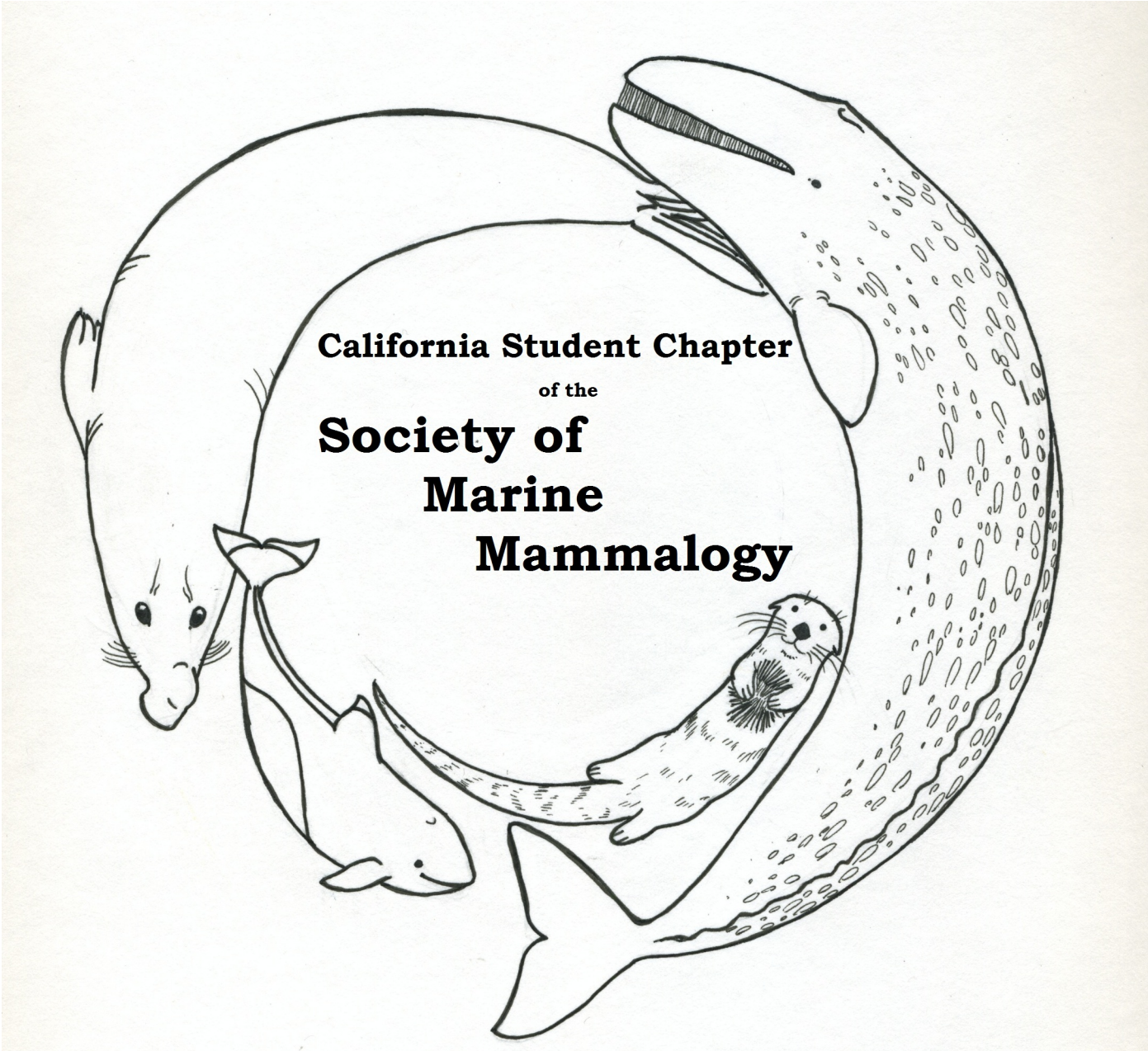

First Annual Conference

UCSC 2013

SATURDAY

8:40 AM 9:00 AM	**CHECK IN/CHECK TALKS**
9:20 AM	**INTRODUCTIONS**
9:40 AM	**Caroline Casey** - REMEMBER THE TITANS: INDIVIDUAL VOCAL SIGNATUTRES REINFORCE DOMINANCE RELATIONSHIPS AMONG MALE NORTHERN ELEPHANT SEALS
10:00 AM	**Kristine Williams** - DIAGNOSTIC USING DIAGNOSTIC MODEL USING WHOLE BLOOD AND SERUM CHEMISTRY VARIABLE OF STRANDED AND WILD CALIFORNIA SEA LIONS
10:20 AM	**Caitlin Jensen** - SPATIAL AND TEMPORAL VARIABILITY IN SHIPPING TRAFFIC AROUND SAN FRANCISCO BAY
10:40 AM	**BREAK**
11:00 AM	**Xochitl Rojas-Rocha** - COUNTING CALORIES: ENERGY INTAKE OF WEDDELL SEALS IN THE ROSS SEA, ANTARCTICA
11:20 AM	**Mike Tift** - ELEVATED CARBON MONOXIDE PRODUCTION IN A MARINE MAMMAL, THE NORTHERN ELEPHANT SEAL
11:40 AM	**BREAK**
12:00 PM 12:20 PM	**Dr. Jerry Kooyman: Keynote Speaker**
12:40 PM 1:00 PM	**LUNCH**
1:20 PM	**Kaja Wierucka** - DIFFERENCES IN SURVIVAL RATES AND THE EFFECT OF THE MORBILLIVIRUS EPIZOOTIC BETWEEN CLUSTERS OF LONG-FINNED PILOT WHALES...
1:40 PM	**Tristan Burgess** - INVESTIGATING BRUCELLA INFECTION IN BERING ISLAND SEA OTTERS
2:00 PM	**Christin Murphy** - A NOVEL ANIMAL-BORNE TAG RECORDS VIBRATIONS FROM SEAL WHISKERS DURING HYDRODYMANIC DETECTION
2:20 PM	**Angela Szesciorka** - DIVE BEHAVIOR AND ECOLOGY OF HUMPBACK WHALES (MEGAPTERA NOVAEANGLIAE) IN AND AROUND SAN FRANCISCO SHIPPING LANES
2:40 PM	**Roxanne Beltran** - WHISKER GROWTH DYNAMICS: A VALIDATED APPROACH FOR ASSIGNING TIMESCALES TO STABLE ISOTOPE ANALYSIS
3:00 PM	**BREAK**
3:20 PM 3:40 PM	**Dr. Ari Friedlander: Invited Speaker**
4:00 PM 5:00 PM	**POSTER SESSION**: **Katie Pelon:** URINARY TESTOSTERONE IN POLAR BEARS (*URSUS MARITIMUS*) AS AN INDICATOR OF TESTICULAR FUNCTION IN MALES AND FEMALES, **Suzanne Manugian:** SURVIVAL AND MOVEMENT OF FEMALE HARBOR SEALS (*PHOCA VITULINA*) IN SAN FRANCISCO AND TOMALES BAYS, CALIFORNIA, **Nicole Barbour/Miranda Domico:** DOLPHIN OCCURRENCE AND BEHAVIOR IN THE CONTEXT OF ORANGE COUNTY MARINE PROTECTED AREAS, **Casey Clark:** EXAMINING HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*) MIGRATORY BEHAVIOR USING PHYSIOLOGICAL AND DEMOGRAPHIC PARAMETERS, **Jed Grundy:** COMPARING BIOLOGICAL AND ANTHROPOGENIC IMPACTS ON HUMPBACK WHALE (*MEGAPTERA NOVAENGLIAE*) POPULATIONS USING FLUKE SCARS OF THE CENTRAL NORTH PACIFIC STOCK
7:00 PM	**BARBEQUE**

SUNDAY

8:40 AM	**Sarah Peterson** - mesopelagic foraging puts deep diving marine mammals at greater risk of mercury accumulation
9:00 AM	**Allison Fuller** - spatial and temporal distribution, haulout use and movement patterns of steller sea lions of steller sea lions in northern california
9:20 AM	**Jeff Sharick** - oxidative stress: a potential cost of breeding in male and female northern elephant seals (*mirounga angustirostris*)
9:40 AM	**Max Tarjan** - delineating marine mammal home ranges: a new algorithm based on knowledge of habitat sustainability and an analysis for sea otters
10:00 AM	**BREAK**
10:20 AM	**Sarah Kienle** - the better to eat you with: the comparative feeding morphology of phocid seals
10:40 AM	**Wiley Archibald** - seasonal changes in the numbers and distribution of hauled out pacific harbor seals in south humboldt bay, california, california...
11:00 AM	**Derek Somo** - body reserves and swimming activity do not impact development of dive capacity during the post weaning fast in northern elephant seal pups
11:20 AM	**Nicole Thometz** - diving and foraging behavior of southern sea otters in resource limited habitats: are sea otters pushing their physiological limits...
11:40 AM	**BREAK**
12:00 PM 12:20 PM	**Dr Dan Costa: Invited Speaker**
12:40 PM 1:00 PM	**LUNCH**
1:20 PM	**Jillian Sills** - auditory profiles of spotted (*phoca largha*) and ringed seals (*pusa hispida*)
1:40 PM	**John Symons** - a model of optimal diving for bottlenose dolphins under human disturbance
2:00 PM	**David Ensminger** - effects of an acute stimulation of the hpa axis on sexual and stress hormones in male northern elephant seals
2:20 PM	**Kane Cunningham** - detection of complex sounds in quiet and masked conditions by a california sea lion and a harbor seal
2:40 PM	

ORAL PRESENTATIONS (Saturday):

REMEMBER THE TITANS: INDIVIDUAL VOCAL SIGNATUTRES REINFORCE DOMINANCE RELATIONSHIPS AMONG MALE NORTHERN ELEPHANT SEALS

Caroline Casey (UC Santa Cruz), Colleen Reichmuth, I. Charrier, N. Mathevon

Social recognition is essential for species with colonial breeding systems. Typical environmental conditions are noisy and complex, and there are advantages to possessing distinctive features that aid in individual identification. Northern elephant seals (*Mirounga angustirostris*) are colonial breeders that operate in one of the most competitive social systems known among mammals. Adult males establish dominance hierarchies that determine access to harems of estrous females during a protracted and energetically demanding breeding season. While dominance relationships may be established through physical fights, they are maintained through stereotypic displays that elicit predictable behavioral responses from spatially separated individuals. To determine whether reliable differences exist in the acoustic displays of individuals and whether these differences function to convey identity, we behaviorally and acoustically sampled male northern elephant seals over two consecutive breeding seasons. Vocalizations were digitally recorded during competitive interactions and analyzed for spectral, temporal, and amplitude characteristics. A cross-validated discriminant function analysis performed on nine call features revealed small differences within—and significant differences between—the calls produced by 17 adult males reliably present at the study site. This finding supports the hypothesis that acoustic displays are reliable individual signatures that males learn to recognize during the breeding season. To test this, we conducted two field playback experiments. We first exposed 10 individuals to the vocalizations of familiar subordinate and dominant rivals, and found significant and predictable differential behavioral responses consistent with relative hierarchical status. To determine whether these reactions were dependent on prior experience, we then exposed 10 foreign males of similar status to the same playback treatments and observed no differential responses. The results demonstrate that these unique acoustic signals serve as individual vocal signatures, and males likely remember the identity of their rivals based on call features that have been associated with the outcome of previous competitive interactions.

DIAGNOSTIC USING DIAGNOSTIC MODEL USING WHOLE BLOOD AND SERUM CHEMISTRY VARIABLE OF STRANDED AND WILD CALIFORNIA SEA LIONS (*ZALOPHUS CALIFORNIANUS*)

Kristine M. Williams (Moss Landing Marine Labs), James T. Harvey and Frances M. Gulland

California sea lions (CSL) are important sentinels of marine ecosystem health. The health of CSL wild populations can be indicative of the health of the surrounding environment. For health assessment studies, researchers commonly examine blood variables to help determine causes of morbidity and mortality in CSLs. Blood samples from wild and stranded CSLs were collected and analyzed to identify blood variable abnormalities produced by different common stranding causes. Wild CSLs, assumed healthy and representative of the population, were sampled from different geographic locations within their range, and included all age classes and sexes. Stranded CSLs were sampled upon admission for veterinary rehabilitation at The Marine Mammal Center, Sausalito, CA. The five categories of diagnosed stranding causes were domoic acid toxicity, leptospirosis, cancer, trauma, and malnutrition/pneumonia. Bootstrap analyses of blood data from the wild and stranding categories provided mean ± 95% confidence interval ranges for 31 blood variables, representative of healthy and unhealthy CSLs. One-way ANOVA indicated significant blood value differences among the wild and stranding categories. Algorithms were produced from the blood values of wild and stranded CSLs to assist in the classification of undiagnosed cases using discriminant function analysis (DFA). The DFA model was able to accurately predict 75.2% of all known cases. Wild cases were predicted with 92.4% accuracy, leptospirosis cases with 86%, domoic acid with 73%, trauma with 67.1%, malnutrition/pneumonia with 65.1%, and cancer with 35.3%. Stranding causes can have characteristic and unique changes to blood values, however, increased data from wild, healthy individuals is necessary to detect these changes, and diagnose with greater accuracy. Diagnostic blood variable ranges from this study will aid in determining the health status of wild, captive, stranded, and rehabilitating CSLs.

SPATIAL AND TEMPORAL VARIABILITY IN SHIPPING TRAFFIC AROUND SAN FRANCISCO BAY

Caitlin Jensen (San Francisco State University), Ellen Hines, T.J. Moore and Jessica Redfern

Shipping traffic poses a worldwide threat to many large whale species, as collisions between ships and whales can lead to increased mortality and jeopardize the viability of small populations. It is necessary to recognize the

dynamic nature of shipping traffic patterns when assessing risk of ship strikes with whales. This project focuses on vessel activity around the San Francisco Bay gateway, a site of very extensive shipping activity. Ship strikes have been identified by NOAA's National Marine Fisheries Service as a threat to the population recovery of endangered blue and humpback whales in the Eastern Pacific. A risk assessment is needed in order to identify areas where collisions between ships and whales are most frequent. The aim of this study is to provide an understanding of shipping traffic patterns around the San Francisco Bay, which will in turn allow for a more realistic spatial assessment of the risk faced by endangered whales in this area. Specifically, using Automatic Identification System (AIS)-generated data, we will explore the dynamic nature of shipping traffic in this area by examining it at various temporal resolutions. First, we will compare traffic from season to season over the course of a year to elucidate how shipping patterns correspond with seasonal whale movements. Second, this study will look at vessel traffic both before and after implementation of the California Air Resources Board's "fuel rule" in order to identify the effects of this regulation. Finally, as recent studies show that blue whales spend more time at the surface during the night, we will compare spatial patterns of daytime and nighttime traffic.

COUNTING CALORIES: ENERGY INTAKE OF WEDDELL SEALS IN THE ROSS SEA, ANTARCTICA

Xochitl Rojas-Rocha (UC Santa Cruz), Kimberly T. Goetz, Jennifer L. Maresh and Daniel P. Costa

Despite being one of the few remaining intact ecosystems in the world, the trophic ecology of the Ross Sea is poorly understood. As top predators, Weddell seals (*Leptonychotes weddellii)* can provide insight into trophic interactions in this region, however the diet and energy intake of this species remain largely unknown. Direct observations of feeding events and stomach content analyses have demonstrated the potential importance of Antarctic silverfish (*Pleuragramma antarcticum*) and toothfish (*Dissostichus mawsoni*) in the diet of Weddell seals and other upper trophic level species, but little else is known about the predator-prey dynamics of this system. Using bomb calorimetry, our study examined the energy density of 11 fish species collected from the Ross Sea in 2011-13, including nine nototheniids (ice fish), one zoarcid (eelpout), and one channichthyid (crocodile icefish). Given the importance of fish to the diet of Weddell seals, determining the energy content of prey items may provide insight into their reliance on high energy prey, especially after reproductive bouts when body condition is poorest. These data contribute to our understanding of the Weddell seal's diet, and can be extrapolated to other seal, bird, and whale species. In conjunction with existing data on the nutrient composition of these fish species, our project has the potential to enhance understanding of the possible effects of climate change on trophic interactions within the Ross Sea. Additionally, understanding the importance of Antarctic toothfish to Weddell seal diet is critical in light of the recent depletion of toothfish by the Ross Sea fishery.

ELEVATED CARBON MONOXIDE PRODUCTION IN A MARINE MAMMAL, THE NORTHERN ELEPHANT SEAL

Michael S. Tift (Scripps Institution of Oceanography, UCSD), Paul Ponganis and Daniel E. Crocker

Carbon monoxide (CO) forms carboxyhemoglobin (COHb) by binding to hemoglobin with a much greater affinity than oxygen. Until the recent discovery of endogenous CO production, CO had long been thought to be strictly a toxic and poisonous gas produced through incomplete combustion of carbon based fuels. However, a low concentration of in vivo metabolic CO is generated through heme catabolism via heme oxygenase (HO). These low values have recently been shown to protect tissues against ischemia-reperfusion injuries and oxidative stress. In marine mammals with high blood volumes and elevated hemoglobin and hematocrit concentrations, it is estimated they might yield high concentrations of COHb. Therefore, we measured COHb in a marine mammal known to have an elevated blood volume, hematocrit and hemoglobin concentration, the northern elephant seal. In pups, COHb was much higher than expected (7.4 ± 0.7 %), reaching maximum values of 10.8%. However, COHb values did not vary across the pups' development period. In adults, mean COHb was even further elevated (9.2 ± 0.6 %), which is consistent with an ontogenetic increase in blood volume, hematocrit and hemoglobin concentration. Serial samples over the course of several days revealed little to no fluctuation in COHb values. The consistent elevation of COHb suggests a more rapid turnover of hemoglobin than previously thought. Also, the consistent presence of elevated CO in blood could be beneficial to marine mammals which are known to exhibit frequent periods of ischemia-reperfusion associated with diving and sleep apnea responses.

DIFFERENCES IN SURVIVAL RATES AND THE EFFECT OF THE MORBILLIVIRUS EPIZOOTIC BETWEEN CLUSTERS OF LONG-FINNED PILOT WHALES (*GLOBICEPHALA MELAS*) IN THE ALBORAN SEA AND THE GULF OF VERA

Kaja Wierucka (University of Wroclaw, Poland), Philippe Verborgh, Rossa Meade, Leyla Colmant, Pauline Gauffier, Ruth Esteban, Renaud de Stephanis, Ana Cañadas

Long-finned pilot whales (*Globicephala melas*) are a commonly encountered species in the Mediterranean Sea. The most prominent regions, with high encounter rates, consist of pelagic parts of the Granada-Almeria area of the Alboran Sea and the Gulf of Vera. Despite inhabiting the same area, different factors may influence mortality and survival rates between groups. In 2006-2007 an outbreak of the Dolphin Morbillivirus (DMV) in the Western Mediterranean resulted in an increase in mortality of long-finned pilot whales. The aim of this study was to determine whether survival rates differ between clusters of the Alboran Sea and Gulf of Vera population and how the epizootic influenced survival rate. Photo identification surveys were conducted between 1992 and 2009. A half weight association index was used in SOCPROG 2.4 to define clusters of individuals that associate with each other more frequently than with others. A Cormack-Jolly-Seber survival rate model was then implemented in Mark 7.1. Goodness-of-fit tests run in U-CARE 2.02 showed no transience or trap-dependence (quadratic $\chi 2=69.7591$, df=137, p=1) and model selection was conducted using Akaike's information criterion. Survival rate estimates varied from 82 to 99% over 11 clusters for the 1992-2009 period. When the effect of the Morbillivirus outbreak was modeled, three clusters with distinctly lower survival rates (82, 89 and 92%) from previous models, presented lower estimates after the outbreak (survival rate dropped from 92 to 55%), supporting a negative influence of the epizootic on certain clusters. This is the first long-term study focused on long-finned pilot whales survival in the Alboran Sea and therefore provides an important step towards understanding the trends and state of the population. This information is critical considering that the species is listed by the IUCN as "data deficient" in the Mediterranean Sea and as "vulnerable" in the Spanish National Catalogue of Endangered Species.

INVESTIGATING BRUCELLA INFECTION IN BERING ISLAND SEA OTTERS

Tristan Burgess (UC Davis), Tracey Goldstein, Woutrina Miller and Christine Kreuder Johnson

Marine strains of Brucella have been recognized since the mid 1990's and are known to be pathogenic in cetaceans, as well as a cause of serious zoonotic infections in humans. Recent evidence indicates these bacteria also have the potential to cause disease in sea otters (*Enhydra lutris*). Sea otters previously tested in most areas tested almost uniformly negative for Brucella exposure using serological tests. In contrast, samples collected from 89 sea otters on Bering Island, Russia indicated a high seroprevalence for Brucella antibodies (28%); this high level of seroprevalence warranted further investigation. One possible explanation for exposure of sea otters to Brucella was the existence of a land-sea pathogen transmission cycle on Bering Island. Bering Island is home to an introduced population of approximately 800 reindeer (*Rangifer tarandus*). Reindeer are a known host of Brucella, generally B. suis serotype 4. Alternatively, a marine cycle, likely involving a marine strain (B. ceti, B. pinnipedialis or a novel species) may be responsible for the high level of exposure. This study aims to i) Determine the infection prevalence of Brucella in the same 89 sea otters from stored rectal swab samples using a sensitive PCR assay, and ii) determine the species of Brucella (if any) present in the sampled animals. Of 89 samples analyzed, 78 contained amplifiable DNA, and of these 3 (3.8%) tested positive for Brucella species DNA (97-100% homology). Further analyses are underway to speciate the positive samples, a key step in determining the most likely route of infection.

A NOVEL ANIMAL-BORNE TAG RECORDS VIBRATIONS FROM SEAL WHISKERS DURING HYDRODYMANIC DETECTION

Christin T. Murphy (University of South Florida, College of Marine Science), W.C. Eberhard, Colleen Reichmuth, B.H. Calhoun and David Mann

The seal whisker is an advanced hydrodynamic sensor that has been shaped by evolutionary processes. The present research aims to learn what signals are available to the seal during hydrodynamic tracking in order to better understand the functioning of this sensory system. We developed a novel, animal-borne tagging device, wLogger, which uses a miniature digital accelerometer to measure signals directly from a seal's whisker. Laboratory testing using excised whiskers in a water flume confirmed that the tag is capable of recording vibrational signals without hampering the natural movement of the whisker. In a laminar flow in the flume, the whisker vibration was dominated by vortex shedding in a narrow frequency range. When a hydrodynamic disturbance from a cylinder

placed upstream was added, this peak diminished in amplitude and the frequencies of vibration broadened. Live animal testing with a trained seal showed similar results, where there was a narrow-bandwidth peak in vibration in the absence of a hydrodynamic trail that diminished in the presence of a trail generated by moving objects. Based on these results, we suggest that the seal vibrissal system could rely on the disruption of whisker's natural vortex shedding to detect hydrodynamic trails.

DIVE BEHAVIOR AND ECOLOGY OF HUMPBACK WHALES (*MEGAPTERA NOVAEANGLIAE*) IN AND AROUND SAN FRANCISCO SHIPPING LANES

Angela Szesciorka (Moss Landing Marine Labs) and John Calambokidis

Cetaceans are vulnerable to ship strikes when their distribution and behaviors overlap with human activities in highly productive coastal upwelling zones. Although research and mitigation became a priority on the east coast of the United States after North Atlantic right whale deaths began exceeding their potential biological removal limits, on the west coast mitigation is minimal and research has focused on distribution, leaving questions about the behavior of whales in shipping lanes. My study investigates the dive behavior and ecology of humpback whales in and around shipping lanes to identify any spatiotemporal, ecological, or biological factors that could put humpback whales at an increased risk of a ship interaction. Using telemetry-equipped depth recorders I documented the dive behavior of humpback whales (n = 8) from 28 Aug to 02 Sept 2013 in major shipping lanes off San Francisco. Prey layers were identified as fish or krill using a dual-frequency sounder (50 and 200 Hz), and large commercial vessels were tracked during tagging events to identify close encounters with whales (overlaps within 500 m). Tags remained on from 44 minutes to 6 hours and 50 minutes. Dive depths reached a maximum of 370 m and averaged between 7.97 to 67.2 m. The preliminary data show that a tagged calf and escort had similar dive profiles, a tagged yearling made deeper dives that the tagged calf, and one tag that stayed on until 22:03 showed noticeable changes in day versus night dive behavior. Three of the tagged whales' dive profiles are being investigated as close encounters with large commercial vessels to determine if the presence of the ships affected their dive behavior. Additional tagging efforts will continue in October and next summer. This talk will focus mostly on methods and preliminary data.

WHISKER GROWTH DYNAMICS: A VALIDATED APPROACH FOR ASSIGNING TIMESCALES TO STABLE ISOTOPE ANALYSIS

Roxanne S. Beltran (University of Alaska, Anchorage), Megan Connolly, Sarah Peterson, Colleen Reichmuth and Daniel P. Costa

The extensive foraging migrations of many pinniped species discourage the use of traditional methodologies (e.g. scat analysis) for dietary reconstruction. Stable isotope analysis (SIA) of serially sub-sampled vibrissae (whiskers) is a common method to investigate pinniped foraging ecology; however, knowledge of tissue synthesis is required to assign accurate timelines to past foraging activity. In some species, whisker synthesis rates slow as the length asymptotes, so equally-sized subsamples for SIA represent differing time-scales. Applying linear growth values to tissues exhibiting non-linear growth would lead to severe misinterpretations of temporal scales represented by serial isotope data. Photogrammetric analysis allows for non-invasive documentation of vibrissae growth and molting patterns in living animals. In this study, we used photogrammetric methods to obtain length measurements of 93 vibrissae over 18 months in a trained, captive northern elephant seal (*Mirounga angustirostris*). Vibrissae exhibited consistent asymptotic growth that was regulated by three von Bertalanffy growth function parameters: (1) initial time of growth, (2) asymptotic length and (3) a species-specific curvature constant. Unfortunately, photogrammetry does not account for the portion of vibrissae contained within the follicle. To correct for this photogrammetric underestimation, we constructed a linear correction model by correlating photogrammetric estimates to direct vibrissae measurements in three deceased northern elephant seals. Lastly, we quantified δ 13C and δ 15N ratios in archived blood, vibrissae, and prey samples from the captive seal. δ 13C and δ 15N ratios fluctuated along the length of each analyzed vibrissae, but exhibited similar values when matched to appropriate time scales based on length-specific curvature values. The vibrissae growth rates calculated from this captive seal are a key component in placing SIA data from vibrissae of wild pinnipeds within appropriate time frames. This study is the first to use vibrissae growth dynamics for appropriate interpretation of isotopic ratios in the northern elephant seal.

POSTERS (Saturday 4-5pm):

EXAMINING HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*) MIGRATORY BEHAVIOR USING PHYSIOLOGICAL AND DEMOGRAPHIC PARAMETERS

Casey Clark (Moss Landing Marine Lab), James Harvey, Alyson Fleming

Humpback whales exhibit the longest migration of any marine mammal, moving between productive high-latitude foraging areas and low-latitude breeding areas. Monterey Bay, California, is an important foraging habitat for whales that breed off Mexico and Central America. We collected skin and blubber biopsies (n = 131) from humpbacks in Monterey Bay from May to November 2011, and April to July 2012. Genetic sex identification, carbon and nitrogen stable isotope analysis, and progesterone assays were used to investigate migratory behavior. We examined how the sex ratio changed through time, and compared these changes with expected values calculated from the literature. The sex ratio did not differ greatly from parity during the study period. A great proportion of whales sampled in October and November 2011 were identified as female, providing support for the hypothesis that females are among the last to leave the feeding area. We examined variability in δ13C and δ15N early in the feeding season (April - June) to investigate the occurrence and detectability of a fasting signal within stable isotope ratios. Variability in isotope signatures remained relatively constant throughout the year, and there was no significant relationship between isotope values and Day of Year in 2011 ($p = 0.747$, $R2 = 0.004$; $p = 0.662$, $R2 = 0.007$) or 2012 ($p = 0.712$, $R2 = 0.002$; $p = 0.087$, $R2 = 0.048$). Thus the fasting effect was non-existent or not detectable. Data from the progesterone assays were used to infer pregnancy status of female humpbacks, establish a pregnancy rate, and to investigate intra-annual variability in this parameter. The pregnancy rate was unexpectedly low late in the year, contradicting previous suggestions that a female majority during this period would be made up primarily of pregnant animals.

DOLPHIN OCCURRENCE AND BEHAVIOR IN THE CONTEXT OF ORANGE COUNTY MARINE PROTECTED AREAS

Nicole Barbour (Orange Coast College), Miranda Domico (Orange Coast College) and Kayla B. Causey

Coastal cetaceans are undoubtedly affected by MPA designations. Therefore, information about the bidirectional relationship between cetacean and fisheries ecology in the context of MPAs is crucial to MPA planning, monitoring, and effectiveness. To provide a better understanding of how coastal cetaceans use MPAs, the Pacific coast common bottlenose dolphin, *Tursiops truncatus*, and long-beaked common dolphin, *Delphinus capensis*, occurrence, distribution, and behavior were studied in Orange County, CA from February 2011 – present. The study area includes five Marine Protected Areas (MPAs). Twenty eight boat surveys and 442 shore surveys documented 225 instances of dolphins in MPAs and 166 sightings of dolphins in non-MPA coastal areas. Of 337 bottlenose dolphin sightings, 199 (58.8%) occurred in MPAs. Of 26 sightings of common dolphins in the coastal region, 12 (46.1%) were in MPAs. Instantaneous scan sampling methods were used to document dolphin behavior during each sighting; every three minutes, behavior was classified as travel, feed, socialize, play, rest, or forage, and an activity budget was created. Dolphins spent a majority of their time traveling (72%) followed by feeding (15%), foraging (7%), socializing (5%), playing (3%), and resting (2%). Preliminary analyses suggest dolphins spend less time traveling and more time feeding within MPAs, but these differences only approached statistical significance. These findings indicate that bottlenose dolphins regularly move through MPAs and suggest the need for further monitoring in this area to determine how coastal dolphin behavior is impacting MPA ecology and vice versa.

COMPARING BIOLOGICAL AND ANTHROPOGENIC IMPACTS ON HUMPBACK WHALE (*MEGAPTERA NOVAENGLIAE*) POPULATIONS USING FLUKE SCARS OF THE CENTRAL NORTH PACIFIC STOCK

James Grundy (California State University Channel Islands)

Humpback whales (*Megaptera novaeangliae*), of the Central North Pacific, travel over 4,000 km during their seasonal migration between Alaskan and Hawaiian waters. This migration places humpbacks in high risk areas where physical damage results from anthropogenic and biological threats. These impacts can be detected through the examination of the whale's fluke, as scars accumulate over the life of the whale. In this study, I examined 264 images of, known humpback whale flukes gathered in Hawaiian waters between 2008 and 2012, in order to detect any gender bias in acquisition rates of scars and markers of physical damage. Scars indicated interactions and

contact with vessels, fishing lines, cookie-cutter shark (*Isistius brasiliensis*) bite marks and also rake marks along the fluke, suggesting interactions with their key predator, the killer whale (*Orcinus orca*). Results indicated no gender bias in rate of scarring due to anthropogenic causes, including vessel strikes (Fisher Exact Test; p=0.0398) or evidence of entanglement (Fishers Exact Test; p=0.162). However, evidence of association between gender and biological threats was evident, with females carrying more rake marks (X2 = 9.440, p=0.002) and cookie-cutter scars (X2 = 6.306, p=0.012). As both these predators preferentially target humpback whale calves rather than adults, these higher rates of scarring on females suggest increased exposure to these sub-lethal forms of predation during the maternal period, which would further elevate the costs associated with reproduction for female humpback whales.

URINARY TESTOSTERONE IN POLAR BEARS (*URSUS MARITIMUS*) AS AN INDICATOR OF TESTICULAR FUNCTION IN MALES AND FEMALES

Katie Pelon (UC Santa Cruz), Katrina Knott and Andrew Kouba

Polar bears are threatened in the wild due to habitat loss occurring as a result of global climate change. Captive breeding programs have the potential to act as a hedge against extinction. Unfortunately, low cub recruitment and poor reproductive success have resulted in a captive population challenged with low genetic diversity. A better understanding of polar bear reproductive physiology is necessary to successfully manage a healthy captive population. Testosterone (T) concentrations positively correlate with sexual behavior in both sexes, are involved with testicular function in males, and influence follicular activity in females. We hypothesized that the synchrony of elevated T in breeding pairs during the breeding season (January-May) is an important factor in successful fertilization following induced ovulation. Urine was collected several times/week, or opportunistically, from female (n=3) and male (n=6) polar bears housed at 9 North American zoos, and T was measured through enzyme immunoassay. Urinary T was highest in mature males (8-23 yrs, <1.0-21.3 ng/mg creatinine), and similar among an immature male (3 yrs, <1.0-2.0 ng/mg creatinine) and females (9-18 yrs, <1.0-3.9 ng/mg creatine). Elevated T in males occurred for approximately 52 days prior and during recorded breeding. Urinary T in females was also elevated during breeding, and matched fecal T profiles, validating urinary T as an indicator of estrous. In 2 of 5 breeding pairs, one of which resulted in the birth of cubs, elevated T concentrations in females were synchronized with those of the males. In the remaining pairs, 1 showed no T elevation for either sex, and 2 pairings were inconclusive due to infrequent urine collection. T in polar bears may be useful in evaluating breeding success and potentially conception. Improved sample collection in additional animals and breeding pairs are needed to verify whether testosterone can assist in management decisions involving mate pairings and pregnancy.

SURVIVAL AND MOVEMENT OF FEMALE HARBOR SEALS (*PHOCA VITULINA*) IN SAN FRANCISCO AND TOMALES BAYS, CALIFORNIA

Suzanne Manugian (Moss Landing Marine Labs), James Harvey and Denise Greig

There is a paucity of basic life history data, such as survival rates, for harbor seals (*Phoca vitulina*) in northern California. To estimate survival probabilities of female harbor seals, radio frequency transmitters (IMP/300/L, Telonics) were implanted subcutaneously between blubber and dorsal cervicular musculature. Tags were duty cycled to transmit eight hours daily during daylight hours to extend tag life to up three years. Adult and subadult females (n=32) in San Francisco (SFB) and Tomales (TB) Bays were tagged summer 2011 and tracked 20 months through spring 2013. Site-specific survival (Φ) and resight (p) rates were estimated for females using the Cormack-Jolly-Seber (CJS) model in program MARK. Individual covariates of axillary girth and (mass/standard length) were included in biologically appropriate models. The top model, based on AIC, included axillary girth and differing recapture rates between Bays: Φ(axillary girth) p(site). Based on the predicted constant survival probabilities for both SFB and TB (0.9820, SE = 0.01, 95% CI = 0.9468-0.9941), seal abundance is not limited by female survival. Different resight rates for SFB (0.0618, SE = 0.02, 95% CI 0.0374-0.1006) and TB (0.2685, SE = 0.03, 95% CI 0.2085-0.3383) could be explained by variations in haulout quality, amount of physical haulout space between Bays, or post-release monitoring sampling bias. These are the first female non-pup survival and resight estimates for harbor seals in California. We suggest the stable rate of the population within SFB is due to some reason other than poor subadult and adult female survival, perhaps emigration or poor pup survival, and recommend further evaluation of demographic data. Understanding population dynamics is integral to supporting future management and conservation decisions in northern California.

ORAL PRESENTATIONS (Sunday):

MESOPELAGIC FORAGING PUTS DEEP DIVING MARINE MAMMALS AT GREATER RISK OF MERCURY ACCUMULATION

Sarah Peterson (UC Santa Cruz), Joshua Ackerman and Daniel Costa

Northern elephant seals (*Mirounga angustirostris*) travel across the northeastern Pacific Ocean during their biannual migrations, foraging in mesopelagic (200-1000 m depth) coastal and open-ocean regions. We examined interactions between foraging ecology and mercury in this deep-diving marine predator. Although little is known about mercury in mesopelagic food webs, we know that mercury is more bioavailable in this zone due to marine chemistry. Elephant seals forage exclusively in this habitat and thus are potentially exposed to higher mercury concentrations than shallower-diving species. Blood, muscle, and fur were sampled from adult females and males before and after foraging trips during 2010-2012 and analyzed for total mercury (THg). Mercury concentrations in muscle ranged from 1.2-13.8 µg/g dw and in fur from 6.0-75.3 µg/g dw, which are among the highest concentrations observed in non-stranded marine predators. Foraging behavior was documented using satellite tags and time-depth recorders for all adult females. For these females, we examined relationships between mercury concentrations and oceanic ecoregions, distance to continental slope, mean dive depths of day and night foraging dives, stable isotopes (nitrogen and carbon), and age. Our results indicate that mesopelagic marine predators may be at greater risk for mercury accumulation than previously assumed and provide insight into the potential for mercury bioaccumulation in more elusive and potentially vulnerable species.

SPATIAL AND TEMPORAL DISTRIBUTION, HAULOUT USE AND MOVEMENT PATTERNS OF STELLER SEA LIONS OF STELLER SEA LIONS (*EUMETOPIAS JUBATUS*) IN NORTHERN CALIFORNIA

Allison Fuller (Humboldt State University) and Patricia Goley

I describe the spatial and temporal distribution, abundance and habitat use of Steller sea lions (Eumetopias jubatus) in northern California between 2006 and 2011 obtained through shore and at-sea surveys and by tracking branded individuals. Understanding Steller sea lion habitat use is critical in designing and implementing nearshore management initiatives such as the Marine Life Protection Act (MPLA) initiative. The MLPA initiative process began in northern California in 2009, affecting areas offshore of Mendocino, Humboldt and Del Norte counties. Between the Oregon border and Trinidad, California (Humboldt County) there is one rookery (Southwest Seal Rock) and eight non-breeding haulouts. Steller sea lions are more abundant on haulouts in northern California during the late spring and summer months than during the rest of the year. When Steller sea lions are numerous in the area, their distribution is influenced by age/sex class and breeding status. Adult males were seen more frequently on in-shore haulouts in both Trinidad and Crescent City, CA in late spring/early summer suggesting that these haulouts serve as staging areas for breeding or near-breeding aged bulls (Otter Rock mean = 7 ± 1, Sea Lion Rock mean = 4 ± 2, Castle Rock mean = 16 ± 5). Breeding Steller sea lion abundance peaked at Southwest Seal Rock during the June and July pupping and breeding season (mean = 574 ± 38). Presence of pups peaked at haulouts in Trinidad the late summer/early fall suggesting that these sites serve as "nurseries" for females and their dependent young (Otter Rock mean = 5 ± 2, Turtle Rocks mean = 6.3 ± 3). Steller sea lion pups were branded on Southwest Seal Rock in 2002 and 2004 by Oregon Department of Fish and Wildlife (ODFW) and National Marine Mammal Lab (NMML) as part of a larger population dynamics study. Females from these cohorts are now actively breeding in northern California, while fewer branded males have come back to the rookery during breeding season (49 females vs. 18 males). Resights of branded females were more common than males. Of the 62 branded animals that were seen in more than one year during the study period, 73% were female. Male Steller sea lions tended to be resighted farther from the natal site than females. Steller sea lions frequented many haulouts during a single year and females, in particular, showed fidelity to the northern California and southern Oregon near shore waters.

OXIDATIVE STRESS: A POTENTIAL COST OF BREEDING IN MALE AND FEMALE NORTHERN ELEPHANT SEALS (*MIROUNGA ANGUSTIROSTRIS*)

Jeff Sharick (Sonoma State University), Jose Pablo Vazques-Medina, Rudy Ortiz and Daniel E. Crocker

The trade-off between reproductive effort and survival is a key concept in life history theory. A variety of studies support the existence of this trade-off but the underlying physiological mechanisms are not well-understood. Oxidative stress has been proposed as a potential mechanism underlying the observed inverse relationship between

reproductive investment and lifespan. Prolonged fasting is associated with oxidative stress including increases in the production of reactive oxygen species, oxidative damage and inflammation. Elephant seals undergo prolonged fasts while maintaining high metabolic rates during breeding. Elephant seals have robust anti-oxidant defenses as evidenced by up-regulation of anti-oxidant enzymes and lack of oxidative damage in weaned pups undergoing extended developmental fasts. We investigated northern elephant seals of both sexes to assess oxidative stress associated with extended breeding fasts. We measured plasma changes in the activity of the oxidant producing enzyme, xanthine oxidase (XO), oxidative damage, inflammatory markers and antioxidant enzymes in 30 adult male and 35 adult female northern elephant seals across their 1-3 month breeding fast. XO levels were high and increased across the fast in both sexes. Plasma levels of anti-oxidant enzymes increased significantly in both sexes. With the exception of nitrotyrosine (NT), a marker for protein oxidation, plasma markers of damage or inflammation did not change in females. Plasma markers of lipid peroxidation (8-isoprostanes and 4-hydroxynonenal), DNA oxidation (8-hydroxy-2-deoxy Guanosine) and inflammation (tumor necrosis factor –α) increased over breeding in adult males, while plasma NT levels. XO, damage and inflammatory markers and antioxidant enzymes were strongly correlated in males but these relationships were weaker or non-existent in females. Anti-oxidant responses in females appear to prevent increased damage or inflammation over their 1 month breeding fast. Oxidative stress associated with the longer (3 month) fast in males exceeded these responses creating oxidative damage as a physiological cost of breeding.

DELINEATING MARINE MAMMAL HOME RANGES: A NEW ALGORITHM BASED ON KNOWLEDGE OF HABITAT SUSTAINABILITY AND AN ANALYSIS FOR SEA OTTERS (*ENHYDRA LUTRIS*)

Maxine Tarjan (UC Santa Cruz) and Tim Tinker

Geographically defining animal home ranges is necessary to formulate expectations about the environment with which an individual will interact. Statistical methods to estimate individual home ranges utilize previously observed re-sighting locations to estimate the future probability of an individual occurring at any point in space, and to delineate a boundary encompassing some cumulative probability of occurrence. A notable limitation of existing methods is their inability to incorporate information about underlying environmental features that influence animal space-use. Due to this limitation, existing methods often perform well in encompassing areas that are used, but perform poorly at identifying unused areas. This limitation is apparent for sea otters, whose space-use is restricted by the complex coastal boundary and water depth. Using radio-telemetry data on sea otter locations, we outline and evaluate a new method of home range estimation with probability values that reflect habitat suitability. We transformed re-sight locations to reflect landscape features, specifically coastal position and water depth. A bivariate kernel probability density function was generated in landscape space, and then back-translated to geographic space to define a permissible home range. We evaluated method performance using three criteria: the sensitivity of home range area to resight sample size, the minimum sample size requirement, and agreement between home range location and known sea otter behavior. Performance of the new method in each category was equivalent or superior to that of two commonly used methods: traditional kernel density estimation and local convex hull analysis. This method is broadly applicable to ecological studies of species whose home ranges are restricted by complex boundaries or across environmental gradients, such as water depth, primary productivity, or temperature. Increased accuracy in defining home ranges will allow researchers and resource managers to better understand habitat use requirements and ultimately improve conservation efforts for a variety of species.

THE BETTER TO EAT YOU WITH: THE COMPARATIVE FEEDING MORPHOLOGY OF PHOCID SEALS

Sarah Kienle (UC Santa Cruz)

Phocids (true seals) evolved feeding strategies to capture and consume prey underwater. Previous qualitative research hypothesized the existence of four feeding strategies in phocids: filter, grip and tear, pierce, and suction feeding. Most species are generalists, employing either pierce or suction feeding. Grip and tear and filter feeding are specialized strategies used only by *Hydrurga leptonyx* (leopard seal) and *Lobodon carcinophaga* (crabeater seal), respectively. The objectives of this study were to 1) determine whether the hypothesized feeding strategies were supported by qualitative and quantitative data, and 2) determine the feeding strategies used by extant phocid species. This was the first study of phocid feeding morphology. Three dimensional landmark data were collected from 220 specimens representing all extant species. Fifty-eight cranial and twenty-four mandibular landmarks were taken per specimen. Principal Component Analysis and Canonical Variate Analysis were performed to summarize cranial and mandibular variation. Data from facial musculature dissections and prey types were included to provide

a comprehensive picture of each strategy. The results of this study found evidence for three of the four previously hypothesized feeding strategies in phocids: filter, grip and tear, and suction. However, there was no evidence of pierce feeding being a distinct feeding category. Instead, most species are generalists, using biting and suction to opportunistically capture prey. Grip and tear and filter feeding are derived strategies that require specific morphological adaptations; these unique adaptations have allowed *H. leptonyx* and *L. carcinophaga* to exploit novel niches and prey types. *Cystophora cristata* (hooded seal) and *Mirounga* spp. (elephant seals) were found to be specialized suction feeders, similar to *Erignathus barbatus* (bearded seal). These results provide a framework for understanding the feeding strategies employed by phocids, enabling us to investigate the evolution of each strategy as well as predict the effects that habitat changes will have on each species.

SEASONAL CHANGES IN THE NUMBERS AND DISTRIBUTION OF HAULED OUT PACIFIC HARBOR SEALS (*PHOCA VITULINA RICHARDII*) IN SOUTH HUMBOLDT BAY, CALIFORNIA, CALIFORNIA: IMPLICATIONS OF A NEWLY ENACTED MARINE PROTECTED AREA

Wiley Archibald (Humboldt State University), Dawn Goley and Daniel Hobby

Baseline data on the spatial and temporal distribution of marine mammals are essential for assessing the efficacy of conservation and management efforts worldwide. While techniques such as tracking and aerial surveys can be useful, they are limited in scope and are often costly in both time and resources. Monitoring populations at specific locations can provide insight into long-term spatial and temporal patterns in pinnipeds. The aim of this study was to document the seasonal changes in hauled-out Pacific harbor seal (*Phoca vitulina richardii*) abundance and distribution within South Humboldt Bay, California, USA- focusing specifically on their relationship to a newly implemented marine protected area (MPA). Beginning in July 2012, we conducted weekly shore-based surveys of seals hauled-out at low tide. Seals were observed using a spotting scope from two sites around the bay. Their group locations and numbers were hand-drawn onto maps, which were later digitized into a geographic information system (GIS). In addition, photographs were used to confirm seal placements. Through March 2013, the average number of seals declined significantly with the season. This decline occurred both inside and outside the MPA, however the rates of decline were drastically different. The number of distinct haul-out groups (> 10 seal lengths apart) also decreased steadily, condensing seals into only a few groups. In addition, kernel and cluster analyses have shown certain locations are chosen more than others for hauling-out. These data reaffirm the need for long-term monitoring to determine changes in habitat use due to a MPA.

BODY RESERVES AND SWIMMING ACTIVITY DO NOT IMPACT DEVELOPMENT OF DIVE CAPACITY DURING THE POST WEANING FAST IN NORTHERN ELEPHANT SEAL PUPS (*MIROUNGA ANGUSTIROSTRIS*)

Derek Somo (Sonoma State University), David Ensminger, Jeffrey Sharick, Shane Kanatous and Daniel Crocker

The post-weaning fast (PWF) in seals has been associated with development of the physiological and behavioral capacity to perform the breath-hold dives which characterize at-sea behavior in these species. Previous studies in juvenile northern elephant seals (*Mirounga angustirostris*) indicate that the duration of the PWF varies substantially with body reserves at weaning, and many suggest that the PWF allows seal pups to develop the capacity to dive before initiating independent foraging at sea. However, few studies have examined the effects of activity in the water on the development of dive capacity during the PWF, and we are aware of no studies of the effect of body reserves at weaning on development. We measured energy reserves at weaning and made longitudinal measurements of components of blood and muscle oxygen stores, regulatory hormones, iron status markers, muscle metabolic enzyme activities, and field metabolic rate in northern elephant seal pups during the first 8 weeks of the PWF. We recorded activity of the pups in the water during the final three weeks of the sampling period. Although myoglobin concentration, a critical determinant of the muscle oxygen store, increases across the first eight weeks of the PWF, other key components of aerobic diving capacity do not increase during this same time period and show no relationship with magnitude of body reserves at weaning or activity in the water. Development of diving capacity may largely occur near the end of the fast or after juveniles have left the natal rookery to initiate independent foraging.

DIVING AND FORAGING BEHAVIOR OF SOUTHERN SEA OTTERS IN RESOURCE LIMITED HABITATS: ARE SEA OTTERS PUSHING THEIR PHYSIOLOGICAL LIMITS IN ORDER TO SURVIVE?

Nicole Thometz (UC Santa Cruz), Martin T. Tinker, Michelle M. Staedler and Terrie M. Williams

Recovery of the threatened southern sea otter (*Enhydra lutris nereis*) has been slow and halting, marked by occasional periods of decline. Elevated mortality, particularly among reproductive females, is the primary factor limiting recovery, and while there is no single underlying source of mortality, nutritional stress is believed to be a contributing factor in areas of high sea otter density in central California. Sea otters are benthic foragers with exceptional metabolic demands and little energetic reserves, and thus diving capability and behavior are critical components of food acquisition and survival. We utilized archival time-depth recorders (TDRs) to study the foraging behavior of southern sea otters, to elucidate behavioral responses to resource limitation and in particular to determine whether sea otters occasionally or regularly exceed their calculated aerobic dive limits (cADLs). TDRs were implanted in 30 adults and 5 sub-adults in two high-density populations in central California. TDRs recorded the diving behavior (15 different parameters) of each individual for an average of 1-2 years. Dive profiles differed significantly by age, sex, and reproductive status. Foraging bouts of sub-adults were significantly longer (129.4±16.0min) and consisted of more dives (58.4±8.9) than adults. Adult males exhibited the deepest average maximum dive depth (61.8±5.6m). Study animals spent a significantly higher percentage of their day foraging (40-48%) as compared to sea otters in resource-abundant habitats (25%). We found that in all groups, less than 2% of dives exceeded age-specific cADLs. These data indicate that sea otters respond to resource limitation by spending a greater proportion of their day foraging, increasing foraging bout length and number of dives per bout, rather than increasing dive times to exceed cADLs. Because adult females with large pups and sub-adults spent the greatest proportion of time foraging, they may be at highest risk from future changes to prey distribution and abundance.

AUDITORY PROFILES OF SPOTTED (*PHOCA LARGHA*) AND RINGED SEALS (*PUSA HISPIDA*)

Jillian M. Sills (UC Santa Cruz), Brandon L. Southall and Colleen Reichmuth

As ice retreats and industrialization increases in Arctic environments, among the many concerns for marine mammals is the potential for behavioral or auditory effects resulting from degradation of acoustic habitat. While many ice seals are known to emit underwater vocalizations, much remains to be learned about their reliance on acoustic cues for orientation, communication, and predator and prey detection in typical conditions of relative darkness. In terms of sound reception, there is limited information available for Arctic seals – some auditory data exist for harp and ringed seals but the most comprehensive data are for the more temperate-living harbor seals. Our aim in this study was to provide quantitative, species-typical auditory profiles for spotted and ringed seals tested in identical experimental conditions. Using a behavioral paradigm, we measured detection thresholds for aerial and underwater tones at frequencies spanning the range of hearing. Two individuals of each species were trained to perform the signal detection task in quiet conditions and in the presence of octave-band masking noise. The resultant audiograms for the spotted seals show acute hearing in both media, although the frequency range of best sensitivity extends two octaves higher under water than in air. The measured peak sensitivity was 51 dB re 1 µPa in water (12.8 kHz) and -13 dB re 20 µPa in air (3.2 kHz). Audiometric testing of the ringed seals is ongoing, but results thus far indicate that hearing sensitivity for the two species is similar. Signal-to-noise ratios measured for both species increased monotonically from 12 dB at 0.1 kHz to 30 dB at 25.6 kHz, suggesting that detecting sounds within background noise is important to these seals. These psychoacoustic studies thoroughly describe the amphibious hearing capabilities of Arctic seals, and inform best management practices for these vulnerable species in a rapidly changing environment.

A MODEL OF OPTIMAL DIVING FOR BOTTLENOSE DOLPHINS UNDER HUMAN DISTURBANCE

John Symons (University of Aberdeen) and David Lusseau

Short-term behavioral responses to human disturbance are well documented in cetaceans, including responses similar to those observed under natural predation risk. However, to understand potential long-term consequences of human disturbance at the population level, we need to first link these short-term responses to bioenergetics effects. Here we developed a theoretical optimal dive model for bottlenose dolphins diving under three potential types of perceived surface predation risks representing human interaction (decreasing instantaneous risk, increasing instantaneous risk, and no predation risk). We then tested the predictions from these models about the effect these interactions would have on net energetic gain at each foraging bout using individual focal follow data. Individual inter-breath interval and boat presence were recorded during foraging bouts observed between December 1999 and February 2002 in the Doubtful Sound, New Zealand, bottlenose dolphin population. We used mixture models to distinguish the different phases of the U-shaped dives performed by individual dolphins. We found that males

significantly increased bottom times and performed fewer bottom dives when boats were present, matching predictions of our model for a perceived decreasing instantaneous risk. In contrast, females significantly decreased bottom times and increased the frequency of bottom dives, matching predictions from the model for a perceived increasing instantaneous risk. Therefore, our results suggest differences in the perception of risk between sexes. From our theoretical model we can conclude that the observed integration of this perceived risk in the way dolphins managed their dives would lead to a decrease in net energy gain when boats interact with dolphins when they are foraging. This is of particular concern as the population is currently listed as critically endangered.

EFFECTS OF AN ACUTE STIMULATION OF THE HPA AXIS ON SEXUAL AND STRESS HORMONES IN MALE NORTHERN ELEPHANT SEALS

David Ensminger (Sonoma State University), Derek Somo, Jeffrey Sharick, Dorian Houser and Daniel Crocker

Little is known about variations in HPA responsiveness and how it affects hormone and metabolite concentrations in wild pinnipeds. To characterize the changes due to acute stress, 18 free living adult male Northern Elephant seals (*Mirounga angustirostris*) were physiologically challenged though an injection of slow release adrenocorticotropic hormone (ACTH). 6 males were challenged during early breeding (EB), 6 late breeding (LB), and 6 mid-molt (MM) to identify differences between fasting states. They were blood sampled over 2 hrs and again at 48 hrs to identify effects of prolonged stress. Cortisol increased two-fold during breeding, and stayed elevated at 48 hrs in EB. Testosterone decreased three-fold during EB but was undetectable LB. Aldosterone increased nearly ten-fold EB, three-fold LB, and returned to baseline at 48hrs, while MM values increased six-fold which is not seen in terrestrial mammals. Glucose was unaffected during breeding, but increased during MM. Lactated was unaffected during breeding, but decreased during MM. Total triidothyronine, reverse triidothyronine, and thyroxine decreased by 48 hrs EB, but remained un-affected LB and MM. Blood urea nitrogen rose across EB, LB, and MM during the 2 hrs, but at 48 hrs, it had returned to baseline EB, while it was still increase LB. Ketones remained constant constant during LB and MM, while increasing at 48 hrs during EB. NEFA rose during the 2 hrs for EB, LB, and MM, and continued to rise during EB while values LB dropped below baseline. Potassium levels rose during the 2 hrs, and decreased at 48 hrs for EB and LB. Sodium concentrations remained stable across all time periods. Males were most affected during breeding season, which has huge implications for stresses affect on their reproduction.

DETECTION OF COMPLEX SOUNDS IN QUIET AND MASKED CONDITIONS BY A CALIFORNIA SEA LION (*ZALOPHUS CALIFORNIANUS*) AND A HARBOR SEAL (*PHOCA VITULINA*)

Kane Cunningham (UC Santa Cruz), Brandon Southall and Colleen Reichmuth

Standard audiometric data, such as absolute detection thresholds and critical ratios, are often used to inform noise-exposure limits for marine mammals. However, these data are traditionally generated using simple stimuli, such as pure-tones and flat-spectrum noise, while natural sounds tend to have more complex structure. In this experiment, detection thresholds for complex stimuli were obtained in (a) quiet and (b) masked conditions for one California sea lion and one harbor seal. For part (a), three stimuli types were synthesized, each isolating a common feature of marine mammal vocalizations: amplitude modulation (AM), frequency modulation (FM), and harmonic structure. Detection thresholds in quiet conditions were then obtained for these stimuli at frequencies spanning the functional hearing range. For part (b), the same complex signals were combined with flat-spectrum noise or shipping noise. To test how well standard hearing data predict detection of complex sounds, the results of parts (a) and (b) were compared to a priori predictions based on previously obtained audiogram and critical ratio data. Preliminary results indicate that absolute detection thresholds for AM and FM stimuli are reliably predicted by audiogram data, but that thresholds for harmonic stimuli are lower than predicted, in some cases by more than 10 dB.