females allocate about 17% and males 6% of their foraging dives to the intertidal, and most intertidal foraging occurs in the -1 to +1 m tidal elevation. Nearly all instrumented animals (n=13) increased their intertidal foraging during spring months, and the mean proportion of intertidal foraging doubled to 28% in spring. The sampling of biomarkers of contaminants should consider spatial and temporal (both annual and seasonal) variation in potential exposure resulting from species life histories.

Update on some research on Canada's sea otters

Linda Nichol
Fisheries and Oceans Canada, Pacific Biological Station

Sea otters occur along the west coast of Vancouver Island and in a small area on the central B.C. coast. By 2004 the population along Vancouver Island ranged from Clayoquot Sound northward to Cape Scott and eastward to Hope Island in Queen Charlotte Strait. On the central B.C. coast the population occupies an area extending from the Goose Island Group northward at least to the edge of Milbanke Sound. A minimum population estimate from counts from 2001 to 2004 is of 3,185 sea otters most of which (~ 2,700) occur along the west coast of Vancouver Island. The central B.C. coast otters appear to be descendents of the reintroduced otters. The presence of sea otters there was first reported in 1989. The occurrence of sea otters on the central B.C. coast is likely a result of early movements of re-introduced otters rather than natural range expansion. Growth on Vancouver Island averaged 18.6% per year between 1977 and 1995, but averaged 15.6% per year from 1977 to 2004 indicating growth slowed after 1995. On the central B.C. coast, growth averaged 12.4% per year between 1990 and 2004. Since 1996 sea otters have been listed as Threatened in Canada. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is reviewing a new assessment completed in 2006 and an assessment recommendation is pending.

Recent estimates of habitat carrying capacity for sea otters in British Columbia have been made to estimate the theoretical carrying capacity population size in presently occupied as well as, as yet, unoccupied habitat (habitat into which the population may expand). Spatial physical models of optimal sea otter habitat were developed based on shoreline and bathymetric complexity, to capture the physical characteristics of the rugged exposed habitat that sea otters presently occupy in B.C. The models and otter density at equilibrium were estimated from Checleset Bay and Kyuquot Sound, on Vancouver Island, areas in which sea otter density appears to have been at equilibrium since the mid 1990s. The results of these models are presented and discussed along with inferences about historical otter abundance and distribution that can be drawn from accounts from the maritime fur trade (mid 1700s to mid 1800s).

Status and Trends of Washington's Sea Otter Population: Results of the 2006 Annual Survey

Steven Jeffries and Ron Jameson
Washington Department of Fish and Wildlife

After being extirpated in the early 1900's, Washington's sea otter population was re-established following translocation of 59 animals from Amchitka Island, Alaska in 1969 and 1970. Washington's sea otters are protected under the Marine Mammal Protection Act, as well as being listed as a "state endangered" species due to their small population size, limited geographic distribution and potential threats i.e., oil spills. Sea otters are currently distributed from Pillar Point in the Strait of Juan de Fuca to Destruction Island on the outer Washington coast. Surveys to determine population status and trends are typically conducted annually during the first part of July. In 2006, the survey occurred between July 11-13, and involved individuals from the Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Olympic Coast National Marine Sanctuary, The Seattle Aquarium and Point Defiance Zoo and Aquarium. All of the sea otter range in Washington was surveyed from a fixed-winged aircraft (Cessna 185) flying between 600' to 800' at 100 knots. The aerial survey was conducted south to north and covered nearshore waters from Point Grenville on the outer coast to Tongue Point in the Strait of Juan de Fuca. Ground observers made simultaneous counts at sites near Cape Johnson, Sand Point, Cape Alava, Duk Point, and inshore of Father and Son Rocks. In 2006, we completed five surveys of the sea otter's range in Washington. Survey totals were calculated by summing the highest daily total for the southern (Pt Grenville to La Push) and northern (La Push to Pillar Point) survey segments. The high count this year was on 13 July for both segments of the range and was 790 otters. Survey results indicate growth of the Washington sea otter population continues to remain positive overall with a finite annual rate of increase of 8% since 1989. North of La Push sea otter numbers appear to be nearing equilibrium while south of La Push sea otter numbers have continued to grow at about 20% per year since 1989. The distribution of Washington's sea otter population has continued to change in recent years with the larger proportion of the population now occurring south of La Push. In 2002, the southern segment accounted for about the same proportion of the total population as the northern, 49 and 51 percent respectively; and this year the shift was even more dramatic with 39% north of La Push and 61% south of La Push. This year 27 pups were counted during the high counts and were present in groups at Destruction Island, Diamond Rock, inshore from Perkins Reef (Rocks 443), Goodman Creek, Giants Graveyard, Cedar Creek, Yellowbanks, Sand Point, Cape Alava, off the Ozette River, and inshore of Father and Son. The pup to independent ratio in 2006 was only 4:100. Future range expansion of Washington's sea otter population is likely, however when and where they will go remains unknown. Potential threats to this population include oil spills and fishery interactions.

Captive Sea Otter Permitting Issues

Melanie Brose
USFWS-DMA

The Mission of the U.S. Fish & Wildlife Service - Division of Management Authority (DMA) is to implement domestic laws of the U.S. and international treaties to promote long-term conservation of global wildlife. One of DMA's primary objectives is to use permits to authorize and monitor activities consistent with conservation, protection, and enhancement of protected wildlife populations. All sea otters are protected by the U.S. Marine Mammal Protection Act (MMPA) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Some sea otter populations are also protected under the U.S. Endangered Species Act (ESA). The requirements to perform activities with sea otters vary greatly depending on the type of activity, the conservation status of the species/population, and the purview of the law(s) and/or treaty governing the species/population.

Southern Sea otter Status: A Summary of Recent Population Surveys and Strandings

Brian B. Hatfield
USGS-BRD-Western Ecological Research Center

The southern sea otter population has been counted each spring and fall using the same methods since 1983. Using a three year running average of the spring surveys, the population has recently been growing, following the decline of the mid- to late 1990s. The last two spring surveys (2005 = 2,735; 2006 = 2,692) have not been as high as the 2004 count (2,825) and the positive growth curve is flattening. If the spring 2007 count is not as high as the 2004 count the trend will turn negative once again. The number of beach-cast sea otter carcasses and live strandings in California continues at an elevated rate, with the combined number averaging 270 sea otters/ year over the last four years, and the per capita strandings at 10% of the spring count over the same time period. This high rate of stranding may be due, in part, to more otters inhabiting areas where, upon death, their carcasses are more likely to strand, be reported, and recovered. Disease continues to be high source of mortality. In addition, white shark-bitten sea otters have been recovered at a relatively elevated rate since 1998, with an average of 15% of strandings having been attacked during this period. Since 2003 there has been a higher proportion of shark-bitten sea otters at the southern end of the range. White sharks are likely slowing range expansion not only at the north end of the range but at the south end as well. All participants in California sea otter surveys, carcass recovery, and necropsy efforts (primarily members of USGS, CA Dept. of Fish and Game, and Monterey Bay Aquarium) are acknowledged.

Predicted Sea Otter Density Based On Habitat Attributes In Prince William Sound, Alaska

Heather A. Coletti
USGS Alaska Science Center

As a benthic foraging marine mammal, sea otters (Enhydra lutris) present a unique opportunity for developing a habitat based density model using GIS because of the sea otter's well defined habitat requirements. Previous predictive models of sea otter density have been constructed, however these models have excluded offshore habitat.

Seven aerial surveys, that included offshore habitats, were conducted between 1995 and 2005 in western Prince William Sound to estimate distribution and abundance of sea otters (Enhydra lutris). The location and densities of sea otters that resulted from these surveys were used to explore relationships between sea otters and habitat attributes, both nearshore and offshore. These relationships described in western Prince William Sound were then used to construct habitat based models to predict sea otter carrying capacity and total abundance at different spatial scales. The resulting predictive density model was based on five habitat attributes; bathymetry, distance to the closest shoreline, distance to the closest protected shoreline, distance to the closest tidewater glacier and distance to the closest anadromous stream. The mean predictive density estimate was 2.0316/ km2 with a total corrected population estimate within the survey boundaries of 16,441, with a range of 14,468 to 18,803 (alpha = 0.05).

Special attention was given to northern Knight Island, an area heavily impacted by the Exxon Valdez oil spill in 1989. Predicted densities within that area were 1.5792/km2 with an estimated abundance of 384. The actual mean abundance estimate at northern Knight Island between 1995 and 2005 was 68 with a range of 34 to 102 (alpha = 0.05), illustrating a discrepancy between predicted estimates and actual survey abundance estimates.

The analysis and results presented in this work give insight into the density and distribution variation of sea otters within Prince William Sound as well as contribute to the understanding of the sea otter's use of its nearshore habitat. The model will be tested and refined in other areas where sea otter aerial survey data has been collected (i.e. Kodiak Island, the Kenai Peninsula, and Glacier Bay National Park). The final model may be utilized to predict sea otter abundance and density in areas such as the Aleutian Archipelago where little pre-decline data exists.

Update from the Alaska Sea Otter and Steller Sea Lion Commission

Lianna Jack, Executive Director - Emily Fruzza, Communications Coordinator

"Our job isn't done until we've taught our children not only what our parents and grandparents taught us, but also what we've managed to learn along the way. The world is always changing. Sometimes our culture even changes with it. But our values, our basic traditional values, will always remain the same. Always."

- Gary Kompkoff, Village Chief, Native Village of Tatitlek

The Alaska Sea Otter and Steller Sea Lion Commission (TASSC) is a tribal consortium and was established in 1988 to promote Alaska Native involvement in policy decisions pertaining to sea otters and Steller sea lions. Since formation, TASSC has worked with coastal Alaska Native peoples and communities to further conservation, local management and local research for marine mammals. TASSC is comprised of twelve representatives from six coastal Alaska ANCSA-based regions, ranging from Southeast to the Aleutians. Each TASSC Commissioner has been appointed by his/her region to represent Alaska Natives and member tribes. Our mission is to ensure and further Alaska Natives' role in sea otter and Steller sea lion conservation, management, research, education, and artistic development. Our goals are to 1) Promote Alaska Native participation in sea otter/Steller sea lion conservation, management and artistic efforts; 2) Assess the health and condition of sea otters/Steller sea lions in Alaska through biological data and tissue collection; 3) Work with regulatory agencies toward the common goal of enhancing and protecting healthy sea otter/Steller sea lion populations; 4) Educate and inform the public on the traditional and contemporary relationship between the sea otter/Steller sea lion and Alaska Natives, and; 5) Encourage the efforts of Alaska Native artists and hunters and their historical, present and future practices.

The Marine Mammal Protection Act of 1972 (MMPA) and the Endangered Species Act of 1973 (ESA) provides Alaska Native exemptions for the non-wasteful harvest of marine mammals for subsistence. In 1994, the MMPA was amended and included Section 119 which provides a formal mechanism for Alaska Native Organizations to work with the federal government on co-management of the subsistence uses of marine mammals.

Alaska Natives have a longstanding relationship with the environment. As the original conservators, they have traditionally managed their environment and provided stewardship of the land. For generations, Alaska Natives have used sea otter for subsistence purposes which include clothing, regalia, bedding, to demonstrate status, and as currency/trade items. Today, use of sea otters for subsistence purposes continues and is vitally important to Alaska Natives. By sharing and maintaining these traditions and culture and passing the knowledge on to future generations, family and community is strengthened and community health is enhanced. Equally important to Alaska Native communities and tribes is the proper management of fish and wildlife resources in traditional use areas. Pro-active harvest management and management planning is necessary for the desired balance between sea otters and other subsistence resources, such as clams.

Throughout TASSC's years of working with tribes and Alaska Native communities, several priorities have been expressed to TASSC in the areas of management plans and research.

Management plan priorities include:

- Management plans should be based on best available information (science and traditional and ecological knowledge (TEK)),
- Management objectives need to be balanced between multiple uses and be consistent with existing laws/ regulations, and
- Pro-active harvest management through planning and partnerships is desired.

Research priorities include:

- Accurate population information for sound decisions and a desire to contribute to the research process,
- Boat and aerial surveys: locally collected information, community buy-in, ownership,
- Co-develop research priorities,
- Build TEK into study design (disparities exist between science/research and TEK),
- Integrate outreach into the research plan and use laymen's terms,
- Build local capacity, train/incorporate community technicians,
- Increase communication about tagged or marked animals (it is legal for Alaska Natives to harvest those animals), and
- Research should not interfere with the subsistence season (there should be local consultation before conducting research).

Through Through a co-management agreement with the U.S. Fish and Wildlife Service with Section 119 funding, TASSC has/is implementing the following sea otter research programs and projects: Sea Otter Biosampling Program (tissue and data sampling from animals taken for subsistence or found on the beach); Sea Otter Winter Mortality Surveys (systematic beach survey for sea otters that die over winter; age and sex structure); Sea Otter Small Boat Survey/Population Assessment (assess sea otter population trend and distribution around specific communities (skiff and aerial based)); Local and Traditional Knowledge of Sea Otters (interviews conducted with elders and local experts in three Alaska Communities); Southeast Local Knowledge Survey; Community Based Real-Time Monitoring of Sea Otter (documentation of real-time observations of sea otters, their predators, prey, and other interactions); Sea Otter Management Planning (regional, local and sub-regional; promotes responsible management of sea otter populations with shared jurisdictional areas); Request for Proposals/TASSC Tribal Projects; Commission Co-management; Local & Regional Sea Otter Management Initiatives; and Communication and Outreach (clear, consistent outreach with increased dialogue between federal agencies, Alaska Native organizations, and the general public; educate the public and Alaska Natives on laws and regulations and subsistence relationship).

Sea Otter Population Genetics Update

Shawn Larson
Seattle Aquarium

The Seattle Aquarium has engaging in sea otter population genetics research for the past 7 years. Our focus is on pre-fur trade diversity and genetic relationships to compare and contrast the diversity and phylogenetic relationships between ancestral and contemporary sea otters. We measured genetic diversity and geneflow within sea otter populations using five microsatellites and the control region of the mtDNA D-loop. We sampled five extant populations (California, Washington, Southeast Alaska, Prince William Sound and Amchitka) and six pre-fur trade sea otter populations (California, Oregon, Washington, Alaska, Russia and Japan). The pre-fur trade populations samples were primarily from sea otter bone fragments found in Indian midden remains ranging in age from 150-400 years ago. Sample sizes for modern and ancestral are equivalent (between 30-40) except for those from the ancestral populations from Oregon, Russia and Japan. Thus we compared the modern to the ancestral sea otter populations using only the ancestral populations from California, Washington and Alaska.

Initial population genetics results were as follows: Average genetic diversity (expected heterozygosity) within extant, modern sea otter populations was 47% while it was 88% for the pre-fur trade populations. The pre fur trade sea otters had approximately 5 times the number of alleles or unique genetic variation within all measured markers. Genetic distance comparisons among populations of both modern and ancestral sea otters suggest that California has always been unique as it is most widely separated by genetic distance within both modern and ancestral populations. The percent of genetic information separating modern populations ranged 2%-26%, with the closet geographic populations being the most similar and California being the most unique. Pre-fur trade comparisons revealed that there were fewer differences among all populations when compared to modern populations with a range of 0%-18% unique allelic variation. The most significant differences found were the comparisons of the northern populations to California as well as the comparison between Oregon and Washington where the split between Northern and Southern sea otters may have

been before fur trade extirpation.

The most significant finding thus far when the ancestral populations are compared to modern sea otters is the huge loss of genetic diversity within the modern populations. Sea otters may now be suffering from fitness related losses due to this loss of genetic diversity and potential fixing of deleterious alleles. More research needs to be done to measure individual fitness variables such as individual growth (ability to compete), levels of disease, stress and fecundity (viability). We are continuing to sample more pre-fur trade populations and are slowly filling in pieces of the puzzle to determine what sea otter populations were like historically.

Sea Otter Studbook
March 2007
C.J. Casson, Seattle Aquarium

NORTHERN SEA OTTERS (*kenyoni*)

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Oregon Coast Aquarium **2.0**
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Point Defiance Zoo & Aquarium **0.2**
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Lisa Triggs – (253) 404-3671 Ltriggs@pdza.org

The John G. Shedd Aquarium **1.4**
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The Seattle Aquarium **3.3**
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The Vancouver Marine Science Center **2.2**
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Vancouver, B.C.
Canada V6B3X8
Contact person:
Marcie Tarvid – (604) 685-3364 tarvidm@vanaqua.org

Total **9.12**

TOTAL # NORTHERN SEA OTTERS **21**

SOUTHERN SEA OTTERS (*nereis*)

Aquarium of the Americas **1.1**
1 Canal St.
New Orleans, LA 70130
Contact person:
Michele Kelley (504) 378-2672 mkelley@audubonius tute.org

Aquarium of the Pacific in Long Beach **1.2**
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Total **13.15**

TOTAL # SOUTHERN SEA OTTERS **28**

TOTAL NUMBER OF SEA OTTERS (*Northern and Southern*) **49**

NUMBER OF N. AMERICAN FACILITIES EXHIBITING SOUTHERN Sps. **9**

NUMBER OF N. AMERICAN FACILITIES EXHIBITING NORTHERN Sps. **6**

TOTAL NUMBER OF N. AMERICAN FACILITIES EXHIBITING SEA OTTERS. **13**

NUMBER OF N. AMERICAN FACILITES THAT ARE CURRENTLY BUILDING OR ARE PLANNING SEA OTTER EXHIBITS. **2**

Some aspects of population structure of the northern sea otter (*Enhydra lutris lutris*) on the Commander Islands

Nadezhda Zimenko
All Russian Scientific Research Institute of Fisheries and Oceanography (VNIRO)

In the XVIII-XIX centuries, sea otters in the Commander Islands, just like all other sea otter populations at this time, were subjected to strong exploitation. There were two periods of sea otters harvest in the Commander islands (Fig. 1). According to I.I. Barabash-Nikiforov, in 1742-1748, sea otters were harvested only on Bering Island. In 1754, about 800 sea otters were also harvested on Medny Island. Then for a long period there were not enough sea otters to continue the harvest. In the second period, sea otters were harvested on Medny Island.

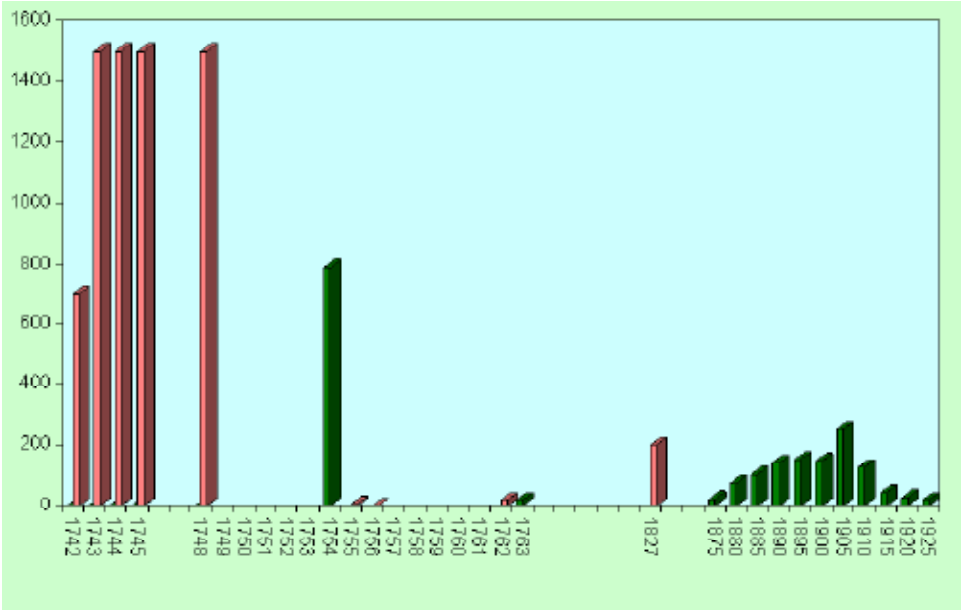

Fig. 1. Harvest of sea otters in the Commander Islands (according to Barabash-Nikiforov, 1947)

As a result of the harvesting, the population was strongly depleted, and at the beginning of the XX century, only some tens of animals remained on Medny Island. Because of protection acts after 1912, the population began to recover, but untill 1970 sea otters inhabited only Medny Island. In 1970, sea otters appeared on Bering Island too, and from 1970 to 1988 their abundance there was steadily increasing as a result of the growth of the Bering Sea otters group as well as of the continuous migrations of sea otters from Medny Island. The recovery of the sea otter population in the Commander Islands continued until 1985. Than the growth of the population stopped, and in 1988-1990, the abundance stabilized on the highest level — about 3500-3880 individuals on both islands. After 1990 the population began to decline.

In the 1988-1995 the mean linear density of sea otters along 30.2% of coastline of Medny Island was 3.4-5.0 individuals; along 41.3% of coastline – 10.4-12.9 individuals. Mean linear densities around southeast and the northern-west capes (where non-breeding animals formed large groups) were 56.4 and 15.1 individuals.

In 1988-1993, on Bering Island the mean linear density of sea otters along 37.3% of coastline was 0.4-4.0 individuals; along 49.4% of coastline – 4.0-9.1 individuals. Mean linear densities around northern-west, northern and near the south of the island capes (where non-breeding sea otters formed large groups) were 58.9, 28.2 and 14.3 individuals.

The total area of shallow waters along Bering Island coastline is two times larger than that on Medny Island. But in 1988-1995, the linear density of sea otters on Bering Island was less than on Medny Island. This phenomenon may be explained from the point of the protective qualities of habitat. On Bering Island the majority of bays are too open, and there are too little reefs and other places where sea otters could refuge. The shoreline is easily accessible for people, polar foxes and transport. Therefore sea otters on Bering Island may be under stress. On the contrary, on Medny Island there are more reefs and places where sea otter could feel safe. In addition, coastal waters of the Medny Island seem more convenient for sea otter foraging (first of all for females with pups).

Since 1985, sea otters inhabited all coastal waters of both islands. Females with pups are observed in all area of the range, with the exception of the large groups of animals resided near the capes of the islands that consist of non-breeding animals only (Fig. 2). Both females and males migrate between islands, and the rate of migrants may reach up to 20% of the population. Since these migrants contribute to the population abundance on both islands, sea otter populations on Medny and Bering Islands form one cohesive population.

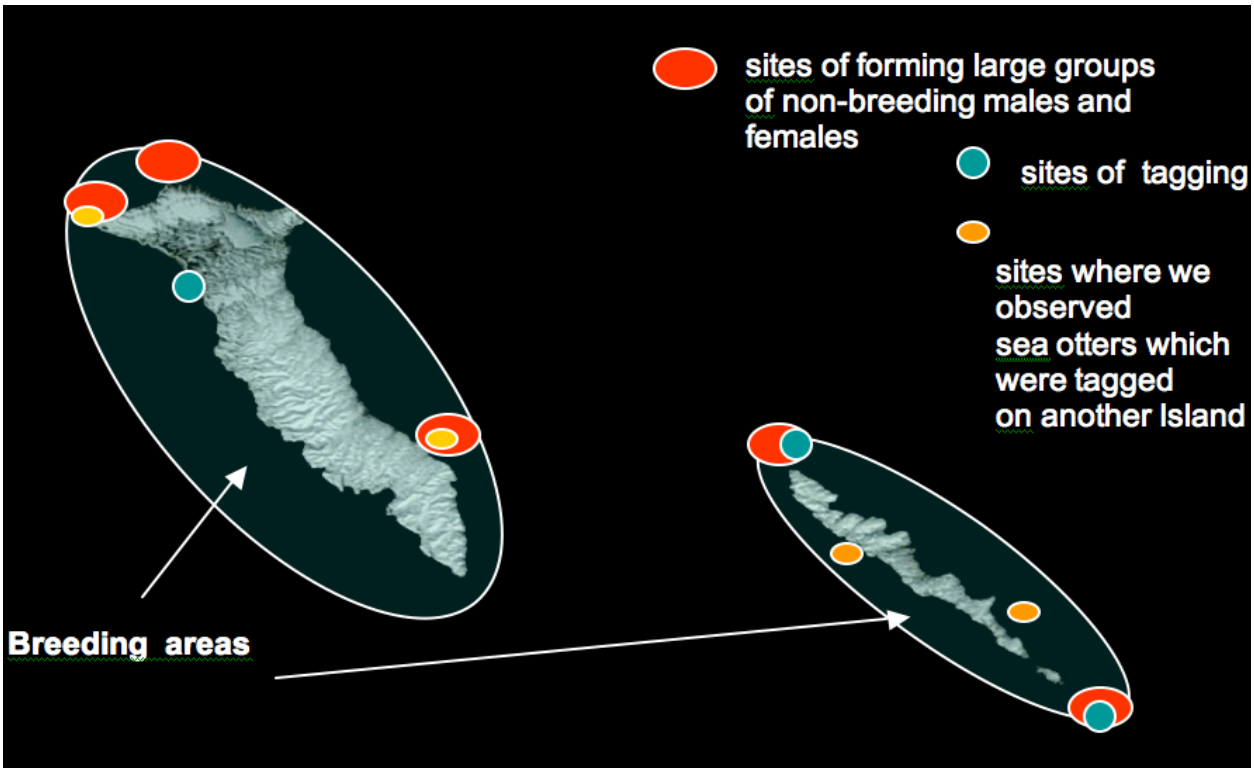

Fig. 2. The distribution of breeding sea otters, large groups of non-breading sea otters and places where tagged sea otters were observed in 1986-1997.

Acknowledge: All the studies were performed with the assistance of many scientists, volunteers and consultants.

Estimate of northern sea otter (Enhydra lutris lutris) status based on population density and nutrition criteria

Kornev S.I
Lab Marine Mammals, Kamchatka Research Institute of Fisheries & Oceanography (KamchatNIRO), Petropavlovsk-Kamchatsky, Russia

Estimation of sea otter status requires reliable and easily obtainable criteria. In the areas, where stable populations of sea otter exist for a long period of time, it is possible to speak about natural equilibrium, when further increase of sea otter abundance is limited by food and habitat availability, as well as other factors, and depends on population density. Such populations exist on the Commander Islands (Bering and Medny Islands) and Urup Island (South Kuril Islands) (Sevostianov and Burdin, 1987; Zorin, 1984).

When considering density as a factor in population change, it is important to take into account carrying capacity of habitat that is determined by food and habitat availability (including availability of cover). This dictates the need to determine sea otter habitat boundaries and select some criteria for nutritional resources evaluation. Sea otter habitat and its foraging range (which as a rule is viewed as the isobat of 50 meters) generally correspond. However, it is important to keep in mind that some individuals (adults males) forage deeper than 50 meters, and that females and young animals prefer to not go deeper than 20 meters (Sheetikov et al., 1973; Bodkin et al. 1997). Usually, sea otter population density is calculated as the numbers of sea otters per 1 km of coastal line. However, more reliable criterion would be the numbers of sea otters per 1 km^2 of foraging area, up to the isobat of 50 meters, because the abundance of food resources for sea otter depends on the area of shallow water, which sometimes exists far-off from the coast.

Among other important characteristics of sea otter habitat are the area of kelp forests, sizes and bio-mass of main types of prey as well as their role in the sea otter nutrition, hydro-meteorological conditions, protective qualities of habitat etc. (Estes et al., 1978, 2003;Sheetikov, 1971 and others). In this presentation, we discuss only some of the above-mentioned criteria.

We calculated equilibrium density and current level of occupancy of habitat for each island on the Kurils and Commander Islands and on Kamchatka using mean indices of population density for Medny Island and percentage of habitat occupancy. Habitat occupancy (or habitat exploitation index%) was calculated as current density of sea otter divided by the equilibrium density and then converted into percentage.

North Kuril Islands (Shumshu, Paramushir)

In 2003, sea otter abundance on Paramushir and Shumshu Islands seemed to reach historical maximum and was more than 15 thousands animals. But 2006 survey conducted on Paramushir and Shumshu Islands gave only 6400 adults and 265 pups – 57.7% decrease.

It is possible that after reaching maximum in 2003, the population started to decrease due to self-regulation and stabilization at the density close to the equilibrium state (about 3.4 individuals per 1 km^2). In 2005-2006, population density for the two islands dropped to 2.5-2.1 individuals per 1 km^2. The next possible cause of the observed decline is poaching, but it is very difficult to evaluate its impact at this point. Fishing may influence the sea otter populations too, but we doubt its significance since it occurs mainly far from shore and over great depth.

Commander Islands

In 2005-2006, on the Commander Islands there was the highest population density in the last 40 years, which was above the optimal density (on Medny Island it was 1.5 times higher than equilibrium density). If our assumptions are correct, we should expect decrease of the abundance in the nearest future.

South and Central Kuril Islands and Kamchatka Peninsula.

The pattern of sea otter distribution suggests that on the big islands the sea otter abundance and population density are usually higher than on the small islands. On the most of the central Kurils, where small islands are situated, sea otter abundance and population density are low, and protective quality of habitat is poor. There are however excellent nutritional resources, which is indicated by large sizes of sea urchins. There, protective quality of habitat is the main limiting factor of sea otter expansion to Kamchatka's north and to the Central and South Kurils.

Sea otter habitat evaluation

Habitat occupancy index is a parameter, which reflects the present usage of habitat by sea otter and therefore indicates how current sea otter abundance differs from the equilibrium abundance and how it can change in the future.

Habitat occupancy for sea otter practically everywhere in the Russian part of sea otter area is low, except of in the Commander islands, on Shumshu and Urup Islands. The total occupancy of the Russian area is only 56%.

Basing on our own and published data, we selected some trophic criteria for evaluation of sea otter status. The most important of those criteria are bio-mass and sizes of sea urchins, the principal prey for sea otter, and changes in sea otter forage content. As our data indicate, in the areas with high sea otter abundance (Islands: Urup, Paramushir, Shumshu, Commander; north cape of Kamchatka Peninsula) the average diameter of sea urchins is small - 30 mm (Kornev, Korneva, 2006), which indicated both the depleted state of the sea urchin population and the certain degree of stabilization of the sea otter population.

In our opinion, the recent exhaustion of the sea otter nutritional resources in the Commander Islands correlates with the increase of consumption of such secondary types of prey as common sand dollar (Echinarachnius parma- 44%), chitons (25%), and gastropods (29%).

There weren't any changes in sea otter forage content on Medny and Bering Islands in the past 3 years, and on Paramushir and Shumshu Islands in the past 6 years. According to divers' surveys in 2006, on Paramushir Island sea urchins and mollusks are scarce up to the depth of 15 meters. The sizes of sea urchins did not exceed 30-35 mm, and the lengths of the mussels were about 40 mm. In small amounts there were observed also some small hermit crabs, other crabs, and northern oysters. Fish (lincod, sole, halibut) was abundant only on the south end of the island.

In conclusion, when sea otter population density reaches optimal numbers, the sizes of prey species, such as sea urchins, decrease. Thus, in the areas with long history of high sea otter abundance (The Commander islands, Urup islands, the North Kuril Islands, South of Kamchatka) sea urchins Strongylocentrotus remain small (30-35 mm) for many years. On the contrary, in the areas with low sea otter density (Central and South Kurils) large-sized sea urchins are present. At the same time, as nutritional resources get exhausted, sea otter forage content becomes more diverse with more prey species. Versatility of the sea otter as a predator, its high adaptability, and its ability to switch prey, when it becomes scarce, ensure survival of the species in case of changes in benthic environment.

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Dive Response And Corresponding End-tidal Carbon Dioxide Levels In Anesthetized Diving Mammals

Margot Monti, BS, LVT
Oregon Zoo

In diving mammals under anesthesia at 100 percent oxygen delivery, it is often noted that end-tidal CO2 levels run significantly higher (60-90 mm Hg) than what is seen normally in wholly terrestrial species (40mm Hg). The use of intermittent positive pressure ventilation (IPPV) to reduce these levels to "normal" can induce respiratory alkalosis from hyperventilation which can lead to cardiac arrest. A case summary of diving marine mammals— focusing on but not limited to southern sea otter (Enhydra lutris), North American river otter (Lontra canadensis) and California Sea Lion (Zalophus californianus) under anesthesia from several institutions was prepared and a literature search into the physiology of CO2 metabolism and dive response was conducted. It was found that these animals reflexively initiate a dive response under the stress of anesthesia, which results in anaerobic metabolism in the peripheral tissues. This, combined with a natural tolerance for high CO2 levels and further decreased CO2 sensitivities from certain general anesthetic agents such as medetomidine, can complicate what otherwise would be a routine anesthesia. Often, maintaining an anesthetized diving mammal at CO2 levels in the 50-60mm Hg range results in the fewest complications for the animal.

Oregon Zoo Facility Update - 2007

Karen Rifenbury, Sea Otter Lead
Oregon Zoo

The Oregon Zoo's sea otter program was very busy over the last two years (2005 and 2006). This presentation will highlight the endeavors of the Marine Life staff as they faced changes to their collection, participation in ongoing research and medical challenges.

- Changes:
  After housing 2.1 southern sea otters for nearly 5 years, the transport of Oz late in 2005 to the Georgia Aquarium presented keepers with different opportunities for training, enrichment and the use of the exhibit and holding space, including training Eddie for a voluntary dental x-ray.
- The opportunity to participate in a research study:
  In December 2005 both Thelma and Eddie were implanted with Deslorelin for birth control. In order to monitor Thelma's hormone levels, staff contacted Dr. Shawn Larson in the hope of participating in her fecal assay research. Thelma was trained to give voluntary samples that were collected and periodically sent to Dr. Larson for analysis. Staff is now in the process of training Eddie to give voluntary fecal samples to check the impact of Deslorelin on males.
- Medical challenges:
  In December 2005 during two anesthesia exams Thelma went into cardiac arrest. These two incidences created a research paper opportunity on CO2 levels in diving mammals for Margot Monti, one of the zoo's veterinary technicians.

In August 2006 the Marine Life and Veterinary staff were again placed into health care crisis mode when Thelma presented symptoms of declining motor skills and labored breathing. The staff initially felt she was exhibiting the same signs as she did in 2004 when she became impacted and required surgery. After x-rays revealed no signs of blockage, Thelma was placed in a quarantine area for observation. Over the course of three days her health deteriorated so veterinary staff felt it was prudent to take her to OHSU for further testing. During a CT scan and MRI it was found that she had pneumothorax of her left lung. The chest cavity pressure was balanced but the lung could not sustain inflation. After several days of trying to keep the lung inflated without success, Thelma was taken to the Northwest Veterinary Specialists where Dr. Donna Lee Taylor did surgery to try to make repairs to the lung. It was decided that the lung was in such poor condition that Thelma's best chance of survival would be to remove it completely. After going through a 4 hour surgery, Thelma has responded positively to treatment. She returned to Steller Cove in early September and continues to build her strength and diving capabilities. The staff hopes to re-unite Eddie and Thelma in early 2007.

Oregon Coast Aquarium - 2007 Update

Judy Tuttle, Curator Marine Mammals

Oregon Coast Aquarium has a large outdoor sea otter exhibit, consisting of a main exhibit pool and an off exhibit holding pool. The exhibit dimensions are approximately 100 feet by 65 feet. The main exhibit pool holds 65,000 gallons of filtered natural sea water. The filtration rate is 1800 gallons per minute. There is a 7,000 gallon connected holding pool which is off exhibit. The sea otters own a varied and large supply of toys which are offered on a rotating schedule. They have become less interested in toys as they have matured.

The Aquarium currently holds four sea otters, two northern sea otters and two southern sea otters, all males. They range in age from 18 years old to 7 years old. The animals are managed without chemicals or hormones. The Aquarium is able to do this due to the large size of the exhibit and the many visual barriers, as well as our interactive training program.

Minnesota Zoological Gardens Sea Otter Update Abstract

Melanie Oerter

In December 2006, Minnesota Zoo welcomed 1.1 Northern Sea Otters to their marine mammal collection. These animals were acquired to be part of the zoos newest exhibit, Russia's Grizzly Coast scheduled to open in the spring of 2008. This exhibit will take guests on a journey of the Russian Far East from the Coastal area of Kamchatka Peninsula further inland where the endangered Amur leopards are found. Since the arrival of the sea otters, the marine mammal staff has been working to develop both a husbandry and training program. Current goals have been establishing husbandry protocol, Establishing husbandry protocol, establishing enrichment protocol, establishing safety guidelines, acclimating the sea otters to their new environment, training staff on protocols and beginning an otter training program, progressing training in the otters' new environment, and working towards the introduction of the otters.

Seattle Aquarium Facility Update 2007

Traci Belting

When last we met in 2005 we had just had another sea otter pup born, a male we named Chugach who is now two years old. That same year C.J. Casson was promoted to Life Sciences Curator and in September 2005, Traci Belting was hired as the new Curator of Mammals and birds.

Our sea otter exhibits are now 30 years old so last summer we did some concrete restoration where old rusty points of contact on the concrete were removed and zinc anodes were installed and the walls patched. The walls were then painted with a fresh coat of tnemec paint and we have been very pleased with the results.

An orphaned female pup named Calypso that was transferred from the Alaska Sea Life Center to the Seattle Aquarium in August of 2003 was barely two years old when she died as a result of a root mesentery torsion. Kelly Helmick of Woodland Park Zoo discussed some of the clinical aspects of this case but I would like to reiterate some of the behavioral observations made by the animal care staff. In the months preceding her death, the staff would often comment about observing undulation-like movements of her abdomen, a movement not observed by the other otters. There were also the occasional observations of a bloated appearance to her abdomen all the while her appetite and activity was normal. On the day of the actual torsion event, her appetite and behavior were normal for the first half of the day but then at the 3:00 feeding she had no interest in eating. Her abdomen appeared bloated, she was keeping her hind flippers tucked up near her abdomen and she was observed repeatedly hunching forward. She was so lethargic that she never struggled when netted out of the water or when physically restrained. Kelly went over the majority of this case and as you recall from her presentation, exploratory surgery revealed that her gut was non-vital so she was humanely euthanized. We want to thank board certified surgeon Dr. Russel Patterson of the Animal Surgical Clinic and veterinary technician Teresa Casson for volunteered their services in the middle of the night to treat Calypso.

Now a story with a happy ending! Lootas is a female that was orphaned in Alaska and was hand raised in 1997. She has had several successful pregnancies but in 2003 she needed a cesarean section to save her life after she was unable to deliver a stillborn pup. The surgery was a success, she recovered well and we are thrilled to report that Lootas went on to deliver a healthy baby boy on Dec 6 ,2005.

As you all know, the current recommendation from USFW is not to breed Northern Sea otters. We are working with the AZA Wildlife Contraception Center on along term study of the contaceptive Deslorelin. Dr. Shawn Larson continues to analyze fecal hormones from our otters as well as many others from the captive population and this data will contribute to the understanding of the efficacy of this contraception option for sea otters.

We continue to evaluate treatment options for our oldest female Nuka. Many of you remember Nuka as one of the otters impacted by the Valdez oil spill. She lived at the John G. Shedd aquarium until 2001 when she was loaned to the Seattle Aquarium. She has had chronic health issues including poor fur quality and a fairly severe case of dermatitis that is resistant to most treatments. In order to reduce the inflammation and hopefully increase her comfort level and quality of life, she is currently on a maintenance dose of prednisone and this has been successful

in keeping the dermatitis from spreading.

One of our young males, Chugach was observed repeatedly sneezing and was leaving a spray pattern of mucus on the exhibit walls and service doors. Dr. Rob Liddell of Radiology Consultants of Washington donated his services to perform a CT scan which revealed acute sinusitis. Live nasal mites seen during the exam confirmed the cause of the sinusitis. A course of oral antibiotics and three sinus flushes with invermectin spaced 2-4 weeks apart have kept Chugach asymptomatic

We have been working with the Pittsburgh Zoo and PPG aquarium in preparation for transferring two young male otters, Chugach and Alki, to their brand new facility this spring. We have been busy training these otters on some of the basics such as crate training, targeting and weighing.

Sea Otter Conservation Education 2007

Cherie Williams, Education Curator
Seattle Aquarium

What have we done in the past two years? Not as much as I had hoped at the close of Sea Otter Conservation Workshop IV. Individually we've continued to increase our public education programs, but collectively we've missed the mark.

A brief review of educational information from other facilities/organizations:

- Alaska Sea Life Center: Although they do not have sea otters on exhibit interpreters in the exhibits inform the public about the recent Southwestern Alaska sea otter population decline and "what to do if they see a sick or injured otter". Public outreach includes staff traveling to present information in communities and schools, placement of signs near high use areas, radio public service announcements, and newspaper notices.
- New York Aquarium: During scheduled daily feedings one of the keepers gives an informative talk about sea otters (conservation, environment, physical features, training and enrichment, etc.). During this time the sea otters will generally be participating in a training session providing the public with a good look at the animal both in and out of the water. A "focus" weekend, or week like Sea Otter Awareness week has an information table staffed by an educator or docent with additional information, literature/handouts, and "props" as well as enrichment sessions featuring toys and interesting food items.
- Monterey Bay Aquarium: Daily narrated feedings for the public with an educational staff members narrating from the deck with the trainers. There are also exhibit volunteer guides around to answer the visitor's questions. Throughout the year there are special events member's evening feedings, and otter days where the otters are the focus with narrations and powerpoints in the auditorium.
- Minnesota Zoological Gardens: Otters are in holding the new exhibit and public programming begins in Spring/Summer 2008.
- Oregon Zoo: Programs are keeper driven. Summer 10 minute informational "keeper talks" in front of the exhibit. Participate in Sea Otter Awareness Week sponsored by Defenders of Wildlife. Two weekends of presentations with a booth, talks, games and items for people to look at and take home. There are informational "otter cards" developed to send out to schools and pass out during otter weeks.
- Vancouver Aquarium: Daily narrations during feedings including natural history, husbandry and sea otter rehabilitation information. Sea otter training tours are offered where participants weigh food and feed otters alongside trainers. Participate in sea otter awareness week with special presentations and enrichment sessions.
- Point Defiance Zoo & Aquarium: Offers a variety of ways to educate the public regarding sea otters. They have academic and community outreach programs,

general public fee based programs, keeper talks, volunteer interpretation and sea otter awareness weekend

- ❖ Marine Wildlife Veterinary Care and Research Center: Primarily a research institutions and only host periodic visitations by groups. Public outreach is through websites www.mwvcrc.org and www.seaotterresearch.org, as well as talks and publications. Cooperate in the development and filming of documentary and public television projects. In 2007-08 there are a number of public outreach efforts scheduled including development and construction of a kiosk at the Seymore Marine Discovery Center, Spanish and English handout materials for schools, public meetings, and cooperative efforts with Monterey Bay Aquarium and Defenders of Wildlife.
- ❖ Defenders of Wildlife: Focus their programs on what scientists consider two of the most serious environmental threats to the planet: the accelerating rate of extinction of species and the associated loss of biological diversity, and habitat alteration and destruction. Sponsorship of Sea Otter Awareness week. http://www.defenders.org/wildlife/new/seaotters.html

Seattle Aquarium

- Continue interpretive training/feeding talks, as well as informal conversations.
- Have added more enrichment activities (ice toys/puzzle feeders) with explanations for our visitors.
- Special Events highlighting Sea Otters:
  - ❖ Winter Break Fantastic Fishtival
  - ❖ Dive into Spring Break
  - ❖ Valentine's Day
  - ❖ Otter Dives
  - ❖ Otter Awareness Weekends
- Next Steps
  - ❖ Change in training/feeding talks format, more variable time schedule two microphones (thanks to Traci)
  - ❖ Consistent conservation messages throughout the Aquarium

Conclusion or how to follow through after this workshop

- We are inspired while attending this workshop, but return home and daily work takes over.
- Educators and animal care staff need to work together; most of the programs are driven by the animal care staff as educators we need to step up and be more involved.
- Can all of us in this room work together on a strong conservation education message? YES I've not given up on this idea as collectively our impact is greater than individually.
- Will we end up with a single method or hand out piece? Probably not as we all have individual facility needs and constraints, but the message can be the same.
- Sea Otter Awareness week (Defenders of Wildlife) appears to be bringing us all towards a common message and specific time for conveying this message to our visitors. As a group what do we do next?
- Time for educators to join together and drive the next steps, educators need to attend this workshop in 2009.

Sea otters at the Rotterdam and Antwerp Zoo 2005-2007

Dennis Blomjous

The past two years at the Rotterdam Zoo have been turbulent, 1-0 Eyak died during the previous workshop on March 18, 2005, after being paralysed for a couple of days. The necropsy showed a blood clot between the spinal cord and the vertebra and it was unlikely he would have recovered. The cause of the injury remains a mystery, but it is possible that he had a weak vain from steroid-medication that administered to him when he was a pup and that he "simply" made a wrong move. When he died he left female Micas behind on her own and although she was doing well we quickly arranged company for her. The couple from Antwerp was going to stay in Rotterdam anyway for two months because they were going to replace the acrylic windows there. Female Maré came over earlier then planned on April 19, 2005 and both females seemed "happy" to meet. Mare had never had much interaction with male Chuluugi in Antwerp and so it was good for both females. One month later Chuluugi came to Rotterdam. It was wonderful to have the threesome together but Chuluugi did not mate with either of the females and so he returned to Antwerp two months later. A second breeding attempt was made in 2006 and Chuluugi came over from March-June. He didn't perform again, besides some mating attempts.

Hormone research

We were very curious to find out if the females were cycling and we started to collect feces. The procedure to track the hormones is the same as it is in the Seattle Aquarium, but we are fortunate to be able to do it in our own lab since we also do research with elephants and Malayan tapirs and have the equipment for it. We started the research a few weeks before Maré came to Rotterdam. The graphs show both females responding to their meeting by an increase of their hormones. When the male arrived the first time Micas responded to it by going into estrus, and the male did mating attempts at the right moment. We weren't able to collect feces from Maré at that time. The second visit of the male in 2006 did not have much effect according to the graphs. Later that year spikes in the graph suggest that the females synchronize their hormone cycle.

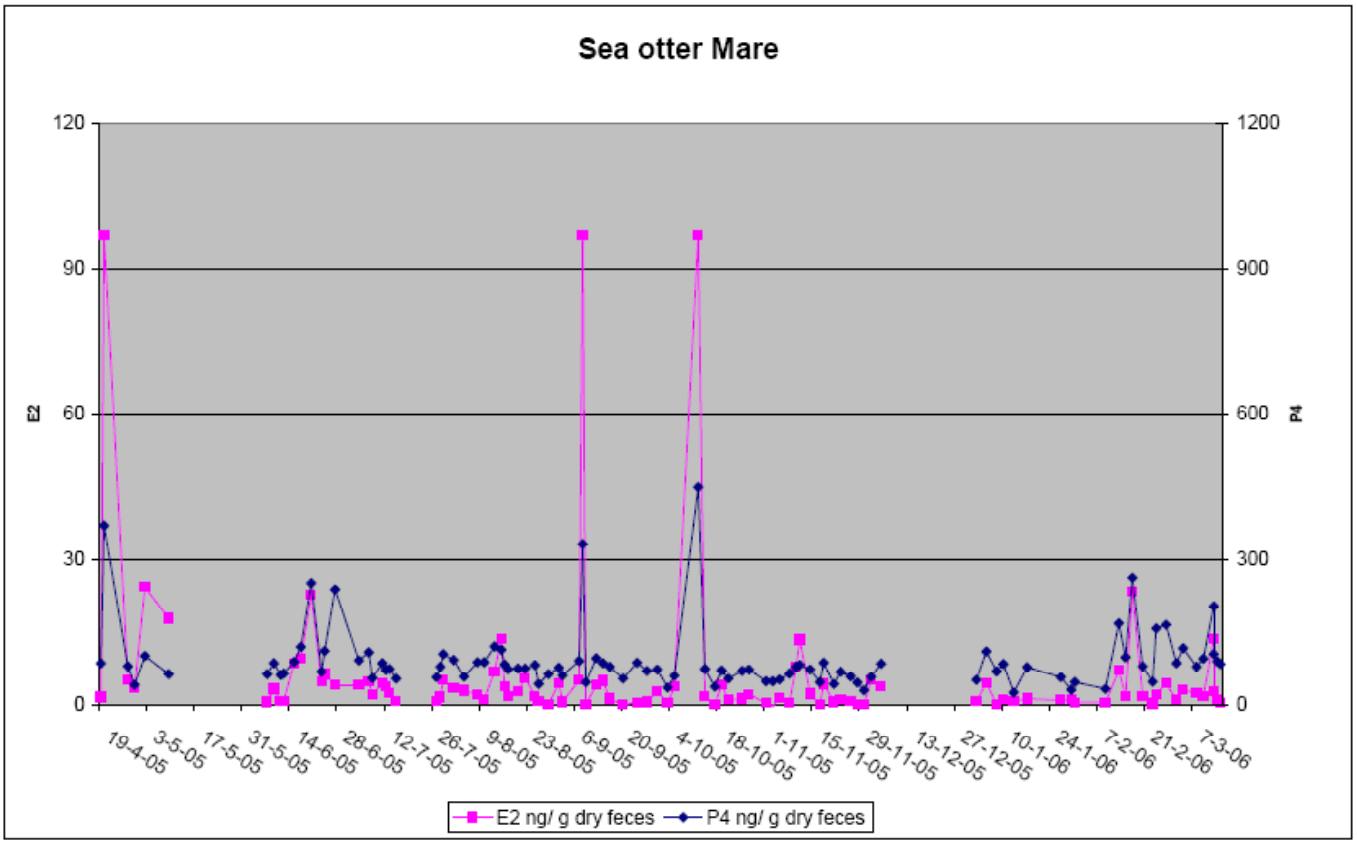
Veterinary stuff and training

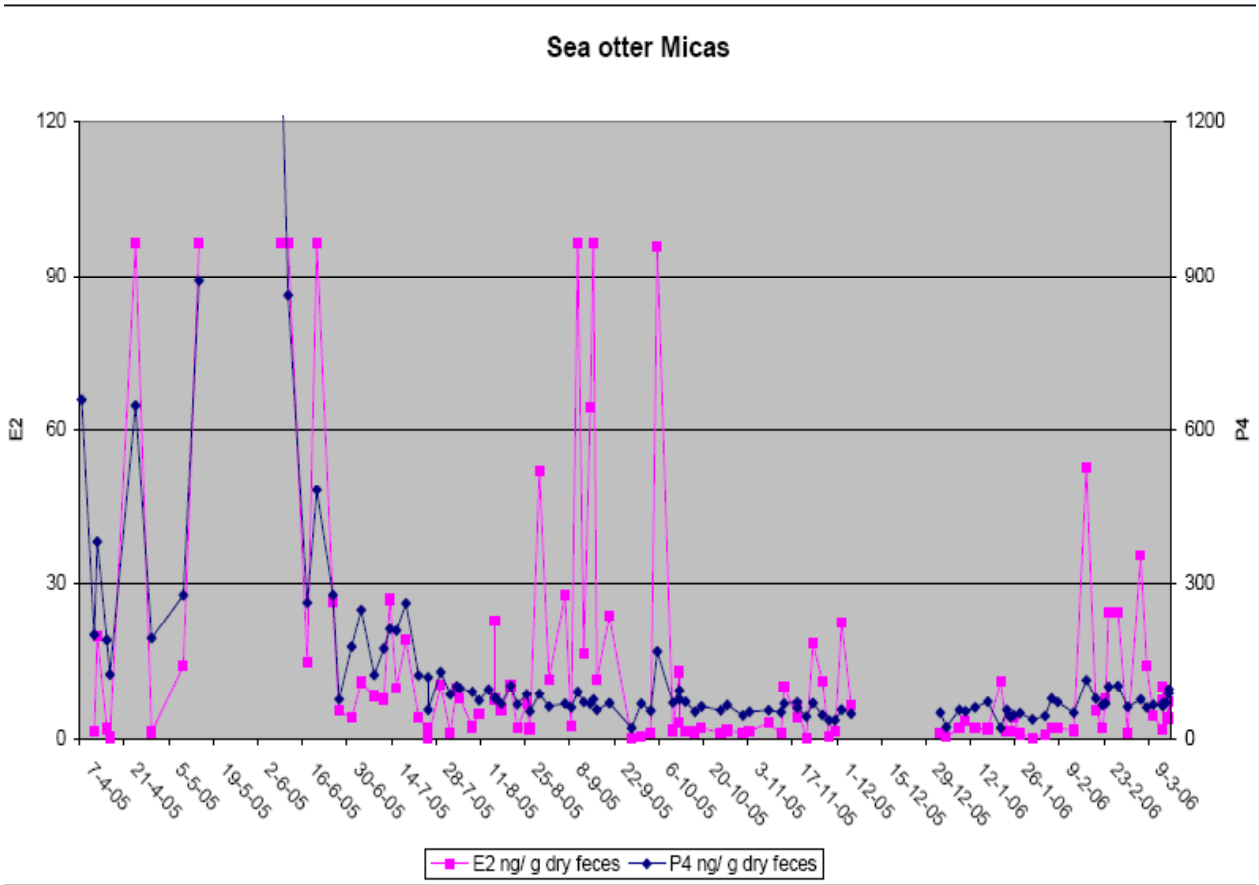
We started cage training the otters hands off. It is quite simple to get them to go into the cage with favourite food items. We weigh them once a month and a scale is put under the cage. Micas weighs 27.5 kg and Maré 24,5 kg.
Being able to get them to go in the cage was very useful when Maré didn't eat for a whole day and we decided to do a check up the next day. We examined her under general anaesthesia, using medetomidene and ketamine for heavy sedation and isoflurane for induction and maintenance of general anaesthesia. The Gastroscopy showed no abnormal findings. On X-ray we noticed a mass of gas-containing "feces" in the cranial loop of the colon.
Immediately after (quick) recovery she started to eat ice; we gave water that she drank from a syringe. Once back in her enclosure she defecated a large amount of fur mixed with crab-legs and feces! Probably the mass we saw on the X-ray. Soon after that she started eating...
We also did an endoscopy of the nose and saw many mites (as we expected already). We treated her directly in the nose with diluted ivermectine and she hasn't shown any clinical signs since then.

Future

The population in Europe only consists of five animals.
0-2 in Rotterdam,
1-0 in Antwerp
1-1 in Lisbon.

We lost hope of cooperation with the US while most animals are not allowed to be exported because of the listing of the SW population of Northern sea otters. Male Adaa who was supposed to come to Rotterdam was not allowed to leave the US. The marine mammal commission also recommends keeping all sea otters in the US and there for making it extremely difficult to set up any breeding programme for Europe. If we want to continue to display sea otters in Europe we need to breed and since the only unrelated male is not breeding the natural way we may want to try artificial insemination. Collecting semen is possible, but finding out when to inseminate will be a challenge. If we are not able to breed we are destined to the extinction of sea otters in Europe and will lose a very charismatic animal species that plays a big role in the education of the oceans in our Oceanarium.




Sea otter Micas
120
90
60
30
0
E2
1200
900
600
300
0
P4
7-4-05
21-4-05
5-5-05
19-5-05
2-6-05
16-6-05
30-6-05
14-7-05
28-7-05
11-8-05
25-8-05
8-9-05
22-9-05
6-10-05
20-10-05
3-11-05
17-11-05
1-12-05
15-12-05
29-12-05
12-1-06
26-1-06
9-2-06
23-2-06
9-3-06
E2 ng/ g dry feces
P4 ng/ g dry feces

Georgia Aquarium Facility Update

Gina Fisher

The Georgia Aquarium opened to the public on November 23, 2005. The sea otter exhibit is centrally located in the Cold Water Quest gallery where the animals can be viewed from three different viewing windows. One month prior to opening two southern sea otters were acquired; Gracie, a ten year old female, from the Aquarium of the Pacific and Oz, a 6 year old male, from the Oregon Zoo. A sea otter training and enrichment program was established as the Aquarium completed construction. Initial training goals focused on basic management control, husbandry behaviors and recovery of previously established behaviors. In May 2006 clinical signs of nasal congestion were observed in Gracie. Diagnostic procedures revealed significant nasal mite infestation in both sea otters. An aggressive treatment protocol of nasal flushes with Ivermectin via anesthesia procedures began in early July and was repeated every 2-3 weeks for a total of six treatments. Nasal mites were not visible in both sea otters at the last two procedures. Rechecks of their nasal cavities will be repeated in approximately one month. Future, short term goals include expanding and enhancing the behavioral training and enrichment program.

Defenders of Wildlife Sea Otter Conservation Efforts

Jim Curland
Marine Program Associate

Defenders of Wildlife's marine program focuses on marine species (sea otters, marine turtles, sharks, manatees, marine birds, fish, orcas and other cetaceans, and various other species) and marine habitat issues (marine protected areas, fisheries, water quality, and overall marine ecosystem health). Since the 2005 meeting, we have added to our marine issue plate: Cook Inlet Belugas, commenting on the proposed polar bear ESA listing, commenting on the southern resident orca draft recovery plan and North Atlantic Right Whales. And, we hired Richard Charter, formally of Environmental Defense, to work on OCS issues and creation of Marine Protected Areas in California.

Our current sea otter conservation efforts revolve around educational outreach, advocacy, facilitation of research through securing funding for outside researchers, and the contracting of experts to assist in reviewing key sea otter recovery and conservation issues.

In California, our current sea otter efforts are concentrated on:

- Implementing a bill, AB 2485, that is designed, in part, to support, through a tax check-off, increased investigation, prevention, and enforcement actions to decrease sea otter mortality, and to provide for research and programs related to sea otters. Among some of the other components of the bill include: cat litter labeling in California to discourage flushing of cat litter down the toilet and modification of state fines and penalties for the "take" of sea otters to mirror that of the federal side.
- Launching of a major campaign with the help of Philippe Cousteau, EarthEcho International, and the California Coastal Conservancy, to get support for the sea otter tax check-off. 1,000 posters were developed and distributed throughout CA. And, radio spots in San Francisco and Los Angeles were aired with Philippe Cousteaus' pitch to contribute to the tax check-off.
- Organizing a workshop in late March on sea otter funding. Defenders coordinated this workshop with the California Coastal Conservancy and the Monterey Bay Aquarium's Center for the Future of the Oceans.
- Working with Congressman Farr's staff and other representatives to pave the way for the reintroduction of the Southern Sea Otter Recovery and Research Act that stalled in previous introductions.
- Educational outreach through school and interest group presentations; distribution of a sea otter unit; the creation of posters and other materials; sea otter documentaries and the annual Sea Otter Awareness Week, the last week in September 2007.
- Advocating for the finalization of the Southern Sea Otter Supplemental Environmental Impact Statement on the Translocation Program/Management Zone issues. Defenders is one of the members of the Southern Sea Otter Recovery Implementation Team.
- The Land-Sea Connection. Defenders' sea otter-water quality campaign.

Our sea otter conservation efforts in Alaska involve being part of the Southwest Alaska Sea Otter Recovery Team now that this Distinct Population Segment of sea otters in Alaska has been listed as "threatened" under the ESA and educational outreach on the imperiled status of the Aleutian sea otter (through a video, brochure and poster). In

addition, Defenders, along with the Humane Society of the U.S., Friends of the Sea Otter, and Oceans Public Trust Initiative, a project of Earth Island Institute, have been providing comments on the U.S. Fish and Wildlife Service's special rule on sea otter native handicraft issues. Our efforts in Washington involve supporting other conservation groups in their efforts to secure a MMPA depleted or "threatened" ESA listing for the Washington sea otter population and providing written comments to WDFW on the state recovery plan. And, lastly our efforts in Canada involve tracking the efforts to develop a National Recovery Strategy for BC sea otters.

Conservation Action for the southern sea otter - What can be done?

Steve Shimek, The Otter Project

Oil and Gas

1) When appropriate, encourage USFWS to be more involved in consultation and EIR review.
2) Monitor large vessel traffic along Central Coast to ensure compliance with large vessel TSS (traffic separation scheme) and distance from shore.
3) Stormwater – see below

Disease

Pathogens

1) Increase standards and compliance for coastal sanitary sewage treatment plants.
2) Encourage step-wise improving standards, education, and compliance with storm water treatment plans.
3) Encourage education and step-wise improving compliance with ASBS regulations.
4) Encourage Monterey Bay NMS regulatory plans on cruise ship discharge.
5) Control wild-living cat populations

Chemical Contamination

1) Review contamination sampling and dredging plans in harbors within sea otter range. Ensure standards and compliance for immuno-suppressive chemicals: PCB, DDT, BTs.
2) Support harbors in their efforts to clean up contaminated sediments and permanently 'fix' sources of chemical contamination.
3) Encourage stormwater monitoring of immuno-suppressive chemicals.
4) Encourage worldwide ban of "dirty dozen" chemicals (Stockholm Convention) including fast-track banning of emerging chemicals (i.e. PBDE).
5) Support ag monitoring and improving compliance with waste water best practices
6) Encourage minimal use of fertilizers and pesticides. Urea – used in many fertilizers – catalyzes toxic algal blooms in the ocean impacting otters, sea lions, and people

Stress

1) Encourage sensitive wildlife watching etiquette
2) Educate boaters (power and paddle) on wildlife etiquette.
3) Encourage Monterey Bay NMS regulatory rules on motorized personal watercraft

Nutrition

1) Encourage establishment of marine reserves
2) Remove barriers to range expansion (see NOZ below)
3) Encourage Monterey Bay NMS regulatory ban on the introduction of introduced species

No-Otter Zone

1) Encourage USFWS to issue a final record of decision on NOZ.

Fisheries Interactions and By-Catch

1) Consider amending MMPA to eliminate otter by-catch exception. (This could be

controversial and there should be otter NGO and fishing community dialogue before action).

2) Place observers on crab and lobster boats to observe (or not!) bycatch rates.

Habitat

1) Encourage establishment of marine reserves
2) Limit factory-ship scale mechanical kelp harvesting

Malicious Take

1) Increase USFWS enforcement capability on Central Coast
2) Educate boaters about safe boating practices when around sea otters
3) See motorized personal watercraft above

Protections

1) Avoid any weakening of the Endangered Species Act
2) Avoid weakening of the Marine Mammal Protection Act

Monterey Bay Aquarium's Sea Otter Field Research

Michelle Staedler

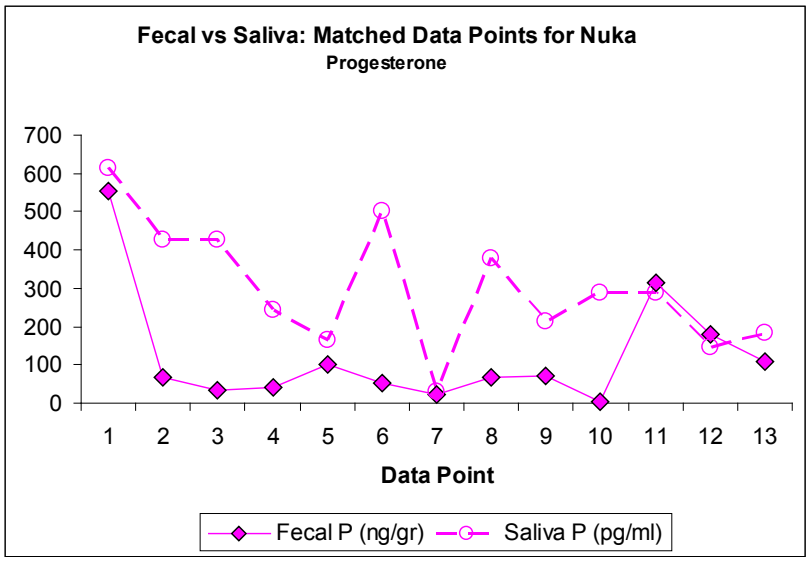
Monterey Bay Aquarium's Sea Otter Research and Conservation Program participates in a wide variety of sea otter field research projects including, but not limited to, demographic studies, new instrumentation techniques, and monitoring all released rehabilitated otters from our animal care program. Currently, our major focus in the field is studying the variation in maternal effort and reproductive success of individual females based on diet specialization. Foraging success and body condition are directly linked to survival and reproductive success in sea otters, and parous females may be more severely impacted by nutritional limitation than other life stages due to the high cost associated with lactation and successful rearing of pups. Variation also exists in rates at which sea otter pups develop skills of grooming, diving, and prey capture. Causes of variation in maternal investment among sea otters as well as pup ontogeny remain largely unexplained: a possible consideration may be reflected in diet specializations which ultimately affect survival, reproductive success and individual fitness. The success of the birth to weaning process based on foraging strategies may have a significant impact on the sluggish growth of the southern sea otter population.

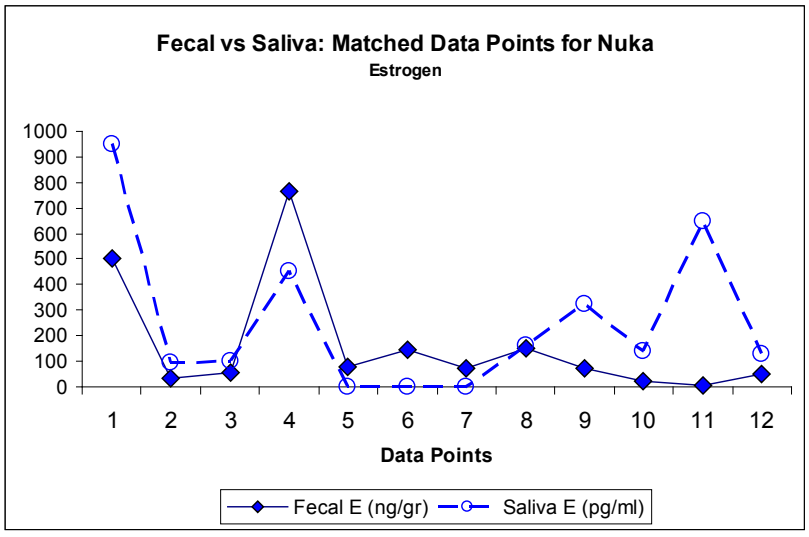
Sea Otter Reproductive Hormone Update

Shawn Larson and Angela Smith
Seattle Aquarium

Saliva vs. Fecal Hormone Metabolites

The Seattle Aquarium has been monitoring reproductive hormones using sea otter fecal extracts for over 10 years. Many facilities have participated in this research. The aquarium continues to monitor the reproductive status of sea otters throughout the world. We are currently testing different non-invasive methods to monitor reproductive status within sea otters. Recently we attempted to measure reproductive cycling via saliva hormone metabolites. We trained one of our sea otters, Nuka, to perform an open mouthed behavior so we could gather saliva from the inside of her mouth using cotton tipped applicators. Below is Nuka's data:



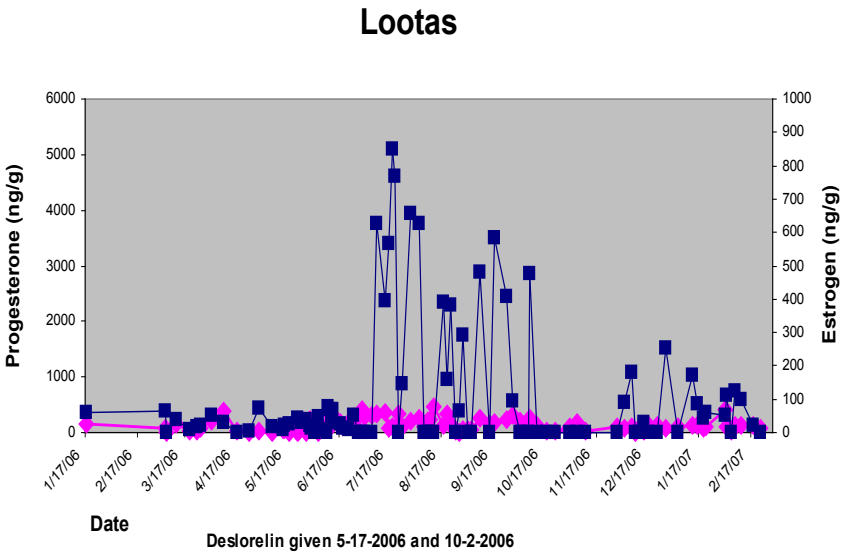


Note that the saliva values are 1000 times lower than the fecal values. The saliva samples are measured in pg/ml of saliva rather than ng/gr fecal extract. There is also some variability in the saliva samples. There only seems to be similar tracking of trends between saliva and fecal samples when using the estrogen assay. We are still testing the feasibility of using saliva

instead of fecal samples to determine sea otter reproductive status but more testing is needed. The fecal samples are still the most reliable when tracking reproductive status within captive sea otters.

Effective duration of reproductive suppression using Deslorelin in sea otters

Due to breeding restrictions of listed sea otter subspecies in captivity as well as the desire to prevent inbreeding, many facilities are now faced with using chemical contraceptives to prevent reproduction. The most popular chemical contraceptive currently used in sea otters is Deslorelin (Suprelorin®) ordered through AZA's Wildlife Contraceptive Center (http://www.stlzoo.org/animals/scienceresearch/contraceptioncenter/). This implant is a gonadotropin releasing hormone (GNRH) inhibitor. It inhibits the production of GNRH from the hypothalamus portion of the brain above the pituitary and thus inhibits the pituitary gland from releasing follicle stimulating hormone (FSH) and luteinizing hormone (LH). FSH stimulates follicular cell development around an unovulated egg in the ovary. When FHS is present then one or more ovarian follicles mature and secrete estrogen stimulating estrus behavior. LH stimulates ovulation of a mature egg from an ovarian follicle and subsequent progesterone production from the remaining follicle cells that once surrounded the egg (causing the formation of a corpus luteum). Deslorelin should prevent both estrogen and progesterone production by preventing the release of both FSH and LH from the pituitary. The duration of a Deslorelin implant is 6 months to 2 years in other species. See reproductive hormone graph (estrogen and progesterone) of one of the Seattle Aquarium otters, Lootas, that was given Deslorelin:



Note: If the Deslorelin in working properly there should be no spiking of either estrogen or progesterone. Lootas has spikes of estrogen 2 months after Deslorelin was given. We also tracked Deslorelin effective duration in another Seattle Aquarium sea otter, Aniak. Her implant only lasted 2-3 months as well. However, another sea otter housed at the Oregon Zoo, Thelma, was reproductively suppressed for 7 months following Desloerin implantation.

Thus Deslorelin doesn't last very long in sea otters. Implants should be replaced every 4-5 months if suppression is desired. In addition the higher dose or the one year duration implant is recommended. The suppression also seems to be temporary. One of the sea otters monitored at the Seattle Aquarium, Aniak, cycled normally and ovulated 4-5 months after the Deslorelin implant was given.

Sea Otter Conservation Workshop VI Dates

March 20-22, 2009

Seattle Aquarium
Seattle, Washington