Appendices

Appendix A: Literature citations resulting from the activities of the MMHSRP and our collaborators

Appendix B: A summary of recent MMHSRP research activities

Appendix C: Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release

Appendix D: NMFS Policy Directive 02-308 and Procedural Directives 02-308-01 and 02-308-02

Appendix E: Selected MMHSRP Protocols

Hazing

E-1: Supporting information for the Killer Whale Section of the Northwest Wildlife Response Plan, Chapter 9970 of the NWACP (available at: http://response.restoration.noaa.gov/sites/default/files/whale_response.pdf)

Disentanglement

E-2: Large Whale Disentanglement Network Advancement Policies

E-3: Alaska Department of Fish & Game Steller Sea Lion Disentanglement Response Protocol

Diagnostic Imaging

E-4: Monk seal Radiography Safety Requirements and Protocol

Sample Collection and Analysis

E-5: Marine Mammal Necropsy: An introductory guide for stranding responders and field biologists (available at: http://hdl.handle.net/1912/1823)

E-6: Odontocete Salvage, Necropsy, Ear Extraction, and Imaging Protocols (available at: http://csi.whoi.edu/download/file/fid/1616)

E-7: Step-by-step Protocol for Gas Sampling in Marine Mammals (available at: http://www.whoi.edu/cms/files/Gas_Sampling_step_by_step_protocol_172344.pdf)

E-8: Killer whale necropsy and disease testing protocol (available at: http://www.seadocsociety.org/wp-content/uploads/Orca-necropsy-protocol-FINAL-May-15-2014.pdf)

E-9: Handbook for recognizing, evaluating, and documenting human interaction in stranded cetaceans and pinnipeds (available at: http://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-510.pdf)

Administration of Medications

E-10: Implementation Strategy for Emergency Vaccination of Hawaiian Monk Seals (DRAFT)

E-11: Right whale sedation protocol for EG 3311

Appendix F: Examples of UASs that have been used by NOAA

Appendix G: Draft Pinniped and Cetacean Oil Spill Response Guidelines (note: when final, this will be published as a NOAA Tech Memo and publicly available. This draft version is provided for PR1 and PR5's use)

Appendix H: MMHSRP Vaccination Plan

Appendix A
Selected Recent Publications by the MMHSRP and Co-Investigators

Acevedo-Whitehouse and F. Gulland (2011). MHC polymorphisms drive seroconversion to infective leptospires in California sea lions. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 7.

Akmajian, A., J. Calambokidis, J. L. Huggins and D. Lambourn (2011). Multi-species comparison of trace metal contaminants from marine mammals stranded in Washington State between 2004 and 2010. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 9.

Akmajian, A. M., D. M. Lambourn, M. M. Lance, S. Raverty and J. K. Gaydos (2012). Mortality related to spotted ratfish (Hydrolagus colliei) in Pacific harbor seals (Phoca vitulina) in Washington State. Journal of Wildlife Diseases 48(4): 1057-1062.

Tissue perforation and penetration by dorsal fin spines of spotted ratfish (Hydrolagus colliei) were responsible for the death of seven harbor seals (Phoca vitulina) in Washington State (USA) between 2006 and 2011. In six animals, necropsy revealed spines or spine parts that had perforated the esophagus or stomach and migrated into vital tissues, resulting in hemothorax, pneumothorax, pleuritis, and peritonitis. In a seventh case, a ratfish spine was recovered from the mouth of a harbor seal euthanized due to clinical symptoms of encephalitis. Gross examination revealed an abscess within the left cerebrum, which was attributed to direct extension of inflammatory infiltrate associated with the ratfish spine. Between 2009 and 2011, spotted ratfish spines were also recovered from the head or neck region of three Steller sea lions (Eumetopias jubatus) and one California sea lion (Zalophus californianus). Ratfish-related trauma appears to be a novel mortality factor for harbor seals in Washington State and could be related to increased ratfish abundance and a shifting prey base for harbor seals. Keywords: Harbor seal; Hydrolagus colliei; Phoca vitulina' predator-prey; spotted ratfish; Washington State.

Andersen, M. S., T. V. N. Cole, K. A. Forney, T. C. Eagle, S. Horstman, L. P. Garrison, B. M. Allen and A. G. Henry (2011). Distinguishing serious from non-serious injuries of marine mammals. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 13-14.

Anthony, S. J., J. A. St. Leger, I. Navarrete-Macias, E. Nilson, M. Sanchez-Leon, E. Liang, T. Seimon, K. Jain, W. Karesh, P. Daszak, T. Briese and W. I. Lipkin (2013). "Identification of a novel cetacean polyomavirus from a common dolphin (Delphinus delphis) with tracheobronchitis." PLoS ONE 8(7): e68239.

A female short-beaked common dolphin calf was found stranded in San Diego, California in October 2010, presenting with multifocal ulcerative lesions in the trachea and bronchi. Viral particles suggestive of polyomavirus were detected by EM, and subsequently confirmed by PCR and sequencing. Full genome sequencing (Ion Torrent) revealed a circular dsDNA genome of 5,159 bp that was shown to form a distinct lineage within the genus Polyomavirus based on phylogenetic analysis of the early and late transcriptomes. Viral infection and distribution in laryngeal mucosa was characterised using in-situ hybridisation, and apoptosis observed in the virus-infected region. These results demonstrate that polyomaviruses can be associated with respiratory disease in cetaceans, and expand our knowledge of their diversity and clinical significance in marine mammals.

Antonelis, G., M. Snover, F. Parrish and C. L. Littnan (2009). Potential positive and negative impacts of commercial fisheries on survival of juvenile Hawaiian monk seals (Monachus schauinslandi) at French

Frigate Shoals. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 17.

Apprill, A., T. A. Mooney, E. Lyman, A. K. Stimpert and M. S. Rappe (2011). "Humpback whales harbour a combination of specific and variable skin bacteria." Environmental Microbiology Reports 3(2): 223-232.

Investigations of marine mammal skin-associated microbiota are limited to cultivation-based studies of lesioned individuals, resulting in a lack of understanding about the composition of 'normal' skin-associated microbial communities, their variation among individuals, and whether or not the microbial communities change with host health or environmental exposures. In this study, bacterial communities associated with the skin of 19 North Pacific humpback whales (Megaptera novaeangliae), including skin from three health-compromised individuals, were examined using small subunit ribosomal RNA gene-based culture-independent techniques. These analyses revealed that the skin-associated bacteria were significantly different from free-living bacterial communities in the surrounding seawater. Two novel groups within the Flavobacteriaceae family of the Bacteroidetes phylum were found to be associated with multiple whales, including a species within the Tenacibaculum genus that associated with 95% of the individuals. Statistical analyses revealed that a group of eight 'healthy' whales harboured similar microbial communities, while the health-compromised and other 'healthy' animals harboured communities that were unique to the specific animal. These results describe two components of the whale skin bacterial community: a specific and potentially co-evolved fraction, and a more variable microbial community fraction that may offer a diagnostic-type tool for investigating the health and life-related events of these endangered animals.

Apprill, A., J. Robbins, A. M. Eren, A. A. Pack, J. Reveillaud, D. Mattila, M. Moore, M. Niemeyer, K. M. T. Moore and T. J. Mincer (2014). "Humpback whale populations share a core skin bacterial community: Towards a health index for marine mammals?" PLoS ONE 9(3): e90785.

Microbes are now well regarded for their important role in mammalian health. The microbiology of skin – a unique interface between the host and environment - is a major research focus in human health and skin disorders, but is less explored in other mammals. Here, we report on a cross-population study of the skin-associated bacterial community of humpback whales (Megaptera novaeangliae), and examine the potential for a core bacterial community and its variability with host (endogenous) or geographic/environmental (exogenous) specific factors. Skin biopsies or freshly sloughed skin from 56 individuals were sampled from populations in the North Atlantic, North Pacific and South Pacific oceans and bacteria were characterized using 454 pyrosequencing of SSU rRNA genes. Phylogenetic and statistical analyses revealed the ubiquity and abundance of bacteria belonging to the Flavobacteria genus Tenacibaculum and the Gammaproteobacteria genus Psychrobacter across the whale populations. Scanning electron microscopy of skin indicated that microbial cells colonize the skin surface. Despite the ubiquity of Tenacibaculum and Psychrobater spp, the relative composition of the skin-bacterial community differed significantly by geographic area as well as metabolic state of the animals (feeding versus starving during migration and breeding), suggesting that both exogenous and endogenous factors may play a role in influencing the skin-bacteria. Further, characteristics of the skin bacterial community from these free-swimming individuals were assembled and compared to two entangled and three dead individuals, revealing a decrease in the central or core bacterial community members (Tenacibaculum and Psychrobater spp), as well as the emergence of potential pathogens in the latter cases. This is the first discovery of a cross-population, shared skin bacterial community. This research suggests that the skin bacteria may be connected to humpback health and immunity and could possibly serve as a useful index for health and skin disorder monitoring of threatened and endangered marine mammals

Apprill, A., J. Robbins, T. Mincer, A. A. Pack and D. K. Mattila (2011). Specificity of the humpback whale skin microbiome across geographically distinct populations. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 16.

Arthur, L., W. McLellan, B. Woodward, M. Piscitelli, J. Winn and D. Pabst (2014). "Estimating force outputs of cetacean axial locomotor muscles." Integrative and Comparative Biology 54(Supplement 1): E238.

Arthur, L. H., B. P. Velten, S. T. Kinsey, W. A. McLellan and D. A. Pabst (2013). "Oxygen storage capacity of a primary locomotor muscle in two similarly-sized, pelagic dolphins." Integrative and Comparative Biology 53(Supplement 1): E239.

Bachman, M. J., J. M. Keller, K. L. West and B. A. Jensen (2014). "Persistent organic pollutant concentrations in blubber of 16 species of cetaceans stranded in the Pacific Islands from 1997 through 2011." Science of the Total Environment 488-489: 115-123.

Persistent organic pollutants (POPs) are toxic man-made chemicals that bioaccumulate and biomagnify in food webs, making them a ubiquitous threat to the marine environment. Although many studies have determined concentrations of POPs in top predators, no studies have quantified POPs in stranded cetaceans within the last 30 years around the Hawaiian Islands. A suite of POPs was measured in the blubber of 16 cetacean species that stranded in the tropical Pacific, including Hawai'i from 1997 to 2011. The sample set includes odontocetes (n = 39) and mysticetes (n = 3). Median (range) contaminant concentrations in ng/g lipid for the most representative species category (delphinids excluding killer whales [n = 27]) are: 9650 (444–99,100) for Σ DDTs, 6240 (408–50,200) for Σ PCBs, 1380 (673–9520) for Σ chlordanes, 1230 (134–5510) for Σ toxaphenes, 269 (199–10,100) for Σ PBDEs, 280 (214–4190) for mirex, 176 (543–857) for HCB, 481 (< 542–566) for Σ HCHs, 339 (< 242–990) for Σ HBCDs, 165 (< 0435–117) for octachlorostyrene and 149 (< 207–131) for pentachlorobenzene. Σ PCB concentrations in these Pacific Island cetaceans approach and sometimes exceed proposed toxic threshold values. Backward stepwise multiple regressions indicated the influence of life history parameters on contaminant concentrations when performed with three independent variables (species category, year of stranding, and sex/age class). No temporal trends were noted (p > 0063), but sex/age class influences were evident with adult males exhibiting greater contaminant loads than adult females and juveniles for Σ DDT, Σ PCBs, Σ CHLs, and mirex (p ≤ 0036). POP concentrations were lower in mysticetes than odontocetes for many compound classes (p ≤ 0003). p,p'-DDE/ Σ DDTs ratios were greater than 06 for all species except humpback whales, suggesting exposure to an old DDT source. These POP levels are high enough to warrant concern and continued monitoringKeywords: Hawai'i; Pacific; Cetaceans; Marine mammals; Persistent organic pollutants; POPs

Bagge, L. E., H. N. Koopman, A. Pokorny, W. A. McLellan and D. A. Pabst (2011). "Depth-specific fatty acid composition and temperature dependent thermal properties of the blubber of short-finned pilot whales (Globicephala macrorhynchus)." Integrative and Comparative Biology 51(Supplement 1): E5.

Bagge, L. E., H. N. Koopman, S. A. Rommel, W. A. McLellan and D. A. Pabst (2012). "Lipid class and depth-specific thermal properties in the blubber of the short-finned pilot whale and the pygmy sperm whale." Journal of Experimental Biology 215(24): 4330-4339.

Blubber, the specialized hypodermis of cetaceans, provides thermal insulation through the quantity and quality of lipids it contains. Quality refers to percent lipid content; however, not all lipids are the same. Certain deep-diving cetacean groups possess blubber with lipids - wax esters (WE) - that are not typically found in mammals, and the insulative quality of 'waxy' blubber is unknown. Our study

explored the influence of lipid storage class blubber WE in pygmy sperm whales (Kogia breviceps; N=7) and typical mammalian triacylglycerols in short-finned pilot whales (Globicephala macrorhynchus; N=7) - on blubber's thermal properties. Although the blubber of both species had similar total lipid contents, the thermal conductivity of G. macrorhynchus blubber (0.20+/- 0.01 W m(-1) degrees C-1) was significantly higher than that of K. breviceps (0.15+/- 0.01. W m(-1) degrees C-1; P=0.0006). These results suggest that lipid class significantly influences the ability of blubber to resist heat flow. In addition, because the lipid content of blubber is known to be stratified, we measured its depth-specific thermal conductivities. In K. breviceps blubber, the depth-specific conductivity values tended to vary inversely with lipid content. In contrast, G. macrorhynchus blubber displayed unexpected depth-specific relationships between lipid content and conductivity, which suggests that temperature-dependent effects, such as melting, may be occurring. Differences in heat flux measurements across the depth of the blubber samples provide evidence that both species are capable of storing heat in their blubber. The function of blubber as an insulator is complex and may rely upon its lipid class, stratified composition and dynamic heat storage capabilities.Author Keywords: odontocete; cetacean; thermal conductivity; wax ester; triacylglycerol.

Bagge, L. E., W. A. McLellan, H. N. Koopman, R. J. McAlarney, P. B. Nilsson, J. E. Blum and D. A. Pabst (2009). Thermal properties of the blubber of adult female shortfinned pilot whales (Globicephala macrorhynchus). Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 22.

Balmer, B., L. Schwacke, R. Wells, J. Adams, C. George, S. Lane, W. McLellan, P. Rosel, K. Sparks, T. Speakman and A. Pabst (2011). Bottlenose dolphin (Tursiops truncatus) stock structure within the estuaries of southern Georgia, U.S.A. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 24-25.

Balmer, B. C., L. H. Schwacke and R. S. Wells (2010). "Linking dive behavior to satellite-linked tag condition for a bottlenose dolphin (Tursiops truncatus) along Florida's northern Gulf of Mexico coast." Aquatic Mammals 36(1): 1-8.

Satellite-linked telemetry is a valuable method to identify small cetacean movement patterns and dive behavior. Data collection from satellite-linked tracking is less labor intensive than comparable radio tracking studies in which intensive field work is required post-tagging. However, there are few studies that have assessed the effects of satellite-linked transmitter attachment and retention on the tagged individual. Dolphin X08, a 24-y-old, male bottlenose dolphin (Tursiops truncatus) captured and released along the northern Gulf coast of Florida during a health assessment project, was tagged with a SPLASH satellite-linked transmitter (Wildlife Computers, Redmond, WA, USA) to remotely obtain data on movement patterns and dive behavior. In addition to the satellite-linked transmitter, a VHF radio transmitter was mounted to X08's dorsal fin to provide short-term movement pattern data and to allow for position acquisition to observe X08 with the satellite-linked transmitter. X08's satellite-linked tag transmitted location data for 54 days and dive duration data for 35 of those days. X08's VHF tag transmitted for over 94 days and allowed for complete monitoring of the satellite-linked tag's life. Dive duration data changed throughout the course of the satellite-linked tag transmissions. These dive data, along with follow-up observations, suggest that as the stability of the satellite-linked tag on the dorsal fin decreased, the number of longer dives increased, possibly to mitigate the amount of time that the satellite-linked tag came into contact with the water surface. This study was the first to identify movement patterns and dive durations of a bottlenose dolphin along the northern Gulf coast of Florida as well as to monitor satellite-linked tag condition throughout the transmission period. Keywords: satellite-linked telemetry, dive dura-tions, radio telemetry, bottlenose dolphin, Tursiops truncatus

Balmer, B. C., L. H. Schwacke, R. S. Wells, J. D. Adams, R. C. George, S. M. Lane, W. A. McLellan, P. E. Rosel, K. Sparks, T. Speakman, E. S. Zolman and D. A. Pabst (2013). "Comparison of abundance and habitat usage for common bottlenose dolphins between sites exposed to differential anthropogenic stressors within the estuaries of southern Georgia, USA." Marine Mammal Science 29(2): E114-E135.

The health of common bottlenose dolphins (Tursiops truncatus) within southern Georgia estuaries is of particular concern due to high levels of anthropogeniccontaminants in their tissues. Dolphins in this region have the highest polychlorinated biphenyl (PCB) concentrations recorded for any marine mammal and these concentrations correlate to distance from a Superfund point-source in the Turtle/Brunswick River Estuary (TBRE). Currently, little is known aboutthe population structure of dolphins in this region. This study identifies and compares baseline data on abundance, habitat use, site-fidelity, and ranging patterns of dolphins across two adjacent field sites; Brunswick, including the TBRE, and Sapelo, including the Sapelo Island National Estuarine ResearchReserve. Sapelo is relatively undeveloped and was selected for comparison to the more contaminated TBRE. Dolphin densities increased with tributary size inboth sites but dolphin density and total abundance were significantly higher in Sapelo than in Brunswick. Anthropogenic stressors within the TBRE may be animportant factor contributing to the differences in abundance, density, and habitat use observed in this study.Keywords: abundance, anthropogenic stressors, bottlenose dolphin, density, habitat use, Tursiops truncatus.

Balmer, B. C., L. H. Schwacke, R. S. Wells, R. C. George, J. Hoguet, J. R. Kucklick, S. M. Lane, A. Martinez, W. A. McLellan, P. E. Rosel, T. K. Rowles, K. Sparks, T. Speakman, E.S. Zolman, and D.A. Pabst (2011). "Relationship between persistent organic pollutants (POPs) and ranging patterns in common bottlenose dolphins (Tursiops truncatus) from coastal Georgia, USA." Science of the Total Environment 409(11): 2094-2101.

Balmer, B. C., R. S. Wells, L. E. Howle, A. A. Barleycom, W. A. McLellan, D. A. Pabst, T. K. Rowles, L. H. Schwacke, F. I. Townsend, A. J. Westgate and E. S. Zolman (2014). "Advances in cetacean telemetry: A review of single-pin transmitter attachment techniques on small cetaceans and development of a new satellite-linked transmitter design." Marine Mammal Science 30(2): 656-673.

Electronic tags have proven to be valuable tools in assessing small cetacean movement and behavior. However, problems associated with tag size and attachment have limited duration and damaged dorsal fins. These outcomes have motivated researchers to develop a new satellite-linked tag design that reduces detrimental effects to tagged animals, while increasing transmission durations. The goals of this study were to review previous studies that deployed single-pin transmitters and determine factors that influence transmission duration. Then, test these factors utilizing computational fluid dynamics (CFD) models to identify an optimal single-pin satellite-linked tag design, and evaluate this prototype through field studies. A review of four projects, which deployed 77 single-pin radio tags, determined that tags attached along the lower third of the dorsal fin and approximately 33 mm from the trailing edge resulted in longer transmission durations and reduced negative impacts to the dorsal fin. Based upon these results and CFD modeling, prototype, single-pin satellite-linked tags (n = 25) transmitted for 163 ± 22 d (mean ± 95% CI) which greatly exceeded transmissions for previous small cetacean telemetry studies. These results suggest that the newly developed single-pin satellite-linked tag design strikes a balance between reducing impacts to the individual while maximizing transmissionsKeywords: bottlenose dolphin; computational fluid dynamics; telemetry; Tursiops truncatus

Balmer, B. C., R. S. Wells, L. H. Schwacke, T. K. Rowles, C. Hunter, E. S. Zolman, F. I. Townsend, B. Danielson, A. J. Westgate, W. A. McLellan and D. A. Pabst (2011). "Evaluation of a single-pin, satellite-

linked transmitter deployed on bottlenose dolphins (Tursiops truncatus) along the coast of Georgia, USA." Aquatic Mammals 37(2): 187-192.

No abstract

Balmer, B. C., R. S. Wells, L. H. Schwacke, J. H. Schwacke, B. Danielson, R. C. George, S. M. Lane, W. A. McLellan, D. A. Pabst, K. Sparks, T. R. Speakman, F. I. Townsend and E. S. Zolman (2013). "Integrating multiple techniques to identify stock boundaries of common bottlenose dolphins (Tursiops truncatus)." Aquatic Conservation: Marine and Freshwater Ecosystems.

Under US policy, a stock is a group of animals shown to be demographically independent from other such groups. Evidence of demographic delineations for marine mammal stocks is gained primarily through genetic analysis. However, additional techniques play an important role in determining fine-scale ranging patterns that can be used to define a stock's geographic boundaries. In cases where genetic studies have not yet been performed, movement and ranging pattern data are essential in identifying a targeted geographic region for tissue sampling and genetic studies. Photo-identification surveys, vessel-based radio telemetry, automated radio telemetry systems (ARTS), and satellite-linked telemetry are sampling techniques that have been used to determine common bottlenose dolphin ranging patterns and provide detailed insight into stock boundaries. The results of near simultaneous use of these sampling techniques are compared using data from a case study of bottlenose dolphins within the estuaries of southern Georgia. Satellite-linked and radio telemetry were determined to be useful sampling techniques for identification of short-term ranging patterns. Satellite-linked telemetry had the second lowest cost per location ($122) and identified dolphin ranging patterns within and outside of the study area boundaries. Vessel-based radio telemetry was more costly ($195 per location) and had relatively limited tracking coverage. However, this sampling technique permitted visual observations of animal and tag condition. The combination of vessel-based radio telemetry and ARTS, which had the lowest cost per location ($34), was an effective method for determining ranging patterns of tagged individuals within and outside of the study area. Photo-identification surveys, relative to satellite-linked and radio telemetry, were not as efficient for determination of targeted individuals' short-term ranging patterns and had the highest cost per location of the four sampling techniques ($292). However, photo-identification is more effective than any other technique for compiling data on large numbers of individuals within a designated study area. Photo-identification surveys are essential for long-term monitoring and provide additional insight into dolphin stock structure that cannot be determined through telemetry alone.

Barbieri, M. (2011). Understanding thermoregulatory physiology in a community of wild bottlenose dolphins and its implications for marine mammal population and ocean health. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 5.

Barbieri, M. M., W. A. McLellan, R. S. Wells, J. E. Blum, S. Hofmann, J. Gannon and D. A. Pabst (2010). "Using infrared thermography to assess seasonal trends in dorsal fin surface temperatures of free-swimming bottlenose dolphins (Tursiops truncatus) in Sarasota Bay, Florida." Marine Mammal Science 26(1): 53-66.

The temperature differential (δT) between a body surface and the environment influences an organism's heat balance. In Sarasota Bay, FL, where ambient water temperature (Tw) ranges annually from 11° to 33°C, ?T was investigated in a resident community of bottlenose dolphins (Tursiops truncatus). Dorsal fin surface temperatures (Tdfin) were measured on wild, free-swimming dolphins using infrared thermography. Field and laboratory calibration studies were also undertaken to assess the efficacy of this non-invasive technology in the marine environment. The portability of infrared thermography permitted measurements of Tdfin across the entire range of environmental temperatures

experienced by animals in this region. Results indicated a positive, linear relationship between Tdfin and Tw ($r2= 0.978$, $P < 0.001$). On average, Tdfin was 0.9°C warmer than Tw across seasons, despite the 22°C annual range in Tw. Changes in integumentary and vascular insulation likely account for the stability of Tdfin:Tw and the protection of core temperature (Tcore) across seasons. The high thermal conductivity of water may also influence this δT. The use of infrared thermography is an effective, non-invasive method of assessing dorsal fin skin surface temperatures (±1°C) across large numbers of wild, free-swimming dolphins throughout their thermally dynamic aquatic environment.

Barbieri, M. M., S. Raverty, M. B. Hanson, S. Venn-Watson, J. K. B. Ford and J. K. Gaydos (2013). Spatial and temporal analysis of killer whale (Orcinus orca) strandings in the North Pacific Ocean and the benefits of a coordinated stranding response protocol. Marine Mammal Science 29(4): E448-E462.

Killer whales (Orcinus orca) are widely distributed throughout the world's oceans, yet little has been documented about their stranding patterns. Knowledge of stranding patterns improves our ability to examine and sample carcasses and provides a foundatio

Barco, S. G., M. C. Lynott and W. M. Swingle (2011). Seasonality of net gear interactions with stranded bottlenose dolphins (Tursiops truncatus) in Virginia, USA. Fifth Biennial Conference on the Biology of Marine Mammals. New England Aquarium, Boston, Massachussetts: 66.

Bargu, S., T. Goldstein, K. Roberts, C. Li and F. Gulland (2012). "Pseudo-nitzschia blooms, domoic acid, and related California sea lion strandings in Monterey Bay, California." Marine Mammal Science 28(2): 237-253.

Blooms of the toxin-producing diatom Pseudo-nitzschia commonly occur in Monterey Bay, California, resulting in sea lion mortality events. The links between strandings of California sea lions suffering from domoic acid (DA) toxicity,toxic cell numbers, and their associated DA concentration in Monterey Bay and in sea lion feces were examined from 2004 to 2007. While Pseudo-nitzschia toxic cells and DA concentrations were detectable in the water column most of the time, they were often at low levels. A total of 82 California sea lions were found stranded in the Bay between 2004 and 2007 with acute or chronic signs associated with DA poisoning. The highest number with detectable DA in feces occurred in April 2007 and corresponded with the presence of a highly toxic bloom in the Bay. Higher DA levels occurred in feces from sea lions stranding with acute toxicosis and lower concentrations in feces of sea lions exhibiting signs of chronic DA poisoning or not exhibiting any neurologic signs. Results indicated that sea lions are likely exposed to varying levels of DA through their prey throughout the year, often at sublethal doses that may contribute to a continued increase in the development of chronic neurologic sequelae. Keywords: California sea lion, harmful algal blooms, domoic acid, Pseudo-nitzschia, acute toxicity, chronic neurologic, Monterey Bay, California.

Bargu, S., M. Silver, T. Goldstein, K. Roberts and F. Gulland (2010). "Complexity of domoic acid-related sea lion strandings in Monterey Bay, California: Foraging patterns, climate events, and toxic blooms." Marine Ecology Progress Series 418: 213-222.

The neurotoxin domoic acid (DA) produced by the diatoms Pseudo-nitzschia has been responsible for deaths of marine mammals and birds in Monterey Bay, California, USA. In this study we examined links between DA-related strandings of the seasonally migrator

Barros, N., P. Ostrom, C. Stricker and R. Wells (2009). Stable isotopes differentiate bottlenose dolphin populations off West-Central Florida, USA. Twenty Third Annual Conference of the European Cetacean Society. Istanbul, Turkey: 38-39.

Barros, N. B. and M. R. Clarke (2009). Diet. Encyclopedia of Marine Mammals. W. F. Perrin, B. Wursig and J. G. M. Thewissen. San Diego, Academic Press: 311-316.

Barros, N. B., P. H. Ostrom, HasGhandi and S. Rossman (2009). Geographic variation in the diet of rough-toothed dolphins (Steno bredanensis) in Florida waters. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 27.

Barros, N. B., P. H. Ostrom, C. A. Stricker and R. S. Wells (2010). "Stable isotopes differentiate bottlenose dolphins off west-central Florida." Marine Mammal Science 26(2): 324-336.

Distinguishing discrete population units among continuously distributed coastal small cetaceans is challenging and crucial to conservation. We evaluated the utility of stable isotopes in assessing group membership in bottlenose dolphins (Tursiops truncatus) off west-central Florida by analyzing carbon, nitrogen, and sulfur isotope values (δ13C, δ 15N, and δ 34S) of tooth collagen from stranded dolphins. Individuals derived from three putative general population units: Sarasota Bay (SB), nearshore Gulf of Mexico (GULF), and offshore waters (OFF). Animals of known history (SB) served to ground truth the approach against animals of unknown history from the Gulf of Mexico (GULF, OFF). Dolphin groups differed significantly for each isotope. Average δ 13C values from SB dolphins (-10.6‰) utilizing sea grass ecosystems differed from those of GULF (-11.9‰) and OFF (-11.9‰). Average δ15N values of GULF (12.7‰) and OFF (13.2‰) were higher than those of SB dolphins (11.9‰), consistent with differences in prey trophic levels. δ34S values showed definitive differences among SB (7.1‰), GULF (11.3‰), and OFF (16.5‰) dolphins. This is the first application of isotopes to population assignment of bottlenose dolphins in the Gulf of Mexico and results suggest that isotopes may provide a powerful tool in the conservation of small cetaceans.Keywords: bottlenose dolphins • Tursiops truncatus • stable isotopes • population assignment • group membership • strandings • Florida • Gulf of Mexico

Bassos-Hull, K., R. M. Perrtree, C. C. Shepard, S. Schilling, A. A. Barleycorn, J. B. Allen, B. C. Balmer, W. E. Pine and R. S. Wells (2013). "Long-term site fidelity and seasonal abundance estimates of common bottlenose dolphins (Tursiops truncatus) along the southwest coast of Florida and responses to natural perturbations." Journal of Cetacean Research and Management 13(1): 19-30.

Information characterising site fidelity and abundance for common bottlenose dolphins (Tursiops truncatus) along the southwest coast of Florida is important for defining stock structure for management purposes. Long-term site fidelity and ranging patterns

Bateman, T. F. K., W. McLellan, M. Piscitelli, C. Harms, S. Barco, V. Thayer, K. Clark, C. Potter and D. Pabst (2014). "Crassicauda infections in kogiid whales." Integrative and Comparative Biology 54(Supplement 1): E241.

Baughman, C. S., L. A. Webb, F. M. Gulland and D. J. Greig (2011). Is the topical de-worming medication Profender® effective for reducing gastrointestinal parasites in yearling California sea lions? Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 27-28.

Bechdel, S. E., M. Cauldwell, M. Mazzoil, M. Stolen, W. Noke Durden, T. Mazza, S. D. McCulloch, G. D. Bossart and G. O'Corry-Crowe (2011). Genetic analysis of bottlenose dolphin (Tursiops truncatus) community structure within estuarine and coastal communities of eastern Florida. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 28-29.

Bechdel, S. E., M. S. Mazzoil, M. E. Murdoch, E. M. Howells, A. M. Schaefer, S. D. McCulloch, G. D. Bossart and J. S. Reif (2009). Prevalence and distribution of shark interactions on bottlenose dolphins

(Tursiops truncatus) from the Indian River Lagoon, FL. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 29.

Beckmen, K. B., K. A. Burek, L. Hughes and T. S. Gelatt (2010). Intestinal hookworm (Uncinaria sp.) burdens and egg shedding in declining and increasing stocks of Steller sea lions in Alaska. Alaska Marine Science Symposium. Hotel Captain Cook, Anchorage, Alaska: 76.

Berens McCabe, E., D. P. Gannon, N. B. Barros and R. S. Wells (2009). Prey selection in a resident common bottlenose dolphin (Tursiops truncatus) community in Sarasota Bay, Florida. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 32.

Berens McCabe, E. J., D. P. Gannon, N. B. Barros and R. S. Wells (2010). "Prey selection by resident common bottlenose dolphins (Tursiops truncatus) in Sarasota Bay, Florida." Marine Biology 157(5): 931-942.

Prey selection was investigated in wild, resident common bottle nose dolphins, Tursiops truncatus, during the summer months in Sarasota Bay, Florida, USA. Stomach content analyses of 15 dolphins with extensive sighting histories and well-documented distributions were used to determine prey use. Prey availability was assessed by purse seine surveys. We compared the relative abundances of prey available to estimates of prey use at closely matching spatial and temporal scales. G-tests determined that dolphins in this study significantly selected for prey at the species, family, and soniferous/non-soniferous prey levels (G (adj) = 753.98-1,775.93, df = 1-21, p a parts per thousand currency sign 0.01). While comprising only 6.3% of the total available prey, soniferous fishes accounted for 51.9% of the total prey consumed. Manly's standardized forage ratios and 95% Bonferroni confidence intervals determined significant positive selection for soniferous prey and against non-soniferous prey (beta(S) = 0.9461 vs. beta(NS) = 0.0539). Dolphins selected against Gerridae, Clupeidae, and Sparidae (beta a parts per thousand currency sign 0.0014), as well as against all the species within those families (beta a parts per thousand currency sign 0.0190). It is likely that passive listening for soniferous prey provides an ecological or energetic advantage to cetaceans utilizing this specific foraging technique.

Berman-Kowalewski, M., F. M. D. Gulland, S. Wilkin, J. Calambokidis, B. Mate, J. Cordaro, D. Rotstein, J. S. Leger, P. Collins, K. Fahy and S. Dover (2010). "Association between blue whale (Balaenoptera musculus) mortality and ship strikes along the California coast." Aquatic Mammals 36(1): 59-66.

Blue whales (Balaenoptera musculus) are distributed worldwide, and although severely depleted by commercial whaling, their abundance off the California coast now appears to be increasing. Little is known about natural causes of mortality of blue whales, but human-related mortality continues despite legal protection. Ship strikes are a significant mortality factor for other species of baleen whale, and changes in shipping traffic have been advocated to minimize further deaths. Between 1988 and 2007, 21 blue whale deaths were reported along the California coast, typically one or two cases annually. Three pulses in strandings were observed, with three carcasses observed in fall 1988, three in 2002, and four in fall 2007. Two of the four animals in 2007 were first observed dead in the Santa Barbara Channel and had wounds typical of a ship strike. Blue whale strandings were spatially associated with locations of shipping lanes, especially those associated with the Ports of Los Angeles and Long Beach, and were most common in the fall months.Keywords: blue whale, Balaenoptera musculus, ship strike, trauma, shipping lane, Sarcocystis

Berman-Kowalewski, M. and S. D. Newsome (2009). You are what you eat but what are you; utilizing stable isotopes to validate morphometric determination of common dolphin (Delphinus) species. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 32-33.

Berman-Kowalewski, M., G. Ylitalo and J. Bolton (2011). Contaminants in coastal dolphins from central and southern California. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 33.

Bernaldo De Quiros, Y., J. S. Seewald, S. P. Sylva, B. Greer, M. Niemeyer, A. L. Bogomolni and M. J. Moore (2013). "Compositional discrimination of decompression and decomposition gas bubbles in bycaught seals and dolphins." PLoS ONE 8(12): e83994.

Gas bubbles in marine mammals entangled and drowned in gillnets have been previously described by computed tomography, gross examination and histopathology. The absence of bacteria or autolytic changes in the tissues of those animals suggested that the ga

Bogomolni, A. L., K. R. Pugliares, S. M. Sharp, K. Patchett, C. T. Harry, J. M. LaRocque, K. M. Touhey and M. Moore (2010). "Mortality trends of stranded marine mammals on Cape Cod and southeastern Massachusetts, USA, 2000 to 2006." Diseases of Aquatic Organisms 88: 143-155.

To understand the cause of death of 405 marine mammals stranded on Cape Cod and southeastern Massachusetts between 2000 and 2006, a system for coding final diagnosis was developed and categorized as (1) disease, (2) human interaction, (3) mass-stranded with no significant findings, (4) single-stranded with no significant findings, (5) rock and/or sand ingestion, (6) predatory attack, (7) failure to thrive or dependent calf or pup, or (8) other. The cause of death for 91 animals could not be determined. For the 314 animals that could be assigned a cause of death, gross and histological
pathology results and ancillary testing indicated that disease was the leading cause of mortality in the region, affecting 116/314 (37%) of cases. Human interaction, including harassment, entanglement, and vessel collision, fatally affected 31/314 (10%) of all animals. Human interaction accounted for 13/29 (45%) of all determined gray seal Halichoerus grypus mortalities. Mass strandings were most likely to occur in northeastern Cape Cod Bay; 97/106 (92%) of mass stranded animals necropsied presented with no significant pathological findings. Mass strandings were the leading cause of death in 3 of the 4 small cetacean species: 46/67 (69%) of Atlantic white-sided dolphin Lagenorhynchus acutus, 15/21 (71%) of long-finned pilot whale Globicephala melas, and 33/54 (61%) of short-beaked common dolphin Delphinus delphis. These baseline data are critical for understanding marine mammal population health and mortality trends, which in turn have significant conservation and management implications. They not only afford a better retrospective analysis of strandings, but ultimately have application for improving current and future response to live animal stranding.

Bolanos-Jimenez, J., A. A. Mignucci-Giannoni, J. Blumenthal, A. Bogomolni, J. J. Casas, A. Henriquez, M. I. Bessega, J. Khan, N. Landrau-Giovannetti, C. Rinaldi, R. Rinaldi, G. Rodriguez, L. Sutty, N. Ward and J. A. Luksenburg (2014). "Distribution, feeding habits and morphology of killer whales Orcinus orca in the Caribbean Sea." Mammal Review.

Killer whales Orcinus orca are found in all oceans of the world, but most of our knowledge on the species comes from studies conducted at higher latitudes. Studies on killer whales in the Caribbean have been scarce. We compiled 176 records of killer whales from the Caribbean, including 95 previously unreported records and 81 records recovered from the literature, consisting of 27 capture or kill records, 4 stranding records and 145 sighting records. Our results indicate that killer whales are

widespread in the Caribbean Sea and can be found year-round in the region. Mean group size was 37 animals. A diversity of prey items was recorded, including sea turtles and marine mammals and possibly fish. We cannot exclude ecotype or morphotype-specific dietary specialization in the Caribbean population. A preliminary morphological analysis of 10 characters in 52 individuals from 21 different groups suggests that Caribbean killer whales do not represent any of the four Antarctic and subantarctic types, type 1 from the northwest Atlantic, or 'resident' and 'transient' killer whales from the northwest Pacific. Some Caribbean killer whales share a combination of characters typical of type 2 in the North Atlantic, whereas others share those typical of 'offshore' killer whales in the northwest Pacific. The significance of this is unclear. Comparison of Caribbean killer whales to previously described morphotypes and ecotypes is hampered by the lack of detailed, quantitative data on variation within other types, as well as by the lack of comparisons of genetic diversity. Our study adds to the growing knowledge of the diversity of killer whales worldwide but underscores that additional research is warranted in the tropicsKeywords: diet; occurrence; predation; spatial and temporal distribution

Bottein, M.-Y. D., L. Kashinsky, Z. Wang, C. Littnan and J. S. Ramsdell (2011). "Identification of ciguatoxins in Hawaiian monk seals Monachus schauinslandi from the northwestern and main Hawaiian Islands." Environmental Science and Technology 45(12): 5403-5409.

Ciguatoxins are potent algal neurotoxins that concentrate in fish preyed upon by the critically endangered Hawaiian monk seal (Monachus schauinslandi). The only report for Hawaiian monk seal exposure to ciguatoxins occurred during a 1978 mortality event when two seal liver extracts tested positive by mouse bioassay. Ciguatoxins were thus proposed as a potential threat to the Hawaiian monk seal population. To reinvestigate monk seal exposure to ciguatoxins we utilized more selective detection methods, the Neuro-2A cytotoxicity assay, to quantify ciguatoxin activity and an analytical method LC-MS/MS to confirm the molecular structure. Tissue analysis from dead stranded animals revealed ciguatoxin activity in brain, liver, and muscle, whereas analysis of blood samples from 55 free-ranging animals revealed detectable levels of ciguatoxin activity (0.43 to 5.49 pg/mL P-CTX-1 equiv) in 19% of the animals. Bioassay-guided LC fractionation of two monk seal liver extracts identified several ciguatoxin-like peaks of activity including a peak corresponding to the P-CTX-3C which was confirmed present by LC-MS/MS. In conclusion, this work provides first confirmation that Hawaiian monk seals are exposed to significant levels of ciguatoxins and first evidence of transfer of ciguatoxin to marine mammals. This threat could pose management challenges for this endangered marine mammal species.

Brock, P. M., A. J. Hall, S. J. Goodman, M. Cruz and K. Acevedo-Whitehouse (2013). "Immune activity, body condition and human-associated environmental impacts in a wild marine mammal." PLoS ONE 8(6): e67132.

Within individuals, immunity may compete with other life history traits for resources, such as energy and protein, and the damage caused by immunopathology can sometimes outweigh the protective benefits that immune responses confer. However, our understan

Brookens, T. J., T. M. O'Hara, R. J. Taylor, G. R. Bratton and J. T. Harvey (2009). Total mercury body burden in Pacific harbor seal (Phoca vitulina richardii) pups from central California. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 41-42.

Browning, N. E., C. Dold, J. I.-Fan and G. A. J. Worthy (2013). "Isotope turnover rates and diet-tissue discrimination in skin of ex situ bottlenose dolphins (Tursiops truncatus)." Journal of Experimental Biology 217(2): 214-221.

Diet-tissue discrimination factors (?15N or ?13C) and turnover times are thought to be influenced by a wide range of variables including metabolic rate, age, dietary quality, tissue sampled, and the taxon being investigated. In the present study, skin sam

Bryan, A., L. Horstmann-Dehn and L. T. Quakenbush (2011). Do stomach contents, fatty acids, and stable isotopes yield the same dietary results? Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 45.

Bryan, C. E., W. C. Davis, W. E. McFee, C. A. Neumann, J. Schulte, G. D. Bossart and S. J. Christopher (2012). "Influence of mercury and selenium chemistries on the progression of cardiomyopathy in pygmy sperm whales, Kogia breviceps." Chemosphere 89(5): 556-562.

More than half of pygmy sperm whales (Kogia breviceps) that strand exhibit signs of cardiomyopathy (CMP). Many factors may contribute to the development of idiopathic CMP in K. breviceps, including genetics, infectious agents, contaminants, biotoxins, and dietary intake (e.g. selenium, mercury, and pro-oxidants). This study assessed trace elements in K. breviceps at various stages of CMP progression using fresh frozen liver and heart samples collected from individuals that stranded along US Atlantic and Gulf coasts between 1993 and 2007. Standard addition calibration and collision cell inductively coupled plasma mass spectrometry (ICP-MS) were employed for total Se analysis and pyrolysis atomic absorption (AA) was utilized for total Hg analysis to examine if the Se/Hg detoxification pathway inhibits the bioavailability of Se. Double spike speciated isotope dilution gas chromatography ICP-MS was utilized to measure methyl Hg and inorganic Hg. Immunoblot detection and colorimetric assays were used to assess protein oxidation status. Data collected on trace elements, selenoproteins, and oxidative status were evaluated in the context of animal life history and other complementary histological information to gain insight into the biochemical pathways contributing to the development of CMP in K. breviceps. Cardiomyopathy was only observed in adult pygmy sperm whales, predominantly in male animals. Both Hg:Se molar ratios and overall protein oxidation were greater in males than females and increased with progression of CMP.Keywords: Mercury; Selenium; Protein oxidation; Cardiomyopathy; Pygmy sperm whale

Bryan, C. E., R. S. Pugh, A. J. Moors and P. R. Becker (2011). U.S. Pacific Island region marine environmental biorepository marine mammal programs. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 45.

Buckmaster, P. S., X. Wen, I. Toyoda, F. M. D. Gulland and W. V. Bonn (2014). "Hippocampal neuropathology of domoic acid-induced epilepsy in California sea lions (Zalophus californianus)." Journal of Comparative Neurology 522(7): 1691-1706.

California sea lions (Zalophus californianus) are abundant human-sized carnivores with large gyrencephalic brains. They develop epilepsy after experiencing status epilepticus when naturally exposed to domoic acid. We tested whether sea lions previously exposed to DA (chronic DA sea lions) display hippocampal neuropathology similar to that of human patients with temporal lobe epilepsy. Hippocampi were obtained from control and chronic DA sea lions. Stereology was used to estimate numbers of Nissl-stained neurons per hippocampus in the granule cell layer, hilus, and the pyramidal cell layer of CA3, CA2, and CA1 subfields. Adjacent sections were processed for somatostatin-immunoreactivity or Timm-stained, and the extent of mossy fiber sprouting was measured stereologically. Chronic DA sea lions displayed hippocampal neuron loss in patterns and extents similar but not identical to those reported previously for human patients with temporal lobe epilepsy. Similar to human patients, hippocampal sclerosis in sea lions was unilateral in 79% of cases, mossy fiber sprouting was a common neuropathological abnormality, and somatostatin-immunoreactive axons were

exuberant in the dentate gyrus despite loss of immunopositive hilar neurons. Thus, hippocampal neuropathology of chronic DA sea lions is similar to that of human patients with temporal lobe epilepsyKeywords: hippocampal sclerosis; mossy fiber sprouting; somatostatin; stereology; dentate gyrus

Burdett Hart, L., D. S. Rotstein, R. S. Wells, K. Bassos-Hull and L. H. Schwacke (2011). "Lacaziosis and lacaziosis-like prevalence among wild, common bottlenose dolphins Tursiops truncatus from the west coast of Florida, USA." Diseases of Aquatic Organisms 95(1): 49-56.

Lacaziosis (lobomycosis; Lacazia loboi) is a fungal skin disease that naturally occurs only in humans and dolphins. The first reported case of lacaziosis in a bottlenose dolphin Tursiops truncatus occurred in 1970 in Sarasota Bay, Florida, USA, and subsequent photo-ID monitoring of the Sarasota Bay dolphin population has revealed persistence of the disease. The objectives of this study were to estimate lacaziosis prevalence (P) in 2 bottlenose dolphin populations on the west coast of Florida (Sarasota Bay and Charlotte Harbor) and compare disease occurrence to other published estimates of lacaziosis in dolphin populations across the globe. Historic photographic records of dolphins captured and released for health assessment purposes (Sarasota Bay) and photo-ID studies (Charlotte Harbor) were screened for evidence of lesions consistent with lacaziosis. Health assessment data revealed a prevalence of lacaziosis in the Sarasota Bay bottlenose dolphin population between 2 and 3%, and analyses of photo-ID data provided a lacaziosis-like prevalence estimate of 2% for Charlotte Harbor dolphins. With the exception of lacaziosis prevalence estimates for dolphins inhabiting the Indian River Lagoon (P = 0068; P = 012), no statistically significant differences were seen among Sarasota Bay, Charlotte Harbor, and other published estimates. Although lacaziosis is a rare disease among these dolphin populations, studies that assess disease burden among different populations can assist with the surveillance of this zoonotic pathogen. Keywords: Lacaziosis • Lobomycosis • Bottlenose dolphin • Tursiops truncatus • Sarasota Bay • Charlotte Harbor

Burdett, L. G., R. S. Wells, J. D. Adams and L. H. Schwacke (2009). Longitudinal photographic and cross-sectional health assessment data to estimate lobomycosis prevalence and lesion growth rates for common bottlenose dolphins in Sarasota Bay, Florida, USA. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 43-44.

Byard, R. W., A. J. Machado and D. McLelland (2011). "Endobronchial sand casts: An unusual marker of saltwater immersion in a juvenile pygmy sperm whale (Kogia breviceps)." Forensic Science, Medicine, and Pathology 7(2): 222-224.

No abstract

Byrd, B. L. and A. A. Hohn (2010). "Challenges of documenting Tursiops truncatus Montagu (bottlenose dolphin) bycatch in the stop net fishery along Bogue Banks, North Carolina." Southeastern Naturalist 9(1): 47-62.

Each fishery presents its own challenges for observers to document bycatch. The North Carolina (NC) stop net fishery is especially challenging because it uses anchored gear (the stop net) that soaks up to 15 days to herd fish, which are then hauled to shore via another gear (a beach seine). Three Tursiops truncatus (Bottlenose Dolphin) entanglements in stop nets and six Bottlenose Dolphin strandings, each suspected of having been entangled in stop net gear based on injuries noted (lesions) and spatio-temporal overlap with the fishery, were documented by the NC Marine Mammal Network between 1992 and 2007. In 2001-2002, new observational techniques and surveys were used to observe this fishery to estimate bycatch and to document dolphin behavior around the gear. Techniques included observations from the beach during net retrievals and in situ surveys using a vessel with a sonar-video

camera system. No entangled dolphins were observed, and, in fact, observations indicated dolphins were not attracted to stop nets and generally changed direction to avoid the gear. Nonetheless, characteristics of the fishery impose severe limitations on the efficacy of bycatch observer methods, rendering those results unreliable. Given low levels of known or suspected entanglements and the challenges of observing this fishery, stranding network data may be the most practical and effective method to monitor dolphin bycatch.

Byrd, B. L., A. A. Hohn, G. N. Lovewell, K. M. Altman, S. G. Barco, A. Friedlaender, C. A. Harms, W. A. McLellan, K. T. Moore, P. E. Rosel and V. G. Thayer (2014). "Strandings as indicators of marine mammal biodiversity and human interactions off the coast of North Carolina." Fishery Bulletin 112(1): 1-23.

The adjacency of 2 marine biogeographic regions off Cape Hatteras, North Carolina (NC), and the proximity of the Gulf Stream result in a high biodiversity of species from northern and southern provinces and from coastal and pelagic habitats. We examined s

Campbell-Malone, R., M. J. Moore and I. Tsukrow (2009). The biomechanical properties of cortical bone from the North Atlantic right whale (Eubalaena glacialis). Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 48.

Cantu-Medellin, N., B. Byrd, A. Hohn, J. P. Vazquez-Medina and T. Zenteno-Savin (2011). "Differential antioxidant protection in tissues from marine mammals with distinct diving capacities. Shallow/short vs. deep/long divers." Comparative Biochemistry and Physiology A Molecular and Integrative Physiology 158(4): 438-443.

The diving response in marine mammals results in bradycardia and peripheral vasoconstriction, with blood flow redistributing preferentially to nervous and cardiac tissues. Therefore, some tissues are rendered ischemic during a dive; with the first breath after a dive, blood flow to all tissues is reestablished. In terrestrial mammals, reactive oxygen species (ROS) production increases in response to ischemia/reperfusion and oxidative damage can occur. The capacity of marine mammals to tolerate repeated ischemia/reperfusion cycles associated with diving appears to be due to an enhanced antioxidant system. However, it is not known if diving depth and/or duration elicit differences in tissue capacity to produce ROS and antioxidant defenses in marine mammals. The objective of this study was to analyze ROS production, antioxidant defenses and oxidative damage in marine mammal species that perform shallow/short vs. deep/long dives. We measured production of superoxide radical (O-2(center dot-)), oxidative damage to lipids and proteins, activity of antioxidant enzymes, and glutathione levels in tissues from shallow/short divers (Tursiops truncatus) and deep/long divers (Kogia spp.). We found that differences between the diving capacity of dolphins and Kogia spp. are reflected in (O-2(center dot-)) production and antioxidant levels. These differences suggest that shallow/short and deep/long divers have distinct mechanisms to successfully maintain redox balance. Keywords: Antioxidants; Diving response; Ischemia/reperfusion; Odontocetes

Carlson-Bremer, D., C. K. Johnson, R. H. Miller, F. M. D. Gulland, P. A. Conrad, J. D. Wasmuth, K. M. Colegrove and M. E. Grigg (2012). "Identification of two novel Coccidian species shed by California sea lions (Zalophus californianus)." Journal of Parasitology 98(2): 347-354.

Routine fecal examination revealed novel coccidian oocysts in asymptomatic California sea lions (Zalophus californianus) in a rehabilitation facility. Coccidian oocysts were observed in fecal samples collected from 15 of 410 California sea lions admitted to The Marine Mammal Center between April 2007 and October 2009. Phylogenetic analysis using the full ITS-1 region, partial small subunit 18S rDNA sequence, and the Apicomplexa rpoB region identified 2 distinct sequence clades, referred to as Coccidia A and Coccidia B, and placed them in the Sarcocystidae, grouped with the tissue-cyst–forming coccidia.

Both sequence clades resolved as individual taxa at ITS-1 and rpoB and were most closely related to Neospora caninum. Coccidia A was identified in 11 and Coccidia B in 4 of 12 sea lion oocyst samples successfully sequenced (3 of those sea lions were co-infected with both parasites). Shedding of Coccidia A oocysts was not associated with age class, sex, or stranding location, but yearlings represented the majority of shedders (8/15). This is the first study to use molecular phylogenetics to identify and describe coccidian parasites shed by a marine mammal.

Carlson-Bremer, D. P., F. M. D. Gulland, C. K. Johnson, K. M. Colegrove and W. G. V. Bonn (2012). "Diagnosis and treatment of Sarcocystis neurona-induced myositis in a free-ranging California sea lion." Journal of the American Veterinary Medical Association 240(3): 324-328.

Case Description-An underweight, lethargic adult female California sea lion (Zalophus califomianus) became stranded along the California shore and was captured and transported to a rehabilitation hospital for assessment and care. Clinical Findings-Initial physical assessment revealed the sea lion was lethargic and in poor body condition. Active myositis was diagnosed on the basis of concurrent elevations in activities of alanine aminotransferase and creatine kinase detected during serum biochemical analysis. Infection with Sarcocystis neurona was diagnosed after serologic titers increased 4-fold over a 3-week period. Diagnosis was confirmed on the basis of histopathologic findings, positive results on immunohistochemical staining, and results of quantitative PCR assay on biopsy specimens obtained from the diaphragm and muscles of the dorsal cervical region. Treatment and Outcome-Anticoccidial treatment was instituted with ponazuril (10 mg/kg [4.5 mg/lb], PO, q 24 h) and continued for 28 days. Prednisone (0.2 mg/kg [0.09 mg/lb], PO, q 12 h) was administered for 2 days and then every 24 hours for 5 days to treat associated inflammation. At the end of treatment, the sea lion was clinically normal, alanine aminotransferase and creatine kinase values were within reference limits, and antibody titers against S neurona had decreased 6-fold. The sea lion was released approximately 3 months after becoming stranded. Clinical Relevance-S neurona-induced myositis was diagnosed in a free-ranging California sea lion. On the basis of the successful treatment and release of this sea lion, anticoccidial treatment should be considered for marine mammals in which protozoal disease is diagnosed.

Carmichael, R. H., W. M. Graham, A. Aven, G. Worthy and S. Howden (2012). "Were multiple stressors a 'perfect storm' for northern Gulf of Mexico bottlenose dolphins (Tursiops truncatus) in 2011?" PLoS ONE 7(7): e41155.

An unusual number of near term and neonatal bottlenose dolphin (Tursiops truncatus) mortalities occurred in the northern Gulf of Mexico (nGOM) in 2011, during the first calving season after two well documented environmental perturbations; sustained cold weather in 2010 and the Deepwater Horizon oil spill (DWHOS). Preceding the stranding event, large volumes of cold freshwater entered the nGOM due to unusually large snowmelt on the adjacent watershed, providing a third potential stressor. We consider the possibility that this extreme cold and freshwater event contributed to the pattern of perinatal dolphin strandings along the nGOM coast. During the 4-month period starting January 2011, 186 bottlenose dolphins, including 46% perinatal calves (nearly double the percentage for the same time period from 2003-2010) washed ashore from Louisiana to western Florida. Comparison of the frequency distribution of strandings to flow rates and water temperature at a monitoring buoy outside Mobile Bay, Alabama (the 4th largest freshwater drainage in the U. S.) and along the nGOM coast showed that dolphin strandings peaked in Julian weeks 5, 8, and 12 (February and March), following water temperature minima by 2-3 weeks. If dolphin condition was already poor due to depleted food resources, bacterial infection, or other factors, it is plausible that the spring freshet contributed to the timing and location of the unique stranding event in early 2011. These data provide strong observational

evidence to assess links between the timing of the DWHOS, other local environmental stressors, and mortality of a top local predator. Targeted analyses of tissues from stranded dolphins will be essential to define a cause of death, and our findings highlight the importance of considering environmental data along with biological samples to interpret stranding patterns during and after an unusual mortality event.

Carretta, J. V., S. M. Wilkin, M. M. Muto and K. Wilkinson (2013). Sources of human-related injury and mortality for U. S. Pacific West Coast Marine Mammal Stock Assessments, 2007-2011, NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center: 87.

No abstract

Cassoff, R. M., K. M. Moore, W. A. McLellan, S. G. Barco, D. S. Rotstein and M. J. Moore (2011). "Lethal entanglement in baleen whales." Diseases of Aquatic Organisms 96(3): 175-185.

Understanding the scenarios whereby fishing gear entanglement of large whales induces mortality is important for the development of mitigation strategies. Here we present a series of 21 cases involving 4 species of baleen whales in the NW Atlantic, describing the available sighting history, necropsy observations, and subsequent data analyses that enabled the compilation of the manners in which entanglement can be lethal. The single acute cause of entanglement mortality identified was drowning from entanglement involving multiple body parts, with the animal's inability to surface. More protracted causes of death included impaired foraging during entanglement, resulting in starvation after many months; systemic infection arising from open, unresolved entanglement wounds; and hemorrhage or debilitation due to severe gear-related damage to tissues. Serious gear-induced injury can include laceration of large vessels, occlusion of the nares, embedding of line in growing bone, and massive periosteal proliferation of new bone in an attempt to wall off constricting, encircling lines. These data show that baleen whale entanglement is not only a major issue for the conservation of some baleen whale populations, but is also a major concern for the welfare of each affected individual.Keywords: Baleen whales; Entanglement; Mortality; Cetacean; Strandings; Fishing gear; Necropsy; Northwestern Atlantic

Cavallero, S., S. A. Nadler, L. Paggi, N. B. Barros and S. D'Amelio (2011). "Molecular characterization and phylogeny of anisakid nematodes from cetaceans from southeastern Atlantic coasts of USA, Gulf of Mexico, and Caribbean Sea." Parasitology Research 108(4): 781-792.

In the present study, 407 anisakid nematodes, collected from 11 different species of cetaceans of the families Delphinidae, Kogiidae, Physeteridae, and Ziphiidae, from the southeastern Atlantic coasts of USA, the Gulf of Mexico, and the Caribbean Sea, were examined morphologically and genetically characterized by PCR restriction fragment length polymorphism to identify them to species level, assess their relative frequencies in definitive hosts, and determine any host preference. Sequence data from nuclear ribosomal internal transcribed spacer and mitochondrial cox2 genes were analysed by maximum parsimony and Bayesian inference methods, as separate and combined datasets, to evaluate phylogenetic relationships among taxa. The results revealed a highly diverse ascaridoid community. Seven Anisakis species and Pseudoterranova species were recovered as adult parasites. Larval forms of Contracaecum multipapillatum were also found in a coastal population of bottlenose dolphins. The phylogenetic trees obtained from the combined dataset (and most individual datasets) revealed the existence of distinct clades, the first including species of the Anisakis simplex complex (A. simplex s.s., Anisakis pegreffii, A. simplex C), (Anisakis nascettii, Anisakis ziphidarum) and the second including Pseudoterranova ceticola ((Anisakis paggiae, (Anisakis physeteris, Anisakis brevispiculata)). This finding, excluding the relationship of P. ceticola, is consistent with the morphology of adult and larval specimens. Considering the presence versus absence of an intestinal cecum, the relationship of P.

ceticola with the members of the second clade of Anisakis appears inconsistent with morphological evidences but consistent with host preference. The position of Anisakis typica as the sister group to the two main anisakid clades indicates that it represents a third distinct lineage.

Citta, J. J., J. J. Burns, L. T. Quakenbush, V. Vanek, J. C. George, R. J. Small, M. P. Heide-Jorgensen and H. Brower (2014). "Potential for bowhead whale entanglement in cod and crab pot gear in the Bering Sea." Marine Mammal Science 30(2): 445-459.

Bowhead whales (Balaena mysticetus) of the western Arctic stock winter in ice-covered continental shelf regions of the Bering Sea, where pot fisheries for crabs (Paralithodes and Chionoecetes spp) and Pacific cod (Gadus macrocephalus) pose a risk of entanglement. In the winter of 2008–2009 and 2009–2010 the spatial distribution of 21 satellite tagged bowhead whales partially overlapped areas in which pot fisheries for cod and blue king crab (Paralithodes platypus) occurred. However, these fisheries ended before whales entered the fishing areas, thus avoiding temporal overlap. A fishery for snow crab (Chionoecetes opilio) typically runs from January to May and provides the greatest potential for bowhead whales to encounter active pot gear. Tagged whales did not enter the area of the snow crab fishery during this study and generally remained in areas with >90% sea ice concentration, which is too concentrated for crab boats to penetrate. Pack ice sometimes overruns active fishing areas, resulting in lost gear, which is the most likely source of entanglement. The western Arctic stock of bowhead whales was increasing as of 2004; as such, incidental mortality from commercial pot fisheries is probably negligible at this time. Regardless, entanglement may increase over time and should be monitored. Keywords: bowhead whale; Balaena mysticetus; Bering Sea; commercial pot fisheries; pot gear; entanglement; Bering Sea-Aleutian Island Crab Rationalization Program; Pacific cod

Cole, T. V. N., A. G. Henry, D. Allen and L. P. Garrison (2011). Predicting lethal outcome of injuries to free-swimming whales. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 64.

Colegrove, K. M., M. E. Grigg, D. Carlson-Bremer, R. H. Miller, F. M. D. Gulland, D. J. Ferguson, D. Rejmanek, B. C. Barr, R. Nordhausen, A. C. Melli and P. A. Conrad (2011). "Discovery of three novel coccidian parasites infecting California sea lions (Zalophus californianus), with evidence of sexual replication and interspecies pathogenicity." Journal of Parasitology 97(5): 868-877.

Enteric protozoal infection was identified in 5 stranded California sea lions (Zalophus californianus). Microscopically, the apical cytoplasm of distal jejunal enterocytes contained multiple stages of coccidian parasites, including schizonts with merozoites and spherical gametocytes, which were morphologically similar to coccidians. By histopathology, organisms appeared to be confined to the intestine and accompanied by only mild enteritis. Using electron microscopy, both sexual (microgametocytes, macrogamonts) and asexual (schizonts, merozoites) coccidian stages were identified in enterocytes within parasitophorous vacuoles, consistent with apicomplexan development in a definitive host. Serology was negative for tissue cyst-forming coccidians, and immunohistochemistry for Toxoplasma gondii was inconclusive and negative for Neospora caninum and Sarcocystis neurone. Analysis of ITS-I gene sequences amplified from frozen or formalin-fixed paraffin-embedded intestinal sections identified DNA sequences with closest homology to Neospora sp. (80%); these novel sequences were referred to as belonging to coccidian parasites A, B, and C. Subsequent molecular analyses completed on a neonatal harbor seal (Phoca vitulina) with protozoal lymphadenitis, hepatitis, myocarditis, and encephalitis showed that it was infected with a coccidian parasite bearing the C sequence type. Our results indicate that sea lions likely serve as definitive hosts for 3 newly described coccidian parasites, at least 1 of which is pathogenic in a marine mammal intermediate host species.

Colegrove, K. M., F. M. D. Gulland, K. Harr, D. K. Naydan and L. J. Lowenstine (2009). "Pathological features of amyloidosis in stranded California sea lions (Zalophus californianus)." Journal of Comparative Pathology 195(2-3): 105-112.

Amyloidosis was diagnosed in 26 stranded adult California sea lions between 1983 and 2006 by retrospective case analysis. The kidneys (92.3% of animals), blood vessels (80.7%) and thyroid glands (65.4%) were most commonly affected. Macroscopically, affected kidneys were swollen, with pale tan cortices and loss of corticomedullary differentiation. Amyloid deposits in the kidney were located in the glomeruli, blood vessels, and peritubular interstitium, most prominently in the outer stripe of the medulla. The amyloid deposits were identified as type amyloid A (AA) by potassium permanganate staining and immunolabelling with antibodies against AA protein. Concurrent diseases, including inflammatory processes and genital carcinoma, were common in affected animals. Serum amyloid A concentrations were high (>1200 mu g/ml) in six of seven affected sea lions, while the median value in clinically healthy animals was <10 mu g/ml. These findings suggest that renal amyloidosis contributes to morbidity and mortality in stranded adult California sea lions.Keywords: AA amyloidosis; California sea lion; sea lion; Zalophus californianus

Colegrove, K. M., F. M. D. Gulland, D. K. Naydan and L. J. Lowenstine (2009). "The normal genital tract of the female California sea lion (Zalophus californianus): Cyclic changes in histomorphology and hormone receptor distribution." Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology 292(11): 1801-1817.

Changes in reproductive tract histomorphology, and estrogen (ER(X) and progesterone receptor (PR) expression throughout the breeding cycle were evaluated in free-ranging stranded female California sea lions (Zalophus californianus). Hormone receptor expression in the ovaries, uterus, cervix, and vagina was evaluated using an immunohistochemical technique with monoclonal antibodies. During a large portion of the cycle, ovaries contained both a corpora lutea (CL) and follicles in varying stages of development. In the periods of pupping and estrus during June and July, and in the spring morphologic features of the endometrium suggested estrogen influence. There were areas of squamous differentiation in the pseudostratified columnar epithelium of the cervix and vagina in some animals during estrus and in the spring. Estrogen receptor immunohistochemical scores were highest during pupping and estrus and in the spring and lowest during embryonic diapause. Cyclic changes in uterine PR expression throughout the cycle were minimal. Both ER alpha and PR were expressed in epithelial and stromal cells throughout the cervix and vagina, however, receptor expression was typically higher in the stroma. Stromal cell hormone receptors may play an important role in epithelial responses to circulating sex hormones. The results of this investigation add to the general knowledge of California sea lion reproduction and establish baseline information on reproductive tract hormone receptors that will aid in determining the factors involved in urogenital cancer development in sea lions. Keywords: California sea lion; embryonic diapause; estrogen receptor; progesterone receptor; reproductive tract; urogenital cancer; Zalophus californianus

Colegrove, K. M., F. M. D. Gulland, D. K. Naydan and L. J. Lowenstine (2009). "Normal morphology and hormone receptor expression in the male California sea lion (Zalophus californianus) genital tract." Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology 292(11): 1818-1826.

Histomorphology and estrogen (ER), and progesterone receptor (PR) expression were evaluated in free-ranging stranded male California sea lions (Zalophus californianus). Hormone receptor expression was evaluated using an immunohistochemical technique with monoclonal antibodies. Estrogen and PRs were identified in the efferent ductules, prostate gland, corpus cavernosa, corpus spongiosum, penile urethra, and in the epithelium and stroma of both the penis and prepuce. In some tissues, ER expression was more intense in the stroma, emphasizing the importance of the stroma in hormone-mediated

growth and differentiation of reproductive organs. To our knowledge, this is the first study to localize ER and PR to the epithelium of the glans penis. The results of this investigation add to the general knowledge of male California sea lion reproduction and suggest that estrogens could have a role in the function of the male reproductive tract. Keywords: California sea lion • estrogen receptor • progesterone receptor • male reproductive tract • urogenital cancer

Colegrove, K. M., F. M. D. Gulland, D. K. Naydan and L. J. Lowenstine (2009). "Tumor morphology and immunohistochemical expression of estrogen receptor, progesterone receptor, p53, and Ki67 in urogenital carcinomas of California sea lions (Zalophus californianus)." Veterinary Pathology 46(4): 642-655.

Colegrove, K. M., J. A. St. Leger, S. Raverty, S. Jang, M. Berman-Kowalewski and J. K. Gaydos (2010). "Salmonella Newport omphaloarteritis in a stranded killer whale (Orcinus orca) neonate." Journal of Wildlife Diseases 46(4): 1300-1304.

Salmonella enterica serovar Newport (Salmonella Newport) was isolated from multiple tissues in a neonate killer whale (Orcinus orca) that stranded dead in 2005 along the central coast of California, USA. Necrotizing omphaloarteritis and omphalophlebitis was observed on histologic examination suggesting umbilical infection was the route of entry. Genetic analysis of skin samples indicated that the neonate had an offshore haplotype. Salmonellosis has rarely been identified in free-ranging marine mammals and the significance of Salmonella Newport infection to the health of free-ranging killer whales is currently unknown. Keywords: Killer whale neonate; omphaloarteritis; Orcinus orca; Salmonella enterica serovar Newport; salmonellosis

Colegrove, K. M., J. F. X. Wellehan Jr., R. Rivera, P. F. Moore, F. M. D. Gulland, L. J. Lowenstine, R. W. Nordhausen and H. H. Nollens (2010). "Polyomavirus infection in a free-ranging California sea lion (Zalophus californianus) with intestinal T-cell lymphoma." Journal of Veterinary Diagnostic Investigation 22(4): 628-632.

An adult female California sea lion (Zalophus californianus) that stranded in central California was found to have a small glossal polypoid mass on gross necropsy. Histologically, the mass was consistent with a fibropapilloma, and intranuclear inclusions were found within endothelial cells lining small arterioles within the mass. Electron microscopy revealed 40-nm virions within endothelial intranuclear inclusions. Rolling circle amplification was used to obtain a partial viral genomic sequence. Sequence analysis identified the virus as a novel polyomavirus, tentatively named California sea lion polyomavirus 1. In addition, the sea lion had a severely thickened small intestine and swollen pale kidneys on gross examination. Severe renal amyloidosis with chronic interstitial nephritis was diagnosed histologically as well as T-cell intestinal lymphoma, which was confirmed via immunophenotyping and molecular clonality. The relationship, if any, between polyomavirus infection and the other disease processes in this sea lion is not known, but it is considered unlikely that the polyomavirus induced the lymphoma. Keywords: California sea lion; fibropapilloma; molecular clonality; polyomavirus

Cook, P., C. Reichmuth, S. Dennison and F. Gulland (2013). "Delayed alternation in wild California sea lions with naturally occurring hippocampal damage." Journal of Cognitive Neuroscience Supplement: 82.

Cook, P., C. Reichmuth and F. Gulland (2011). "Auditory habituation as a diagnostic measure of domoic acid toxicosis in wild sea lions." Journal of the Acoustical Society of America 129(4): 2432-2433.

Cook, P., C. Reichmuth and F. Gulland (2011). "Rapid behavioural diagnosis of domoic acid toxicosis in California sea lions." Biology Letters 7(4): 536-538.

Domoic acid is a neurotoxic metabolite of widely occurring algal blooms that has caused multiple marine animal stranding events. Exposure to high doses of domoic acid, a glutamate agonist, may lead to persistent medial temporal seizures and damage to the hippocampus. California sea lions (Zalophus californianus) are among the most visible and frequent mammalian victims of domoic acid poisoning, but rapid, reliable diagnosis in a clinical setting has proved difficult owing to the fast clearance of the toxin from the blood stream. Here, we show that the behavioural orienting responses of stranded sea lions diagnosed with domoic acid toxicosis habituate more slowly to a series of non-aversive auditory stimuli than do those of sea lions with no apparent neurological deficits. A signal detection analysis based on these habituation measures was able to correctly identify 50 per cent of subjects with domoic acid toxicosis while correctly rejecting approximately 93 per cent of controls, suggesting potential diagnostic merit. Keywords: behavioural diagnostics; habituation; hippocampus; domoic acid; marine mammals; sea lions

Costidis, A. and S. A. Rommel (2012). "Vascularization of air sinuses and fat bodies in the head of the bottlenose dolphin (Tursiops truncatus): Morphological implications on physiology." Frontiers in Physiology 3.

Costidis, A. M. (2012). Arteriovenous patterns in beaked whales, Office of Naval Research: 3.
No abstract

Costidis, A. M. (2013). Arteriovenous patterns in beaked whales, Office of Naval Research: 15.
No abstract

Costidis, A. M., M. A. Piscitelli, S. A. Rommel, C. A. Harms, W. A. McLellan, D. S. Rotstein and D. A. Pabst (2009). Elaborate venous structures in the thorax of Kogiids, Physeteriids and Ziphiids. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 61-62.

Cowan, D. F. (2009). Pathology. Encyclopedia of Marine Mammals. W. F. Perrin, B. Wursig and J. G. M. Thewissen. San Diego, Academic Press: 836-844.
No abstract

Cowan, D. F. (2013). "Pathological assessment of acoustic noise effects in stranded dolphins." Bioacoustics 17: 297-299.

Cramer, S. R., D. R. Ketten, J. Arruda, M. Yamato, S. R. Williams, C. Merigo, K. Touhey and T. A. Mooney (2009). Computed Tomography (CT): A non-invasive technique for asssessing trauma and disease in stranded marine mammals. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 62-63.

Cranford, T. W., M. H. Rasmussen, C. W. Potter and P. Krysl (2011). "Hyperoodon echo-morphology: Biosonar anatomy in the northern bottlenose whale." Journal of the Acoustical Society of America 130(4 part 2): 2560.

D'Alessandro, D., D. Duffield, S. Raverty, J. Gaydos, D. Lambourn, J. Huggins, J. Calambokidis, T. McKlveen, S. Dennison, B. Norberg, K. Wilkinson, L. Barre, B. Hanson, P. Foreman, A. Traxler and H. Brubaker (2013). Stranding evaluation of Southern Resident killer whale L-112 by the Northwest Marine Mammal Stranding Network. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 54.

D'Amico, A., R. C. Gisiner, D. R. Ketten, J. A. Hammock, C. Johnson, P. L. Tyack and J. Mead (2009). "Beaked whale strandings and naval exercises." Aquatic Mammals 35(4): 452-472.

Mass strandings of beaked whales (family Ziphiidae) have been reported in the scientific literature since 1874. Several recent mass strandings of beaked whales have been reported to coincide with naval active sonar exercises. To obtain the broadest assessment of surface ship naval active sonar operations coinciding with beaked whale mass strandings, a list of global naval training and anti-submarine warfare exercises was compiled from openly available sources and compared by location and time with historic stranding records. This list includes activities of navies of other nations but emphasizes recent U.S. activities because of what is available in publicly accessible sources. Of 136 beaked whale mass stranding events reported from 1874 to 2004, 126 occurred between 1950 and 2004, after the introduction and implementation of modern, high-power mid-frequency active sonar (MFAS). Of these 126 reports, only two reported details on the use, timing, and location of sonar in relation to mass strandings. Ten other mass strandings coincided in space and time with naval exercises that may have included MFAS. An additional 27 mass stranding events occurred near a naval base or ship but with no direct evidence of sonar use. The remaining 87 mass strandings have no evidence for a link with any naval activity. Six of these 87 cases have evidence for a cause unrelated to active sonar. The large number of global naval activities annually with potential MFAS usage in comparison to the relative rarity of mass stranding events suggests that most MFAS operations take place with no reported stranding events and that for an MFAS operation to cause a mass stranding of beaked whales, a confluence of several risk factors is probably required. Identification of these risk factors will help in the development of measures to reduce the risk of sonar-related strandings. Keywords: stranding event, mass stranding event, mid-frequency active sonar, MFAS, beaked whale, Navy sonar, Ziphiidae

Dau, B. K., K. V. K. Gilardi, F. M. Gulland, A. Higgins, J. B. Holcomb, J. S. Leger and M. H. Ziccardi (2009). "Fishing gear-related injury in California marine wildlife." Journal of Wildlife Diseases 45(2): 355-362.

We reviewed medical records from select wildlife rehabilitation facilities in California to determine the prevalence of injury in California Brown Pelicans (Pelecanus occidentalis), gulls (Larus spp.), and pinniped species (Zalophus californianus, Mirounga angustirostris, and Phoca vitulina) due to fishing gear entanglement and ingestion from 2001 to 2006. Of 9,668 Brown Pelican, gull, and pinniped cases described during the 6-yr study period (2001–06), 1,090 (11.3%) were fishing gear–related. Pelican injuries caused by fishing gear were most common in the Monterey Bay region, where 59.6% of the pelicans rescued in this area and admitted to a rehabilitation center were injured by fishing gear over the 6-yr period. The highest prevalence of fishing gear–related injury in gulls was documented in the Los Angeles/Orange County region (16.1%), whereas the highest prevalences in pinnipeds were seen in the San Diego region (3.7%). Despite these higher prevalences of gull and pinniped fishing gear–related injuries in these specific regions, there was no statistical significance in these trends. Juvenile gulls and pinnipeds were more commonly injured by fishing gear than adults (gulls: $P = 0.03$, odds ratio = 1.29; pinnipeds: $P = 0.01$, odds ratio = 2.07). Male pinnipeds were twice as likely to be injured by fishing gear as females ($P < 0.01$, odds ratio = 2.19). The proportion of fishing gear–related injury cases that were successfully rehabilitated and released (percentage of cases successfully rehabilitated to the point of release out of the total number of fishing gear–related injury cases) was high in all three species groups (pelicans: 63%; gulls: 54%; pinnipeds: 70%). Fishing gear–related injuries in Brown Pelicans and gulls were highest in the fall, but there was only a significant difference between seasons for fishing gear–related injuries in pelicans. Fishing gear–related injuries in pinnipeds most commonly occurred in summer; however, a statistical difference was not detected between seasons for pinnipeds. Derelict fishing gear—lost, abandoned or discarded sport and commercial line, nets, traps, etc.—in the marine environment is a significant cause of injury in California coastal marine wildlife. We evaluated data for

stranded animals only; our results may underestimate the true number of coastal marine animals injured by lost or discarded fishing gear in California.Keywords: California, derelict fishing gear, entanglement, gull, hook, pelican, pinniped, rehabilitation facilities.

De Maio, L., D. Thompson, C. Reichmuth, P. Cook and F. Gulland (2012). The evaluation of olfaction in stranded California sea lions (Zalophus californianus) and its relevance to Domoic Acid Toxicosis. Twenty-Sixth Annual Conference of the European Cetacean Society. Galway, Ireland: 330.

De Maio, L. M., D. Thompson, P. Cook, C. Reichmuth and F. Gulland (2011). The evaluation of olfaction in stranded California sea lions (Zalophus californianus) and relevance to domoic acid toxicosis. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 77.

Delong, R. L., A. J. Orr, R. S. Jenkinson and E. T. Lyons (2009). "Treatment of northern fur seal (Callorhinus ursinus) pups with ivermectin reduces hookworm-induced mortality." Marine Mammal Science 25(4): 944-948.

No abstract

Delynn, R., G. Lovewell, R. S. Wells and G. Early (2011). "Congenital scoliosis of a bottlenose dolphin." Journal of Wildlife Diseases 47(4): 979-983.

There are many reports of cetaceans with deformed and twisted bodies. Skeletal pathology descriptions have shown changes to axial skeletons because of injury, trauma, or disease. We present a bottlenose dolphin (Tursiops truncatus) that shows characteristic patterns of congenital skeletal deformity, including malformed vertebrae, ribs, and sternum. These malformations were consistent with segmentation and formation defects arising during early embryonic development, with a resulting cascade of deformity and compensatory pathology. In spite of severe deformities, the dolphin lived 18 yr, raised two calves, and likely would have lived longer had she not succumbed to sepsis and the piercing of the aorta caused by a stingray barb. Keywords: Bottlenose dolphin; congenital scoliosis; formation defect; segmentation defect

Dennison, S., M. J. Moore, A. Fahlman, K. Moore, S. Sharp, C. T. Harry, J. Hoppe, M. Niemeyer, B. Lentell and R. S. Wells (2012). "Bubbles in live-stranded dolphins." Proceedings of the Royal Society of London Series B Biological Sciences 279(1732): 1396-1404.

Bubbles in supersaturated tissues and blood occur in beaked whales stranded near sonar exercises, and post-mortem in dolphins bycaught at depth and then hauled to the surface. to evaluate live dolphins for bubbles, liver, kidneys, eyes and blubber–muscle interface of live-stranded and capture-release dolphins were scanned with B-mode ultrasound. Gas was identified in kidneys of 21 of 22 live-stranded dolphins and in the hepatic portal vasculature of 2 of 22. Nine then died or were euthanized and bubble presence corroborated by computer tomography and necropsy, 13 were released of which all but two did not re-strand. Bubbles were not detected in 20 live wild dolphins examined during health assessments in shallow water. Off-gassing of supersaturated blood and tissues was the most probable origin for the gas bubbles. In contrast to marine mammals repeatedly diving in the wild, stranded animals are unable to recompress by diving, and thus may retain bubbles. Since the majority of beached dolphins released did not re-strand it also suggests that minor bubble formation is tolerated and will not lead to clinically significant decompression sickness.Keywords: stranding; decompression sickness; gas bubbles; diving physiology; marine mammals

Dennison, S. E., W. V. Bonn, M. Boor, J. Adams, N. Pussini, T. Spraker and F. M. D. Gulland (2011). "Antemortem diagnosis of a ventricular septal defect in a California sea lion Zalophus californianus." Diseases of Aquatic Organisms 94(1): 83-88.

A yearling California sea lion Zalophus californianus stranded in poor body condition, and on physical examination a heart murmur was audible bilaterally. The sea lion was diagnosed with a left-to-right shunting membranous ventricular septal defect (VSD) using B-mode, color-flow Doppler and continuous-wave Doppler echocardiography. A left-to-right intracardiac shunting lesion was confirmed during cardiac angiographic computed tomography. The VSD defect was verified during the necropsy examination. On histologic examination concurrent mild multifocal myocarditis with focal mild ventricular free-wall myocardial necrosis were identified. A specific cause for the myocarditis and myocardial necrosis was not found, and association with the VSD and resultant myocardial dysfunction was presumed. This is the first report of the antemortem diagnosis of a VSD in a marine mammal and the first report of a VSD in a California sea lion.Keywords: Echocardiography; Congenital defect; Cardiac disease; Heart disease; Ultrasound

Dennison, S. E., M. Boor, D. Fauquier, W. V. Bonn, D. J. Greig and F. M. D. Gulland (2011). "Foramen ovale and ductus arteriosus patency in neonatal harbor seal (Phoca vitulina) pups in rehabilitation." Aquatic Mammals 37(2): 161-166.

Twenty neonatal harbor seal (Phoca vitulina) pups in rehabilitation following maternal separation underwent serial echocardiographic studies to assess patency and subsequent age of functional closure of the ductus arteriosus (d.a.). B-mode, color-flow Doppler, and pulse and continuous wave Doppler were utilized to identify the d.a. and determine patency and directionality of blood flow. Seals were also evaluated for evidence of foramen ovale (f.o.) patency. B-mode ultrasound was used to evaluate the inter-atrial septum for abnormal (aneurismal) motion, a sign of f.o. patency in other species. In one harbor seal, this motion was confirmed as being consistent with f.o. patency by contrast echocardiography. Closure of the f.o. was not confirmed in any harbor seal prior to release back into the free-ranging population. Data acquired indicate that there is patency of the f.o. and d.a. after birth for a longer period in phocids than in described terrestrial mammals. The f.o. may be patent up to 7 wks of age, and the d.a. may be patent up to 6 wks of age without evidence of clinical consequence. This difference in ontogeny between terrestrial mammals and harbor seals is presumptively a diving adaptation. Such an adaptation is counterintuitive given that humans with f.o. patency are at increased risk of stroke following the introduction or formation of intravascular gas bubbles and suggests that con-current protective mechanisms may be present. Keywords: echocardiography, echocardiology, harbor seals, Phoca vitulina, pinniped, congenital defect

Dennison, S. E., L. Forrest and F. M. D. Gulland (2009). "Normal thoracic radiographic anatomy of immature California sea lions (Zalophus californianus) and immature northern elephant seals (Mirounga angustirostris)." Aquatic Mammals 35(1): 36-42.

Immature California sea lions (Zalophus californianus) and northern elephant seals (Mirounga angustirostris) without evidence of thoracic disease were radiographed under anesthesia. Important species-specific variations were noted on thoracic radiographs. For the California sea lions, the mean vertebral heart score was 8.65 from the left lateral view, and the cardiac silhouette occupied a mean of 66% of the internal thoracic width. The tracheal bifurcation in California sea lions was located at the level of the first thoracic vertebral body. For the northern elephant seals, there was variation in the number of thoracic vertebrae and ribs from 12 to 15, a lack of pulmonary lobation, and an indistinct cardiac silhouette. Cardiac measurements could only be made on ventrodorsal (VD) and dorsoventral (DV) digital radiographs where the cardiac silhouette occupied a mean of 62% of the internal thoracic width. The combination of smooth to rounded lung lobe margins with border effacement of the cardiac

silhouette and diaphragmatic margin is an important, normal, species-specific finding of the northern elephant seal that could be easily mistaken for pleural effusion. The carina in the northern elephant seals was at the level of the fifth thoracic vertebral body. In both species, the aortic bulb was evident as a focal, fairly symmetrical cranial mediastinal widening cranial to the cardiac silhouette on the VD and DV views, resulting in the aorta being identifiable on both the right and the left. This is an important normal finding in marine mammals that should not be mistaken for pathology. Both species had a diffuse bronchointerstitial pulmonary pattern that was slightly more prominent in California sea lions. This finding was consistent with variation between these species in the tissues supporting the small airways.This prospective study serves as a normal reference for immature California sea lions and northern elephant seals in veterinary care.Keywords: Radiology, radiography, diagnostic imaging, marine mammal, seal, vertebral heart score, lung, trachea, pinniped, California sea lion, Zalophus californianus, northern elephant seal, Mirounga angustirostris

Dennison, S. E., L. J. Forrest, M. L. Fleetwood and F. M. D. Gulland (2009). "Concurrent occipital bone malformation and atlantoaxial subluxation in a neonatal harbor seal (Phoca vitulina)." Journal of Zoo and Wildlife Medicine 40(2): 385-388.

A stranded male harbor seal (Phoca vitulina) neonate with progressive clinical signs or ataxia, tremors, and deteriorating consciousness was evaluated using magnetic resonance imaging for suspected cerebellar brain disease Prior to euthanasia because of grave prognosis. Magnetic resonance imaging identified occipital bone dysplasia with cerebellar herniation and concurrent atlantoaxial subluxation with spinal cord compression. These imaging findings elucidated the cause of histopathology changes including gliosis of the cerebellum and axonal degeneration and dilation of myelin sheaths of the dorsal funiculus of the spinal cord. Occipital bone dysplasia and/or atlantoaxial subluxation Should be considered as differentials for abnormal neurologic signs in harbor seal neonates. Magnetic resonance imaging is a valuable Modality for antemortem diagnosis.Keywords: Magnetic resonance imaging; marine mammal; radiology; congenital malformation; neurologic disorder

Dennison, S. E., F. M. D. Gulland and W. E. Braselton (2010). "Standardized protocols for plasma clearance of iohexol are not appropriate for determination of glomerular filtration rates in anesthetized California sea lions (Zalophus californianus)." Journal of Zoo and Wildlife Medicine 41(1): 144-147.

Plasma clearance of iohexol was evaluated in eight anesthetized California sea lions (Zalophus californiauus), without evidence of renal dysfunction, to determine if the one-compartment model and the sample protocol used in dogs and cats could be applied to this species. Non linearity between samples in 75% (6/8) of sea lions voided those results. An additional two anesthetized sea lions were sampled at 5, 30, 45, 60, 120, 180, 240, and 360 min post iohexol injection and semi-logarithmic curves calculated. Plasma iohexol clearance values calculated by one-, two-, and noncompartment models were in poor agreement, suggesting that the standardized protocol described for dogs and cats cannot simply be applied to California sea lions, probably due to the effects of the dive reflex induced during anesthesia.Keywords: Renal dysfunction; renal disease; kidney; iodinated contrast medium; contrast media reaction

Dennison, S. E. and M. J. Moore (2009). Use of B-Mode ultrasonography to evaluate bycatch and stranded (dead and alive) marine mammals for evidence of gas bubbling. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 69-70.

Di Giovanni, R., K. F. Durham, J. N. Wocial and A. M. Chaillet (2009). An increase in gray seal (Halichoerus grypus) sightings and strandings in New York waters. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 71.

DiGiovanni Jr., R. (2009). Summary of marine mammal and sea turtle stranding summary for 2008, Riverhead Foundation for Marine Research and Preservation.

DiGiovanni Jr., R. A. (2010). Summary of marine mammal and sea turtles strandings for June 2009 through May 2010, Riverhead Foundation for Marine Research and Preservation.

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Dunshea, G., N. B. Barros, E. J. B. McCabe, N. J. Gales, M. A. Hindell, S. N. Jarman and R. S. Wells (2013). "Stranded dolphin stomach contents represent the free-ranging population's diet." Biology Letters 9(3): Article 20121036.

Diet is a fundamental aspect of animal ecology. Cetacean prey species are generally identified by examining stomach contents of stranded individuals. Critical uncertainty in these studies is whether samples from stranded animals are representative of the diet of free-ranging animals. Over two summers, we collected faecal and gastric samples from healthy free-ranging individuals of an extensively studied bottlenose dolphin population. These samples were analysed by molecular prey detection and these data compared with stomach contents data derived from stranded dolphins from the same population collected over 22 years. There was a remarkable consistency in the prey species composition and relative amounts between the two datasets. The conclusions of past stomach contents studies regarding dolphin habitat associations, prey selection and proposed foraging mechanisms are supported by molecular data from live animals and the combined dataset. This is the first explicit test of the validity of stomach contents analysis for accurate population-scale diet determination of an inshore cetacean. Keywords: DNA-based; PCR; Sarasota; foraging.

Durden, W. N., M. Stolen, S. Venn-Watson, B. Puschner, T. Mazza, E. Nilson and J. St. Leger (2011). Trace element and heavy metal concentrations in stranded bottlenose dolphins from the Atlantic Ocean, Eastern Florida. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 84.

Ellisor, D., W. McLellan, H. Koopman, L. Schwacke, W. McFee and J. Kucklick (2013). "The distribution and stratification of persistent organic pollutants and fatty acids in bottlenose dolphin (Tursiops truncatus) blubber." Science of the Total Environment 463-464: 581-588.

Blubber has been used for decades to monitor exposure of marine mammals to persistent organic pollutants (POPs). However, little is known about POP variability as a function of blubber depth and across the body of the animal. Remote blubber biopsy sampling (e.g, projectile biopsy) is the most common technique used to acquire samples from free-swimming animals, yet such techniques may result in variable sampling. It is important to understand whether blubber stratification or body location affects POP concentration or the concentration of other important blubber constituents such as fatty acids (FA). To investigate the influence of sampling depth and location on POP concentration, full depth blubber samples were taken from one stranded bottlenose dolphin (Tursiops truncatus) at six different body sites to assess variation in FA distribution and contaminant storage with body location. Three of the samples from different body locations were separated into histologically distinct layers to examine the effect of blubber depth and body location on POPs and FAs. In this individual, both POPs and FAs were heterogeneous with blubber depth and body location. POP concentrations were significantly greater in ventral (average ?PBDEs 1350 ng/g lipid) and anterior (average ?PCBs 28700 ng/g lipid) body locations and greater in the superficial blubber layer (average ?PCBs 35500 ng/g lipid) when compared

to the deep (8390 ng/g lipid) and middle (23,700 ng/g lipid) layers. Proportionally more dietary FAs were found in dorsal blubber and in middle and deep layers relative to other locations while the reverse was true for biosynthesized FAs. Stratification was further examined in blubber from the same body location in five additional stranded bottlenose dolphins. Although FAs were stratified with blubber depth, lipid-normalized POPs were not significantly different with depth, indicating that POP concentrations can vary in an individual with blubber depth though the direction of POP stratification is not consistent among individuals.Keywords: Persistent organic pollutants; Fatty acids; Bottlenose dolphin; Blubber; Biopsy sampling; Strandings.

Fahlman, A., S. H. Loring, M. Ferrigno, C. Moore, G. Early, M. Niemeyer, B. Lentell, F. Wenzel, R. Joy and M. J. Moore (2011). "Static inflation and deflation pressure-volume curves from excised lungs of marine mammals." Journal of Experimental Biology 214(22): 3822-3828.

Excised lungs from eight marine mammal species [harp seal (Pagophilus groenlandicus), harbor seal (Phoca vitulina), gray seal (Halichoerus grypus), Atlantic white-sided dolphin (Lagenorhynchus acutus), common dolphin (Delphinus delphis), Risso's dolphin (Grampus griseus), long-finned pilot whale (Globicephala melas) and harbor porpoise (Phocoena phocoena)] were used to determine the minimum air volume of the relaxed lung (MAV, N=15), the elastic properties (pressure-volume curves, N=24) of the respiratory system and the total lung capacity (TLC). Our data indicate that mass-specific TLC (sTLC, l kg(-1)) does not differ between species or groups (odontocete vs phocid) and agree with that estimated (TLC(est)) from body mass (M(b)) by applying the equation: TLC(est)=0.135M(b)(0.92). Measured MAV was on average 7% of TLC, with a range from 0 to 16%. The pressure-volume curves were similar among species on inflation but diverged during deflation in phocids in comparison with odontocetes. These differences provide a structural basis for observed species differences in the depth at which lungs collapse and gas exchange ceases.Keywords: lung mechanics; total lung capacity; minimum air volume; excised lung; diving physiology

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Fahlman, A., P. L. Tyack, M. Moore, W. Zapol, R. Anderson and S. Trumble (2012). Physiological monitoring in diving mammals, Office of Naval Research: 7.

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Fahlman, A., P. L. Tyack, M. Moore, W. Zapol, R. Anderson and S. Trumble (2013). Physiological monitoring in diving mammals, Office of Naval Research: 19.

No abstract

Fauquier, D. A., M. J. Kinsel, M. D. Dailey, G. E. Sutton, M. K. Stolen, R. S. Wells and F. M. D. Gulland (2009). "Prevalence and pathology of lungworm infection in bottlenose dolphins Tursiops truncatus from southwest Florida." Diseases of Aquatic Organisms 88(1): 85-90.

Parasitism of the respiratory system is a relatively common finding in stranded cetaceans; however, no systematic investigations regarding the severity, distribution, and clinical consequences of these infections in bottlenose dolphins Tursiops truncatus have been conducted previously. The present study determined the prevalence of lungworm infections in dead stranded (n = 22) and live bottlenose dolphins (n = 44) from southwestern Florida, USA, during the period from 2003 to 2005. Dead stranded bottlenose dolphins were necropsied and lungs were examined visually, by palpation, and histologically for lesions consistent with verminous pneumonia. When present, nematodes were counted, measured,

and identified to species based upon their morphology. Dolphin feces and blowhole swabs were collected and examined for nematode larvae. Lungworm prevalence was 77% in dead animals (n = 22). The lesions in most cases were mild, chronic, and not the primary cause of death. Only 13% of dead animals examined had patent infections, with larvae present in blowhole and fecal cytology, and only 18% of animals had intact worms present at necropsy, with a geometric mean intensity of infection of 22.6 worms animal(-1). Intact worms were identified as either Halocercus lagenorhynchi or Skrjabinalius cryptocephalus. The highest prevalence of active infections was found in neonates and calves, including 1 stillborn calf. For free-ranging animals, all blowhole swabs (n = 44) were negative, and fecal cytology (n = 22) showed a 3% prevalence of patent infection. Findings from the present study support the theory that bottlenose dolphins can be infected transplacentally by lungworms. The impact that such infections may have on neonatal survival is unknown; however, these infections could increase neonatal mortality.Keywords: Lungworm; Bottlenose dolphin; Nematode; Transplacental infection; Florida; Tursiops truncatus

Ferrante, J. A., J. M. Arthur, F. M. D. Gulland, E. Hill, J. Almeida and M. G. Janech (2009). Serum cytokines as predictors of domoic acid exposure in California sea lions (Zalophus californianus). Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 80.

Fertall, S. C., K. L. West and B. A. Jensen (2011). Establishing a biomarker for contaminant exposure in hawaiian cetaceans: Cytochrome P4501A1 expression. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 92.

Finneran, J. J., D. S. Houser, B. Mase-Guthrie, R. Y. Ewing and R. G. Lingenfelser (2009). "Auditory evoked potentials in a stranded Gervais' beaked whale (Mesoplodon europaeus)." Journal of the Acoustical Society of America 126(1): 484-490.

Efforts to identify the specific causal mechanisms responsible for beaked whale strandings coincident with naval exercises have been hampered by lack of data concerning the hearing abilities of beaked whales and their physiological and behavioral responses to sound. In this study, auditory capabilities of a stranded Gervais' beaked whale (Mesoplodon europaeus) were investigated by measuring auditory evoked potentials. Click-evoked potentials, auditory thresholds as a function of frequency, and the modulation rate transfer function were determined. The evoked potentials and modulation rate transfer function were similar to those measured in other echolocating odontocetes; the upper limit of functional hearing was 80–90 kHz.

Fire, S., Z.-H. Wang, T. Leighfield, S. Morton, W. McFee, W. McLellan, R. W. Litaker, P. Tester, A. Hohn, G. Lovewell, C. Harms, D. Rotstein, S. Barco, A. Costidis, B. Sheppard, G. Bossart, M. Stolen, W. N. Durden and F. V. Dolah (2009). Domoic acid exposure in pygmy and dwarf sperm whales (Kogia spp) from southeastern and mid-Atlantic US. waters. Eighteenth Biennial Conference on the Biology of Marine Mammals. Quebec City, Canada: 81-82.

Fire, S. E., M. J. Twiner, Z. Wang, T. Leighfield, R. S. Wells, S. L. Morton and H. R. Whitehead (2011). Concurrent exposure of multiple classes of HAB toxins In marine mammals from U.S. coastal waters. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 93-94.

Fire, S. E., Z. Wang, M. Berman, G. W. Langlois, S. L. Morton, E. Sekula-Wood and C. R. Benitez-Nelson (2010). "Trophic transfer of the harmful algal toxin domoic acid as a cause of death in a minke whale (Balaenoptera acutorostrata) stranding in southern California." Aquatic Mammals 36(4): 342-350.

Unusually high concentrations of the neurotoxin domoic acid (DA) were detected in a minke whale (Balaenoptera acutorostrata) carcass recovered during a severe harmful algal bloom (HAB), which occurred in southern California in April 2007. Cell fragments of the toxigenic diatom Pseudo-nitzschia australis were observed in whale gastric fluid and feces, corresponding to a dominance of Pseudo-nitzschia spp. in the phytoplankton com-munity at the time of stranding. A high abundance of otoliths from a prominent DA vector, the northern anchovy (Engraulis mordax), were recovered in whale stomach contents, indicating trophic transfer of DA via the food web. Whale feces contained 258 µg DA per gram sample, exceeding DA concentrations reported for any marine mammal. DA intoxication was identified as the cause of mortality of this animal, expanding on the limited understanding of the impacts of DA-producing HABs on large whales.Keywords: domoic acid, harmful algal bloom, algal toxin, stranding, marine mammal, minke whale, Balaenoptera acutorostrata

Fire, S. E., Z. Wang, M. Byrd, H. R. Whitehead, J. Paternoster and S. L. Morton (2011). "Co-occurrence of multiple classes of harmful algal toxins in bottlenose dolphins (Tursiops truncatus) stranding during an unusual mortality event in Texas, USA." Harmful Algae 10(3): 330-336.

During February-April 2008, an unusual mortality event occurred in Texas coastal waters that resulted in over 100 bottlenose dolphin (Tursiops truncatus)deaths. This mortality event overlapped spatially and temporally with a harmful algal bloom (HAB) composed of the toxin-producing genera Dinophysis spp. and Prorocentrum spp., and was associated with shellfish bed closures due to HAB toxins. A bloom of the toxin-producing diatom Pseudo-nitzschia pungens was also detected in Texas coastal waters in early April, towards the end of the dolphin mortality event. Analysis of dolphin gastrointestinal contents collected during this event demonstrated the presence of the HAB toxins domoic acid and okadaic acid in association with these blooms, as well as evidence of brevetoxin exposure in the absence of an associated K. brevis bloom.Historical dolphin stranding data for Texas waters indicate seasonal stranding peaks similar to the present study, indicating a need for investigating potential HAB involvement in mass strandings in previous years and in future events. This study marks the first reported occurrence of okadaic acid in marine mammals, and documents a unique co-occurrence of multiple HAB toxins associated with an unusual mortality event. Texas waters harbor a high diversity of HAB events relative to other coastal regions, and this study highlights the importance of efforts to understand the impacts of such HAB events on the health of Texas marine wildlife. Published by Elsevier B.V.Keywords: Bottlenose dolphin; Biotoxin; Brevetoxin; Domoic acid; HAB; Harmful algal bloom; Okadaic acid; Tursiops truncatus; Unusual mortality event

Fire, S. E., Z. Wang, T. A. Leighfield, S. L. Morton, W. E. McFee, W. A. McLellan, R. W. Litaker, P. A. Tester, A. A. Hohn, G. Lovewell, C. Harms, D. S. Rotstein, S. G. Barco, A. Costidis, B. Sheppard, G. Bossart, M. Stolen, W. Noke-Durden, and F.M. VanDolah (2009). "Domoic acid exposure in pygmy and dwarf sperm whales (Kogia spp.) from southeastern and mid-Atlantic US waters." Harmful Algae 8(5): 658-664.
The neurotoxin domoic acid (DA) was detected in urine and fecal samples recovered from pygmy sperm whales (Kogia breviceps) and dwarf sperm whales (Kogia sima) stranding along the U.S. Atlantic coast from 1997 to 2008. Of the 41 animals analyzed from Virginia, North Carolina, South Carolina and Florida, 24 (59%) tested positive for DA at concentrations of 0.4-1.8 ng/mL in urine and 12-13,566 ng/g in feces as determined by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Feces appeared to be the best indicator of DA exposure in Kogia spp., with 87% of all fecal samples analyzed testing positive for this toxin. Additional stranded animals (n = 40) representing 11 other cetacean species were recovered from the same region between 2006 and 2008 and analyzed by LC-MS/MS, however DA was not detected in any of these individuals. DA is produced naturally by diatoms in the genus Pseudo-nitzschia. Although blooms of DA-producing Pseudo-nitzschia have been associated with repeated large-scale marine mammal mortalities on the west coast of the U.S., there is no documented history of

similar blooms on the southeast U.S. coast, and there were no observed Pseudo-nitzschia blooms in the region associated with any of these strandings. The feeding habits of Kogia spp. are poorly documented; thus, the vector(s) for DA exposure to these deep-diving species remains to be identified. Toxin accumulation in these pelagic whale species may be an indication of cryptic harmful algal bloom activity in offshore areas not currently being monitored. This study highlights the need for a better understanding of the role of toxigenic algae in marine mammal morbidity and mortality globally.Keywords: Domoic acid; Dwarf sperm whale; Harmful algal bloom; Kogia; Phycotoxin; Pygmy sperm whale

Fortune, S. M. E., A. W. Trites, W. L. Perryman, M. J. Moore, H. M. Pettis and M. S. Lynn (2012). "Growth and rapid early development of North Atlantic right whales (Eubalaena glacialis)." Journal of Mammalogy 93(5): 1342-1354.

Body growth of North Atlantic right whales (Eubalaena glacialis) was described from measurements of known-age live and dead individuals to gain insights into the nutritional needs and life-history strategies of this endangered species. Body lengths from 154 individuals revealed that calves more than doubled in size and attained three-fourths of asymptotic adult size by the time they had weaned at 12 months. Calves gained on average 1.7 cm and 34 kg per day while nursing during this extremely rapid growth phase. Mean predicted lengths and body mass were 4.2 m and 1.1 metric tons (mt) at birth, 10.3 m and 13.5 mt at weaning, and 13.6 m and 29.6 mt when fully grown. Growth of right whales was best described using a 2-phased Gompertz growth model and could not be fit using any of the single continuous growth models commonly used for other mammals. Rapid growth during dependency may minimize the risk of predation and maximize calf survival. Rapid calf growth also may maximize development of the mouth and baleen to optimize foraging efficiency of juveniles at the time of weaning, as well as improve reproductive fitness by reducing the age at which sexual maturity is attained. However, transferring the amount of energy needed to support the rapid postnatal growth of North Atlantic right whales may ultimately affect the intervals between pregnancies (>3 years) of mature females.Keywords: Eubalaena glacialis, growth models, length, mass, reproductive costs, right whale.

Frame, E. and K. Lefebvre (2013). ELISA methods for domoic acid quantification in multiple marine mammal species and sample matrices, NOAA, National Marine Fisheries Service, Northwest Fisheries Science Center: 35.

Fravel, V., W. V. Bonn, C. Rios and F. Gulland (2011). "Meticillin-resistant Staphylococcus aureus in a harbour seal (Phoca vitulina)." Veterinary Record 169(6): 2.

Freeman, K. S., S. M. Thomasy, S. D. Stanley, W. Van Bonn, F. M. D. Gulland, A. S. Friedlaender and D. J. Maggs (2011). Plasma pharmacokinetics and relative tear concentrations following oral doxycycline administration to elephant seals (Mirounga angustirostris). Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 99.

Gabriele, C. M., C. Lockyer, J. M. Straley, C. M. Jurasz and H. Kato (2010). "Sighting history of a naturally marked humpback whale (Megaptera novaeangliae) suggests ear plug growth layer groups are deposited annually." Marine Mammal Science 26(2): 443-450.

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Gabriele, C. M., J. L. Neilson, A. S. Jensen and J. M. Straley (2011). Summary of reported whale -vessel collisions in Alaskan waters. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 102.

Gaydos, J. K., L. I. Vilchis, M. M. Lance, S. J. Jeffries, A. Thomas, V. Greenwood, P. Harner and M. H. Ziccardi (2013). "Postrelease movement of rehabilitated harbor seal (Phoca vitulina richardii) pups compared with cohort-matched wild seal pups." Marine Mammal Science 29(3): E282-E294.

Harbor seal (Phoca vitulina richardii) populations in the inland waters of Washington and British Columbia are at or near carrying capacity. Stranded pups often are collected and admitted to rehabilitation centers, and then released when they reach a weight of 22 kg and meet a variety of preestablished health and release conditions. While rehabilitation is common practice, it is unclear if rehabilitated seal pups behave like wild weaned pups. Using satellite transmitters, we compared movement patterns of 10 rehabilitated pups with 10 wild weaned pups. When released, rehabilitated seals were longer and heavier than wild pups, while wild pups had a larger mean axillary girth. No clinically different blood parameters were detected. On average, rehabilitated harbor seal pups traveled nearly twice as far cumulatively, almost three times as far daily, and dispersed over three times as far from the release site compared to wild weaned seals. Additionally, wild harbor seals transmitted nearly twice as long as did rehabilitated seals. These patterns suggest that learned behavior during the brief 3–4 wk nursing period likely enables wild harbor seal pups to move less daily and remain closer to their weaning site than rehabilitated pups. Keywords: harbor seal, Phoca vitulina, movement, rehabilitation, site fidelity, stranding, telemetry.

Gibson, A. K., S. Raverty, D. M. Lambourn, J. Huggins, S. L. Magargal and M. E. Grigg (2011). "Polyparasitism is associated with increased disease severity in Toxoplasma gondii-infected marine sentinel species." PLoS Neglected Tropical Diseases 5(5): e1142.

In 1995, one of the largest outbreaks of human toxoplasmosis occurred in the Pacific Northwest region of North America. Genetic typing identified a novel Toxoplasma gondii strain linked to the outbreak, in which a wide spectrum of human disease was observed. For this globally-distributed, water-borne zoonosis, strain type is one variable influencing disease, but the inability of strain type to consistently explain variations in disease severity suggests that parasite genotype alone does not determine the outcome of infection. We investigated polyparasitism (infection with multiple parasite species) as a modulator of disease severity by examining the association of concomitant infection of T. gondii and the related parasite Sarcocystis neurona with protozoal disease in wild marine mammals from the Pacific Northwest. These hosts ostensibly serve as sentinels for the detection of terrestrial parasites implicated in water-borne epidemics of humans and wildlife in this endemic region. Marine mammals (151 stranded and 10 healthy individuals) sampled over 6 years were assessed for protozoal infection using multi-locus PCR-DNA sequencing directly from host tissues. Genetic analyses uncovered a high prevalence and diversity of protozoa, with 147/161 (91%) of our sampled population infected. From 2004 to 2009, the relative frequency of S. neurona infections increased dramatically, surpassing that of T. gondii. The majority of T. gondii infections were by genotypes bearing Type I lineage alleles, though strain genotype was not associated with disease severity. Significantly, polyparasitism with S. neurona and T. gondii was common (42%) and was associated with higher mortality and more severe protozoal encephalitis. Our finding of widespread polyparasitism among marine mammals indicates pervasive contamination of waterways by zoonotic agents. Furthermore, the significant association of concomitant infection with mortality and protozoal encephalitis identifies polyparasitism as an important factor contributing to disease severity in marine mammals.

Gill, S., T. Goldstein, D. Situ, T. S. Zabka, F. M. D. Gulland and R. W. Mueller (2010). "Cloning and characterization of glutamate receptors in Californian sea lions (Zalophus californianus)." Marine Drugs 8(5): 1637-1649.

Domoic acid produced by marine algae has been shown to cause acute and chronic neurologic sequelae in Californian sea lions following acute or low-dose exposure. Histological findings in affected animals included a degenerative cardiomyopathy that was hypothesized to be caused by over-excitation of the glutamate receptors (GluRs) speculated to be present in the sea lion heart. Thus tissues from five sea lions without lesions associated with domoic acid toxicity and one animal with domoic acid-induced chronic neurologic sequelae and degenerative cardiomyopathy were examined for the presence of GluRs. Immunohistochemistry localized mGluR 2/3, mGluR 5, GluR 2/3 and NMDAR 1 in structures of the conducting system and blood vessels. NMDAR 1 and GluR 2/3 were the most widespread as immunoreactivity was observed within sea lion conducting system structures. PCR analysis, cloning and subsequent sequencing of the seal lion GluRs showed only 80% homology to those from rats, but more than 95% homologous to those from dogs. The cellular distribution and expression of subtypes of GluRs in the sea lion hearts suggests that exposure to domoic acid may induce cardiac damage and functional disturbances.Keywords: harmful algal blooms; domoic acid; Californian sea lion; conducting system; heart; immunohistochemistry; glutamate receptors

Gilmartin, W. G., T. C. Johanos, D. P. Demaster and J. R. Henderson (2011). "Hawaiian monk seals (Monachus schauinslandi) at Kure Atoll: Some life history effects following effort to enhance pup survival." Aquatic Mammals 37(3): 326-331.

No abstract

Glass, A. H., T. V. N. Cole and M. Garron (2009). Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2003-2007 (second edition), National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center.

The Northeast Fisheries Science Center (NEFSC) has developed criteria to evaluate reports of human-caused injury and mortality to large whales. The criteria minimize the identification of false positive human-caused mortalities and serious injuries, and therefore provide a minimum value of human impact to whale stocks. Serious injury is defined as an injury that is likely to lead to death. This report describes determinations made for reports received from 2003 through 2007 involving right (Eubalaena glacialis), humpback (Megaptera novaeangliae), fin (Balaenoptera physalus), sei (B. borealis), blue (B. musculus), minke (B. acutorostrata) and Bryde's (B. edeni) whales observed along the eastern seaboard of the United States and adjacent Canadian Maritimes. A total of 537 unique large whale events were verified during the period, including carcasses (both beached and at-sea) and live whales. We confirmed 153 unique entanglement, 52 ship strike, and 349 mortality events. Twenty-one (14%) of the entanglements and 30 (58%) of the ship strikes were fatal. Serious injury was sustained in 16 (10%) of the entanglement events and in 2 (4%) of the confirmed ship strikes. Twenty-four (16%) of the entanglements and five (10%) of the ship strike events did not have adequate documentation to determine if serious injury occurred. Seventy-six (50%) of the entanglement events and 13 (25%) of the ship strike events did not cause serious injury or death. Of the 349 confirmed mortalities, 280 (80%) lacked sufficient evidence to determine cause of death. Minke whales had the greatest number of entanglement mortalities (n=9); humpback whales had the highest number of serious injury events resulting from entanglements (n=10); and right whales had the greatest number of ship strike mortalities (n=9) and serious injuries (n=2) from ship strikes. These mortality and serious injury numbers are minimum counts due to poor detection probabilities and inadequate documentation. Thus, the true

level of human impact to these stocks is assumed to be greater than that reported here, however the amount greater is unknown.

Glass, A. H., T. V. N. Cole and M. Garron (2010). Mortality and serious injury determinations for baleen whale stocks along the United States and Canadian Eastern Seaboards, 2004-2008, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center: 27.

The Northeast Fisheries Science Center (NEFSC) has developed criteria to evaluate reports of human-caused injury and mortality to large whales. The criteria minimize the identification of false positive human-caused mortalities and serious injuries and therefore provide a minimum value of human impact to whale stocks. Serious injury is defined as an injury that is likely to lead to death. This report describes determinations made for reports received from 2004 - 2008 involving North Atlantic right (Eubalaena glacialis), humpback (Megaptera novaeangliae), fin (Balaenoptera physalus), sei (B. borealis), blue (B. musculus), minke (B. acutorostrata), and Bryde's (B. edeni) whales observed along the eastern seaboard of the United States and adjacent Canadian Maritimes. A total of 539 unique large whale events were verified during the period, including carcasses (both beached and at-sea) and live whales. We confirmed 188 unique entanglement, 57 ship strike, and 330 mortality events. Twenty-four (13%) of the entanglements and 30 (53%) of the ship strikes were fatal. Serious injury was sustained in 18 (10%) of the entanglement events and in 2 (4%) of theconfirmed ship strikes. Thirty-three (18%) of the entanglements and six (11%) of the ship strike events did not have adequate documentation to determine if serious injury occurred. Seventy-nine (42%) of the entanglement events and 15 (26%) of the ship strike events were determined to have not caused serious injury or death. Of the 330 confirmed mortalities, 256 (78%) lacked sufficient evidence to determine cause of death. Minke whales had the greatest number of entanglement mortalities (n=11); humpback whales had the highest number of serious injury events resulting from entanglements (n=11); fin whales had the greatest number of ship strike mortalities (n=10); and right whales had the only serious injuries (n=2) from ship strikes. These mortality and serious injury numbers are minimum counts because of poor detection probabilities and inadequate documentation. Thus, the true level of human impact to these stocks is assumed to be greater than that reported here, however the amount greater is unknown.

Gobush, K. S., J. D. Baker and F. M. D. Gulland (2011). "Effectiveness of an antihelminthic treatment in improving the body condition and survival of Hawaiian monk seals." Endangered Species Research 15(1): 29-37.

Food limitation and poor body condition are significant factors affecting the survival of juvenile Hawaiian monk seals Monachus schauinslandi in the Northwestern Hawaiian Islands. Previous research has indicated that juvenile monk seals infected with cestodes are in worse body condition than those that are uninfected. To test whether individual growth and survivorship are boosted by intermittently reducing parasites, we initiated a deworming study on juvenile seals at Laysan Island. Forty-three unique juvenile seals were captured, weighed, measured, feces-sampled, and either given an injectable antihelminthic (praziquantel) or used as untreated controls up to 4 times at 8 to 16 wk intervals across a 7 month period. The effect of treatment on survival, egg shedding, and gain in mass was evaluated. Survival of the subset of the 3 cohorts included in the study was 100% for the 2007 and 2008 cohorts and 85.2% for the 2009 cohorts. Egg prevalence did not differ significantly between control and treated seals. Percent daily mass gain was greatest in the March to May period. Older juveniles gained more mass than young-of-the-year (treated and control), which lost mass between the first 2 treatments. Percent mass gain was significantly greater for treated than control seals during March to May, but not during December to March or over the entire treatment period (December to May). The questionable efficacy of injectable praziquantel indicates that a different route of administration or dosage of

praziquantel or a different antihelminthic may be more suitable for treatment of cestodes in this species.Keywords: Hawaiian monk seal; Monachus schauinslandi; Antihelminthic; Praziquantel; Cestodes

Gobush, K. S., F. M. Gulland and J. Baker (2011). The effectiveness of an anti-helminthic treatment in improving the body condition and survival of Hawaiian monk seals. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 110-111.

Goldstein, T., K. M. Colegrove, M. Hanson and F. M. D. Gulland (2011). "Isolation of a novel adenovirus from California sea lions Zalophus californianus." Diseases of Aquatic Organisms 94(3): 243-248.

Viral hepatitis associated with adenoviral infection has been reported in California sea lions Zalophus californianus admitted to rehabilitation centers along the California coast since the 1970s. Canine adenovirus 1 (CAdV-1) causes viral hepatitis in dogs and infects a number of wildlife species. Attempts to isolate the virus from previous sea lion hepatitis cases were unsuccessful, but as the hepatitis had morphologic features resembling canine infectious hepatitis, and since the virus has a wide host range, it was thought that perhaps the etiologic agent was CAdV-1. Here, we identify a novel adenovirus in 2 stranded California sea lions and associate the infection with viral hepatitis and endothelial cell infection. Phylogenetic analysis confirmed the classification of the sea lion adeno virus in the Mastadenovirus genus with the most similarity to tree shrew adenovirus 1 (TSAdV-1, 77%). However, as the sea lion adenovirus appeared to be equally distant from the other Mastadenovirus species based on phylogenetic analysis, results indicate that it represents an independent lineage and species. Although sequences from this novel virus, otarine adenovirus 1 (OtAdV-1), show some similarity to CAdV-1 and 2, it is clearly distinct and likely the cause of the viral hepatitis in the stranded California sea lions.Keywords: California sea lion; Zalophus californianus; Adenovirus; Viral hepatitis; Corneal edema

Goldstein, T., J. A. K. Mazet, V. A. Gill, P. L. Boveng, J. M. London, T. Gelatt, B. S. Fadely, M. A. Lander, L. D. Rea, K. A. Burek, S. L. Cosby and J. A. Hammond (2013). Emergence of phocine distemper virus in Arctic and Sub-arctic pinnipeds in the Northeast Pacific off Alaska. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 82.

Goldstein, T., I. Mena, S. J. Anthony, R. Medina, P. W. Robinson, D. J. Greig, D. P. Costa, W. I. Lipkin, A. Garcia-Sastre and W. M. Boyce (2013). "Pandemic H1N1 influenza isolated from free-ranging northern elephant seals in 2010 off the central California coast." PLoS ONE 8(5): e62259.

Interspecies transmission of influenza A is an important factor in the evolution and ecology of influenza viruses. Marine mammals are in contact with a number of influenza reservoirs, including aquatic birds and humans, and this may facilitate transmission among avian and mammalian hosts. Virus isolation, whole genome sequencing, and hemagluttination inhibition assay confirmed that exposure to pandemic H1N1 influenza virus occurred among free-ranging Northern Elephant Seals (Mirounga angustirostris) in 2010. Nasal swabs were collected from 42 adult female seals in April 2010, just after the animals had returned to the central California coast from their short post-breeding migration in the northeast Pacific. Swabs from two seals tested positive by RT-PCR for the matrix gene, and virus was isolated from each by inoculation into embryonic chicken eggs. Whole genome sequencing revealed greater than 99% homology with A/California/04/2009 (H1N1) that emerged in humans from swine in 2009. Analysis of more than 300 serum samples showed that samples collected early in 2010 (n = 100) were negative and by April animals began to test positive for antibodies against the pH1N1 virus (HI titer of >= 1:40), supporting the molecular findings. In vitro characterizations studies revealed that viral replication was indistinguishable from that of reference strains of pH1N1 in canine kidney cells, but replication was inefficient in human epithelial respiratory cells, indicating these isolates may be elephant

seal adapted viruses. Thus findings confirmed that exposure to pandemic H1N1 that was circulating in people in 2009 occurred among free-ranging Northern Elephant Seals in 2010 off the central California coast. This is the first report of pH1N1 (A/Elephant seal/California/1/2010) in any marine mammal and provides evidence for cross species transmission of influenza viruses in free-ranging wildlife and movement of influenza viruses between humans and wildlife.

Goldstein, T., T. S. Zabka, R. L. Delong, E. A. Wheeler, G. Ylitalo, S. Bargu, M. Silver, T. Leighfield, F. V. Dolah, G. Langlois, I. Sidor, J. L. Dunn and F. M. D. Gulland (2009). "The role of domoic acid in abortion and premature parturition of California sea lions (Zalophus californianus) on San Miguel Island, California." Journal of Wildlife Diseases 45(1): 91-108.

Domoic acid is a glutaminergic neurotoxin produced by marine algae such as Pseudonitzschia australis. California sea lions (Zalophus californianus) ingest the toxin when foraging on planktivorous fish. Adult females comprise 60% of stranded animals admitted for rehabilitation due to acute domoic acid toxicosis and commonly suffer from reproductive failure, including abortions and premature live births. Domoic acid has been shown to cross the placenta exposing the fetus to the toxin. To determine whether domoic acid was playing a role in reproductive failure in sea lion rookeries, 67 aborted and live-born premature pups were sampled on San Miguel Island in 2005 and 2006 to investigate the causes for reproductive failure. Analyses included domoic acid, contaminant and infectious disease testing, and histologic examination. Pseudo-nitzschia spp. were present both in the environment and in sea lion feces, and domoic acid was detected in the sea lion feces and in 17% of pup samples tested. Histopathologic findings included systemic and localized inflammation and bacterial infections of amniotic origin, placental abruption, and brain edema. The primary lesion in five animals with measurable domoic acid concentrations was brain edema, a common finding and, in some cases, the only lesion observed in aborted premature pups born to domoic acid–intoxicated females in rehabilitation. Blubber organochlorine concentrations were lower than those measured previously in premature sea lion pups collected in the 1970s. While the etiology of abortion and premature parturition was varied in this study, these results suggest that domoic acid contributes to reproductive failure on California sea lion rookeries.Keywords: Abortion, California sea lion, contaminants, domoic acid, infectious disease, premature births, reproduction.

Grant, R. J., A. C. Banyard, T. Barrett, J. T. Saliki and C. H. Romero (2009). "Real-time RT-PCR assays for the rapid and differential detection of dolphin and porpoise morbilliviruses." Journal of Virological Methods 45(1-2): 117-123.

Real-time RT-PCR (rtRT-PCR) assays for identifying and differentiating infections caused by dolphin morbillivirus (DMV) and porpoise morbillivirus (PMV) were developed by targeting the hypervariable C-terminal domain of the nucleocapsid (N) gene. Total DMV and PMV RNA extracted from infected Vero cells expressing the canine signaling lymphocyte-activation molecule (SLAM) produced positive cycle threshold (CT) values after the 17th and 25th cycles, respectively. The assays were then validated using infected cetacean tissue RNA. The assays were specific for either DMV or PMV and did not cross-react with canine distemper virus (CDV), phocid distemper virus (PDV), rinderpest virus (RPV), peste des petits ruminants virus (PPRV) and measles virus (MV). The glyceraldehyde 3-phosphate dehydrogenase (GAPDH) gene was targeted as control for RNA quality, and a consensus GAPDH probe that reacted with 11 different marine mammal species, generating positive CT values ranging from the 21st to the 37th cycle was used. The rtRT-PCR assays have advantages over conventional assays in that they are rapid, easier to scale up, and are less prone to cross-contamination and have improved the limit of detection and specificity.Keywords: Cetacean; Dolphin morbillivirus; Porpoise morbillivirus; Real-time RT-PCR; Nucleocapsid gene

Greenman, J. (2012). A characterization of bottlenose dolphin (Tursiops truncatus) interactions with the commercial shrimp trawl fishery of South Carolina. Charleston, South Carolina, College of Charleston. M.S.: vii + 114.

In the United States, interactions between the shrimp trawl fishery and bottlenose dolphins (Tursiops truncatus) are known to exist, however the level of mortality is largely unknown. The current study attempted to determine if interactions between bottlenose dolphins and commercial shrimp trawlers pose a significant threat to dolphin populations and if fishery related mortality is underreported. This was accomplished with a combination of on-board observations, a shrimp fisher mail survey, and stranding record research. On-board observations were made during a 112 day field study consisting of fishery-dependent (Aug. – Dec. 2010) and fishery-independent (Apr. – Nov. 2010 & 2011) sampling. These observations focused on direct physical interactions with the gear and depredation behaviors. Additionally, a sub-sample of shrimp fishers in South Carolina were asked to participate in a mailed survey. The survey included questions related to gear, dolphin observations, and the status of the shrimp fishery. This study also utilized historical dolphin stranding data from the South Carolina Marine Mammal Stranding Network to ascertain signs of shrimp fishery interactions. A three-leveled flow diagram was developed to characterize each stranding case according to the likelihood that mortality resulted from trawler interaction. Field results point to significant dolphin presence around commercial trawlers ($x2 = 23.406$, $p < 0.001$). In addition, survey results showed substantial evidence that fishery related mortality is higher than reported. Finally, stranding records revealed several more cases with signs of possible trawler interaction. Therefore, the current designation of the fishery as a Category II fishery is correct. In addition, increased observer coverage and improved communication with the fishery on the importance of reporting takes is warranted.

Greig, D., M. Flannery, S. Pemberton, L. Rust, E. Wheeler, K. Colegrove and S. Dennison (2013). Causes of mortality in small cetaceans from central California determined by CT scan, gross examination, and histopathology. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 85.

Greig, D. J., F. M. D. Gulland, C. A. Rios and A. J. Hall (2010). "Hematology and serum chemistry in stranded and wild-caught harbor seals in central California: Reference intervals, predictors of survival, and parameters affecting blood variables." Journal of Wildlife Diseases 46(4): 1172-1184.

Blood was collected from stranded harbor seal (Phoca vitulina) pups at admission (n=64) and release (n=45) from rehabilitation in 2007 and 2008 and from wild-caught harbor seal pups, subadults, and adults (n=110) in 2004, 2007, and 2008. Blood values measured at the time of admission were not predictive of survival during rehabilitation. Mass was associated with survival until release, and all pups that died weighed less than 10 kg at the time of admission. Döhle bodies were observed in leukocytes from 15% to 22% of the pups in rehabilitation, but not in the wild pups. Thresholds (95% confidence intervals) among wild pups were less than those in the released pups for leukocytes, neutrophils, total cholesterol, alanine aminotransferase (ALT), glucose, phosphorus, sodium, potassium, total protein, albumin, and globulin; thresholds were greater in wild pups than in released pups for hemoglobin (HGB), hematocrit (HCT), and glucose. Thresholds among released pups were less than those in wild pups for HGB, HCT, mean cell volume, chloride, and creatine kinase; thresholds among released pups were greater than those in wild pups for neutrophils, platelets, total cholesterol, triglycerides, ALT, aspartate aminotransferase, sorbitol dehydrogenase, bilirubin, phosphorus, potassium, total protein, and albumin. Age, girth, and geographic location affected the blood variables from wild-caught pups; age class, geographic location, sex, and body condition affected the blood variables of wild-caught, subadult and adult harbor seals.Keywords: Harbor seal, hematology, Phoca vitulina, reference intervals, rehabilitation, serum chemistry, stranding.

Greig, D. J., G. M. Ylitalo, E. A. Wheeler, D. Boyd, F. M. D. Gulland, G. K. Yanagida, J. T. Harvey and A. J. Hall (2011). "Geography and stage of development affect persistent organic pollutants in stranded and wild-caught harbor seal pups from central California." Science of the Total Environment 409(18): 3537-3547.

Persistent organic pollutants have been associated with disease susceptibility and decreased immunity in marine mammals. Concentrations of polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane and its metabolites (DDTs), polybrominated diphenyl ethers (PBDEs), chlordanes (CHLDs), and hexachlorocyclohexane isomers (HCHs) were evaluated in terms of stage of development and likely exposure routes (in utero, suckling, fasting) in the blubber of 202 stranded and wild-caught, primarily young of the year (n=177), harbor seals (Phoca vitulina) in the central California coast. This is the first report of HCH concentrations in the blubber of California seals. Lipid normalized concentrations ranged from 200 to 330,000 ng/g for sum PCBs, 320–1,500,000 ng/g for sum DDTs, 23–63,000 ng/g for sum PBDEs, 29–29,000 ng/g for sum CHLDs, and 2–780 ng/g for sum HCHs. The highest concentrations were observed in harbor seal pups that suckled in the wild and then lostmass during the post-weaning fast. Among the pups sampled in the wild and those released from rehabilitation, there were no differences in mass, blubber depth, or percent lipid although contaminant concentrations were significantly higher in the pups which nursed in the wild. When geographic differences were evaluated in a subset of newborn animals collected near their birth locations, the ratio of sum DDTs to sum PCBs was significantly greater in samples from an area with agricultural inputs (Monterey), than one with industrial inputs (San Francisco Bay). A principal components analysis distinguished between seals from San Francisco Bay and Monterey Bay based on specific PCB and PBDE congeners and DDT metabolites. These data illustrate the important influence of life stage, nutritional status, and location on blubber contaminant levels, and thus the need to consider these factors when interpreting single sample measurements in marine mammals.Keywords: PCB; DDT; PBDE; HCH; Phoca vitulina; Blubber

Gulland, F. M. D., A. J. Hall, D. J. Greig, E. R. Frame, K. M. Colegrove, R. K. N. Booth, S. K. Wasser and J. C. R. Scott-Moncrieff (2012). "Evaluation of circulating eosinophil count and adrenal gland function in California sea lions naturally exposed to domoic acid." Journal of the American Veterinary Medical Association 241(7): 943-949.

Objective-To determine the effect of natural exposure to domoic acid (DA) on eosinophil counts and adrenal gland function in California sea lions (Zalophus californianus). Design-Cross-sectional prospective study. Animals-39 California sea lions. Procedures-Adult female sea lions admitted to a rehabilitation hospital during 2009 were classified into 1 of 3 groups (acute DA toxicosis, chronic DA toxicosis, or no DA exposure) on the basis of clinical signs, DA concentration in urine or feces, and hippocampal morphology. Endoparasite burden, eosinophil count, and serum cortisol and plasma ACTH concentrations were determined for each sea lion. For a subset of 8 sea lions, fecal glucocorticoid concentration after IM administration of cosyntropin was determined. Results-Sea lions exposed to DA (acute DA toxicosis, n = 11; chronic DA toxicosis, 19) had higher eosinophil counts and lower serum cortisol concentrations, compared with values for sea lions with no DA exposure (9). Eosinophil count was not associated with endoparasite burden. Serum cortisol concentration was associated with plasma ACTH concentrations in sea lions from the no DA exposure group but not in sea lions in the acute or chronic DA toxicosis groups. Following cosyntropin injection, fecal glucocorticoid concentrations increased in all sea lions evaluated except 1. Conclusions and Clinical Relevance-In adult sea lions, eosinophilia may be a cost-effective biomarker for DA exposure and may reflect alterations in hypothalamic, pituitary gland, or adrenal gland function. Domoic acid exposure may have subtle health effects on marine animals in addition to induction of neurologic signs.

Gundersen, D. T., D. A. Duffield, T. Randall, N. Wintle, D. N. D'Alessandro, J. M. Rice and D. Shepherdson (2013). "Organochlorine contaminants in blubber from stranded marine mammals collected from the northern Oregon and southern Washington coasts: Implications for re-introducing California condors, Gymnogyps californianus, in Oregon." Bulletin of Environmental Contamination and Toxicology 90(3): 269-273.

Re-introduction of California Condors into Oregon is currently being considered, but there are concerns about the safety of potential food sources of this species. Condors are opportunistic feeders and a largely available food source for this species will be stranded marine mammal carcasses. We analyzed 37 blubber samples from 7 different marine mammal species collected from the Oregon and Southern Washington coasts for 18 organochlorine (OC) pesticides and 16 polychlorinated biphenyls (PCBs). Dichlorodiphenyldichloroethylene (DDE) was the most prevalent OC contaminant, making up more than 58 % of the total OC concentration measured. There were no significant differences in OC content between species or sexes.

Hall, A. J., F. M. D. Gulland, J. A. Hammond and L. H. Schwacke (2010). Epidemiology, disease, and health assessment. Marine Mammal Ecology and Conservation: A Handbook of Techniques. I. L. Boyd, W. D. Bowen and S. J. Iverson, Oxford University Press: 144-164.

No abstract

Hansen, A. M. K., C. E. Bryan, K. West and B. A. Jensen (2013). Hepatic trace element levels in 16 Pacific cetacean species, and examination of metallothionein and thioredoxin reductase as biomarkers of trace element exposure. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 88-89.

Hansen, C. M., K. Hueffer, F. Gulland, R. S. Wells, B. C. Balmer, J. M. Castellini and T. O'Hara (2014). "Use of cellulose filter paper to quantify whole-blood mercury in two marine mammals: Validation study." Journal of Wildlife Diseases 50(2): 271-278.

Whole blood (WB) is commonly used to assess mercury (Hg) exposure in mammals, but handling and shipping samples collected in remote areas can be difficult. We describe and validate use of cellulose filter paper (FP) for quantifying WB total Hg concentration. Advantec Nobuto® FP was soaked with bottlenose dolphin (Tursiops truncatus) or harbor seal (Phoca vitulina) WB (collected between March and July 2012), then air dried. Untreated blood-soaked FPs were analyzed or were eluted with phosphate-buffered saline (PBS) and the eluate and PBS-treated FP Hg concentrations were determined. Total Hg from dried blood-soaked FPs, postelution FPs, and PBS-based eluate were compared with total Hg concentrations from WB. Recovery (on a concentration basis) for soaked FP relative to WB was 089±015, for postelution FP was 086±013, and for eluate (with a correction factor applied) was 096±023. Least-squares linear regressions were fit for soaked papers (y?=?115x, R2?=?097), postelution FPs (y?=?122x, R2?=?095), and for eluate with a correction factor applied (y?=?091x+003, R2?=?097) as compared with WB. These data show that FP technology can have a valuable role in monitoring blood Hg concentrations in wildlife populations and FPs have the advantage of being easy to use, store, and transport as compared with WBKeywords: Biomonitoring, marine mammal, Nobuto filter paper, total mercury, wildlife

Hansen, M. J., M. F. Bertelsen, M. A. Delaney, V. A. Fravel, F. Gulland and A. M. Bojesen (2013). "Otariodibacter oris and Bisgaardia genomospecies 1 isolated from infections in pinnipeds." Journal of Wildlife Diseases 49(3): 661-665.

We document the first associations of two recently described species of Pasteurellaceae bacteria with lesions in wild pinnipeds in rehabilitation. Samples were collected from nine lesions in four California sea lions (Zalophus californianus) and two Pacif

Harms, C. A., W. A. McLellan, M. J. Moore, S. G. Barco, E. O. Clarke III, V. G. Thayer and T. K. Rowles (2014). "Low-residue euthanasia of stranded mysticetes." Journal of Wildlife Diseases 50(1): 63-73.

Euthanasia of stranded large whales poses logistic, safety, pharmaceutical, delivery, public relations, and disposal challenges. Reasonable arguments may be made for allowing a stranded whale to expire naturally. However, slow cardiovascular collapse from gravitational effects outside of neutral buoyancy, often combined with severely debilitating conditions, motivate humane efforts to end the animal's suffering. The size of the animal and prevailing environmental conditions often pose safety concerns for stranding personnel, which take priority over other considerations. When considering chemical euthanasia, the size of the animal also necessitates large quantities of euthanasia agents. Drug residues are a concern for relay toxicity to scavengers, particularly for pentobarbital-containing euthanasia solutions. Pentobarbital is also an environmental concern because of its stability and long persistence in aquatic environments. We describe a euthanasia technique for stranded mysticetes using readily available, relatively inexpensive, preanesthetic and anesthetic drugs (midazolam, acepromazine, xylazine) followed by saturated KCl delivered via custom-made needles and a low-cost, basic, pressurized canister. This method provides effective euthanasia while moderating personnel exposure to hazardous situations and minimizing drug residues of concern for relay toxicityKeywords: Analgesia, beaching, drug residue, euthanasia, mysticete, relay toxicity, sedation, stranding

Harris, H. S., P. Facemire, D. J. Greig, K. M. Colegrove, G. M. Ylitalo, G. K. Yanagida, F. B. Nutter, M. Fleetwood and F. M. D. Gulland (2011). "Congenital neuroglial heterotopia in a neonatal harbor seal (Phoca vitulina richardsi) with evidence of recent exposure to polycyclic aromatic hydrocarbons." Journal of Wildlife Diseases 47(1): 246-254.

A male neonatal Pacific harbor seal (Phoca vitulina richardsi) stranded off the coast of California, USA, was presented for rehabilitation with numerous partially haired, soft tissue masses around the mouth and in the oropharynx. Because of the extent of the lesions, the seal was humanely euthanized. Histologically, the masses consisted of subepithelial connective tissue and subcutis expanded by a proliferation of streams and bundles of spindle to stellate cells. Morphology of these cells suggested a neural origin, which was confirmed by positive immunohistochemistry for two neural markers, S-100 protein and glial fibrillary acidic protein, so the masses were diagnosed as neuroglial heterotopia. Heterotopic neuroglial tissue is a rare lesion comprisedof benign mature neural tissue in an ectopic location with no connection to the central nervous system. Results of polycyclic aromatic hydrocarbon (PAH) metabolite analysis of bile indicated recent exposure to a petroleum source. Although fetal exposure to PAHs in utero can cause neurotoxicity and affect normal embryonic development, it is unknown whether gestational exposure occurred in this case.Keywords: Congenital defect, neuroglial heterotopia, PAH, oil, harbor seal, Phoca vitulina.

Harris, H. S., S. C. Oates, M. M. Staedler, M. T. Tinker, D. A. Jessup, J. T. Harvey and M. A. Miller (2010). "Lesions and behavior associated with forced copulation of juvenile Pacific harbor seals (Phoca vitulina richardsi) by southern sea otters (Enhydra lutris nereis)." Aquatic Mammals 36(4): 331-341.

Nineteen occurrences of interspecific sexual behavior between male southern sea otters (Enhydra lutris nereis) and juvenile Pacific harbor seals (Phoca vitulina richardsi) were reported in Monterey Bay, California, between 2000 and 2002. At least three different male sea otters were observed harassing, dragging, guarding, and copulating with harbor seals for up to 7 d postmortem. Carcasses of 15 juvenile harbor seals were recovered, and seven were necropsied in detail by a

veterinary pathologist. Necropsy findings from two female sea otters that were recovered dead from male sea otters exhibiting similar behavior are also presented to facilitate a comparison of lesions. The most frequent lesions included superficial skin lacerations; hemorrhage around the nose, eyes, flippers, and perineum; and traumatic corneal erosions or ulcers. The harbor seals sustained severe genital trauma, ranging from vaginal perforation to vagino-cervical transection, and colorectal perforations as a result of penile penetration. One harbor seal developed severe pneumoperitoneum subsequent to vaginal perforation, which was also observed in both female sea otters and has been reported as a postcoital lesion in humans. This study represents the first description of lesions resulting from forced copulation of harbor seals by sea otters and is also the first report of pneumoperitoneum secondary to forced copulation in a nonhuman animal. Possible explanations for this behavior are discussed in the context of sea otter biology and population demographics. Keywords: sea otter, Enhydra lutris nereis, harbor seal, Phoca vitulina richardsi, forced copulation, interspecific sexual behavior, mating trauma, pneumoperitoneum

Harry II, C. T., R. Kenney, S. Sharp, J. Hoppe, M. Niemeyer and K. Moore (2011). Marine mammal stranding frequency correlates to North Atlantic Oscillation variability in New England waters, USA. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 125.

Hart, L. B., D. S. Rotstein, R. S. Wells, J. Allen, A. Barleycorn, B. C. Balmer, S. M. Lane, T. Speakman, E. S. Zolman, M. Stolen, W. McFee, T. Goldstein, T. K. Rowles and L. H. Schwacke (2012). "Skin lesions on common bottlenose dolphins (Tursiops truncatus) from three sites in the Northwest Atlantic, USA." PLoS ONE 7(3): e33081.

Skin disease occurs frequently in many cetacean species across the globe; methods to categorize lesions have relied on photo-identification (photo-id), stranding, and by-catch data. The current study used photo-id data from four sampling months during 2009 to estimate skin lesion prevalence and type occurring on bottlenose dolphins (Tursiops truncatus) from three sites along the southeast United States coast [Sarasota Bay, FL (SSB); near Brunswick and Sapelo Island, GA (BSG); and near Charleston, SC (CHS)]. The prevalence of lesions was highest among BSG dolphins ($P = 0.587$) and lowest in SSB ($P = 0.380$), and the overall prevalence was significantly different among all sites ($p < 0.0167$). Logistic regression modeling revealed a significant reduction in the odds of lesion occurrence for increasing water temperatures (OR = 0.92; 95% CI: 0.906-0.938) and a significantly increased odds of lesion occurrence for BSG dolphins (OR = 1.39; 95% CI: 1.203-1.614). Approximately one-third of the lesioned dolphins from each site presented with multiple types, and population differences in lesion type occurrence were observed ($p < 0.05$). Lesions on stranded dolphins were sampled to determine the etiology of different lesion types, which included three visually distinct samples positive for herpesvirus. Although generally considered non-fatal, skin disease may be indicative of animal health or exposure to anthropogenic or environmental threats, and photo-id data provide an efficient and cost-effective approach to document the occurrence of skin lesions in free-ranging populations.

Hart, L. B., R. S. Wells, J. D. Adams, D. S. Rotstein and L. H. Schwacke (2010). "Modeling lacaziosis lesion progression in common bottlenose dolphins Tursiops truncatus using long-term photographic records." Diseases of Aquatic Organisms 90(2): 105-112.

Lacaziosis (lobomycosis) is a skin disease caused by Lacazia loboi, occurring naturally only in humans and dolphins. Attempts to culture the pathogen in vitro have been unsuccessful, and inoculation studies of lacaziosis development in mice have provided only limited, short-term data on the progression and propagation of L. loboi. The present study used photographic data from long-term photo-identification and health assessment projects to model and quantify the progression of lacaziosis lesions in 3 common bottlenose dolphins Tursiops truncatus from Sarasota Bay, Florida, USA. Dorsal fin

images throughout each animal's sighting history were examined for lesion growth, and the proportion of lesion coverage in each photograph was estimated using image analysis tools in Adobe Photoshop (R). The progression of lacaziosis lesions and lesion growth rates were modeled using a non-linear monomolecular growth model. As data on lacaziosis development and advancement are limited in humans and laboratory animals, dolphins with a long-term case history of the disease may serve as a good animal model to better understand lacaziosis progression. Furthermore, this study demonstrates the utility of long-term population monitoring data for tracking the progression of a poorly understood disease that is relevant to both dolphin and human health.Keywords: Lacaziosis; Lacazia loboi; Bottlenose dolphin; Monomolecular growth model; Skin disease; Sarasota Bay; Lobomycosis

Hart, L. B., R. S. Wells and L. H. Schwacke (2013). "Reference ranges for body condition in wild bottlenose dolphins Tursiops truncatus." Aquatic Biology 18(1): 63-68.

Marine mammal body condition, as evaluated by a combination of mass, length, and/or girth measurements, is considered an indicator of nutritional status. We used measurements of total mass, total length, and maximum girth from long-term bottlenose dolphin Tursiops truncatus capture-release research conducted in Sarasota Bay, Florida, USA, (1987 to 2009) to develop 95th percentile reference ranges for 2 body condition models: (1) total mass versus total length and (2) maximum girth versus total length. Nonlinear and linear quantile regression methods were used to estimate the parameters for the reference ranges and develop predictive models to examine body condition among individual dolphins. The flexibility of these models and reliance upon commonly acquired morphometrics allows for broad application among researchers lacking data on mass or age. Ultimately, these reference ranges can be used to evaluate and compare the body condition of individual animals and provide an additional metric for evaluating the general health of coastal populations. Keywords: Marine mammal; Morphometrics; Health assessment; Nutritional condition; Mass; Girth; Length; Reference range; Quantile regression; Sarasota Bay.

Harvey, J. T., T. Friend and E. A. McHuron (2014). "Cephalopod remains from stomachs of sperm whales (Physeter macrocephalus) that mass-stranded along the Oregon coast." Marine Mammal Science 30(2): 609-625.

On 16 June 1979, a herd of 41 sperm whales stranded near the mouth of the Siuslaw River in Florence, Oregon. The stomach contents from 32 whales were collected, identified to the lowest taxonomic level possible, enumerated, and measured. A total of 20,247 cephalopod lower beaks that represented 24 species from 14 different families were recovered. The most numerous species were Histioteuthis hoylei (259%), Taonius borealis (129%), Galiteuthis phyllura (112%), Gonatopsis/Berryteuthis type (109%), and Moroteuthis robusta (107%). Reconstructed estimates of mass indicated that M. robusta contributed almost 50% of the total mass of cephalopods consumed, followed by H. hoylei (193%), and T. borealis (70%). The most important species in the diet of stranded whales were M. robusta, H. hoylei, T. borealis, G. phyllura, Octopoteuthis deletron, and Gonatopsis/Berryteuthis type. There were significant differences in the diet of males and females, but no differences between sperm whales of different age groups. Overall, sperm whales primarily consumed small cephalopods that were likely eaten south of 45ºN in or near the California Current System. This study provides new estimates of the food habits of sperm whales in the northeast Pacific from one of the largest strandings of this species. Keywords: sperm whale; Physeter macrocephalus; diet; cephalopods; stranded; Oregon

Henry, A. G., T. V. N. Cole, M. Garron and L. Hall (2011). Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States, and Canadian Eastern Seaboards, 2005-

2009, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center: 32.

The Northeast Fisheries Science Center (NEFSC) has developed criteria to evaluate reports of human-caused injury and mortality to large whales. The criteria minimize the identification of false positive human-caused mortalities and serious injuries and provide a minimum value of human impact to whale stocks. Serious injury is defined as an injury that is likely to lead to death. This report describes determinations made for reports received from 2005 - 2009 involving North Atlantic right (Eubalaena glacialis), humpback (Megaptera novaeangliae), fin (Balaenoptera physalus), sei (B. borealis), blue (B. musculus), minke (B. acutorostrata), and Bryde's (B. edeni) whales observed along coastal Gulf of Mexico and the eastern seaboard of the United States and adjacent Canadian Maritimes. A total of 496 unique large whale events were verified during the period, of which 252 (51%) involved human interactions, 20 (4%) did not involve a human interaction, and for 224 (45%) of the events it was unknown if a human interaction occurred. Of the events involving human interactions, we confirmed 193 unique entanglements and 63 ship strikes. Four events had evidence of both entanglement and ship strike, and are included in the totals for both these event categories. Eighteen (9%) of the entanglements and 28 (44%) of the ship strikes were fatal. Serious injury was sustained in 22 (11%) of the entanglement events and in 2 (3%) of the confirmed ship strikes. Serious injury was prevented due to disentanglement efforts in 30 (16%) entanglement events. Forty-one (21%) of the entanglements and 11 (17%) of the ship strike events did not have adequate documentation to determine if serious injury occurred. Seventy-eight (40%) of the entanglement events and 18 (29%) of the ship strike events were determined to have not caused serious injury or death. We also confirmed a total of 308 mortalities: 46 (15%) due to human interaction, 16 (5%) due to natural causes and 246 (80%) which lacked sufficient evidence to determine cause of death. Minke whales had the greatest number of entanglement mortalities (n=7); humpback whales had the highest number of serious injury events resulting from entanglements (n=12); fin whales had the greatest number of ship strike mortalities (n=9); and right whales had the only serious injuries (n=2) from ship strikes. These mortality and serious injury numbers are minimum counts because of poor detection probabilities and inadequate documentation for the majority of events. Thus, the true level of human impact to these stocks is assumed to be greater than that reported here; the amount greater is unknown.

Herreman, J. K., A. D. McIntosh, R. K. Dziuba, G. M. Blundell, M. Ben-David and E. C. Greiner (2011). "Parasites of harbor seals (Phoca vitulina) in Glacier Bay and Prince William Sound, Alaska." Marine Mammal Science 27(1): 247-253.

No abstract

Himworth, C. G., M. Haulena, D. M. Lambourn, J. K. Gaydos, J. Huggins, J. Calambokidis, J. K. B. Ford, K. Zaremba and S. Raverty (2010). "Pathology and epidemiology of phocid herpesvirus-1 in wild and rehabilitating harbor seals (Phoca vitulina richardsi) in the northeastern Pacific." Journal of Wildlife Diseases 46(3): 1046-1051.

Phocid herpesvirus-1 (PhHV-1, subfamily Alphaherpesvirinae) was isolated from harbor seals (Phoca vitulina vitulina) in the Netherlands in 1985, and was subsequently identified in Pacific harbor seals (Phoca vitulina richardsi) from California, USA in the

Hohn, A. A., D. S. Rotstein and B. L. Byrd (2013). Unusual mortality events of harbor porpoise strandings in North Carolina, 1997-2009. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 96-97.

Hooker, S. K., A. Fahlman, M. J. Moore, N. Aguilar de Soto, Y. Bernaldo de Quiros, A. O. Brubakk, D. P. Costa, A. M. Costidis, S. Dennison, K. J. Falke, A. Fernandez, M. Ferrigno, J. R. Fitz-Clarke, M. M. Garner, D. S. Houser, P. D. Jepson, D. R. Ketten, P. H. Kvadsheim, P. T. Madsen, N. W. Pollock, D. S. Rotstein, T. K. Rowles, S. E. Simmons, W. Van Bonn, P. K. Weathersby, M. J. Weise, T. M. Williams and P. L. Tyack (2011). "Deadly diving? Physiological and behavioural management of decompression stress in diving mammals." Proceedings of the Royal Society Biological Sciences Series B 279(1731): 1041-1050.

Decompression sickness (DCS; 'the bends') is a disease associated with gas uptake at pressure. The basic pathology and cause are relatively well known to human divers. Breath-hold diving marine mammals were thought to be relatively immune to DCS owing to multiple anatomical, physiological and behavioural adaptations that reduce nitrogen gas (N2) loading during dives. However, recent observations have shown that gas bubbles may form and tissue injury may occur in marine mammals under certain circumstances. Gas kinetic models based on measured time-depth profiles further suggest the potential occurrence of high blood and tissue N2 tensions. We review evidence for gas-bubble incidence in marine mammal tissues and discuss the theory behind gas loading and bubble formation. We suggest that diving mammals vary their physiological responses according to multiple stressors, and that the perspective on marine mammal diving physiology should change from simply minimizing N2 loading to management of the N2 load. This suggests several avenues for further study, ranging from the effects of gas bubbles at molecular, cellular and organ function levels, to comparative studies relating the presence/absence of gas bubbles to diving behaviour. Technological advances in imaging and remote instrumentation are likely to advance this field in coming years. Keywords: diving physiology; marine mammals; gas bubbles; embolism; decompression sickness

Houser, D. S., K. Moore, S. Sharp and J. J. Finneran (2010). "Rapid acquisition of marine mammal evoked potential audiograms by stranding networks." Journal of the Acoustical Society of America 128(4 part 2): 2299.

Huggins, J. L., J. Calambokidis, D. Lambourn, B. A. Diehl, J. Oliver, S. J. Jeffries and S. Raverty (2011). Tropical cetaceans in southern Puget Sound: Anomalous sightings and strandings in Washington State, 2010-2011. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 138-139.

Huggins, J. L., C. L. Leahy, J. Calambokidis, D. Lambourn, S. J. Jeffries, S. A. Norman and S. Raverty (2013). "Causes and patterns of harbor seal (Phoca vitulina) pup mortality at Smith Island, Washington, 2004-2010." Northwestern Naturalist 94(3): 198-208.

Harbor Seals (Phoca vitulina) are the most common and widely distributed pinniped in Washington State coastal waters. Serving as sentinels of marine ecosystem health, stranded animals are useful in detecting environmental disease and contaminant levels. F

Hughes, S. N., D. J. Greig, W. A. Miller, B. A. Byrne, F. M. D. Gulland and J. T. Harvey (2013). "Dynamics of vibrio with virulence genes detected in Pacific harbor seals (Phoca vitulina richardii) off California: Implications for marine mammal health." Microbial Ecology 65(4): 982-994.

Given their coastal site fidelity and opportunistic foraging behavior, harbor seals (Phoca vitulina) may serve as sentinels for coastal ecosystem health. Seals using urbanized coastal habitat can acquire enteric bacteria, including Vibrio that may affect their health. To understand Vibrio dynamics in seals, demographic and environmental factors were tested for predicting potentially virulent Vibrio in free-ranging and stranded Pacific harbor seals (Phoca vitulina richardii) off California. Vibrio prevalence did not vary with season and was greater in free-ranging seals (29 %, n?=?319) compared with stranded seals (17 %, n?=?189). Of the factors tested, location, turbidity, and/or salinity best predicted Vibrio

prevalence in free-ranging seals. The relationship of environmental factors with Vibrio prevalence differed by location and may be related to oceanographic or terrestrial contributions to water quality. Vibrio parahaemolyticus, Vibrio alginolyticus, and Vibrio cholerae were observed in seals, with V. cholerae found almost exclusively in stranded pups and yearlings. Additionally, virulence genes (trh and tdh) were detected in V. parahaemolyticus isolates. Vibrio cholerae isolates lacked targeted virulence genes, but were hemolytic. Three out of four stranded pups with V. parahaemolyticus (trh+ and/or tdh+) died in rehabilitation, but the role of Vibrio in causing mortality is unclear, and Vibrio expression of virulence genes should be investigated. Considering that humans share the environment and food resources with seals, potentially virulent Vibrio observed in seals also may be of concern to human health.

Hughes, S. N., J. T. Harvey and F. M. Gulland (2011). Prevalence of Vibrio spp. in Pacific harbor seals (Phoca vitulina richardii) off central California. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 139.

Hunt, K., R. Rolland, J. Robbins and S. Kraus (2013). Detection of steroid and thyroid hormones in respiratory vapor of two baleen whale species via immunoassay. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 100.

Jackson, K., A. S. Jensen, E. Lyman and K. Savage (2011). All tied up: Taking a closer look at humpback whale entanglement in Alaska, 1990-2011. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida.

Jacob, J. M., G. A. Levine, K. L. West and B. A. Jensen (2013). Screening and characterization of morbillivirus in Hawaiian cetaceans. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 103-104.

Jacobsen, J. K., L. Massey and F. Gulland (2010). "Fatal ingestion of floating net debris by two sperm whales (Physeter macrocephalus)." Marine Pollution Bulletin 60(5): 765-767.

Jang, S., L. Wheeler, R. B. Carey, B. Jensen, C. M. Crandall, K. N. Schrader, D. Jessup, K. Colegrove and F. M. D. Gulland (2010). "Pleuritis and suppurative pneumonia associated with a hypermucoviscosity phenotype of Klebsiella pneumoniae in California sea lions (Zalophus californianus)." Veterinary Microbiology 141(1-2): 174-177.

The aim of this study is to document the isolation of a hypermucoviscosity (HMV) phenotype of Klebsiella pneumoniae from 25 cases of suppurative pneumonia and pleuritis and two cases of abscesses in California sea lions (Zalophus californianus) from the central California coast, representing the first report of this zoonotic pathogen from the marine environment and only the second report in non-humans. Animals died 2 h to 4 days after first being observed sick on beaches. Clinical signs varied from dyspnoea to coma. Gross post-mortem examination of 25 cases revealed fibrinous pleuritis, copious pus in the pleural cavity and suppurative bronchopneumonia. K. pneumoniae isolates obtained from lung and pleural swabs and the hepatic and subcuticular abscesses were highly mucoid on blood agar culture media and were positive to the string test. Twenty-one of the 27 isolates were examined by PCR and all were positive for rmpA and K2wyz and negative for K1magA genes. Although pneumonia and pleuritis have previously commonly been observed in marine mammals, their association with pure cultures of a zoonotic bacteria, K. pneumoniae HMV phenotype, has not. This report provides further evidence of the role marine mammals play as sentinels of health risks to humans from coastal

waters.Keywords: Klebsiella pneumoniae; Hypermucoviscosity type; Pleuritis; Suppurative pneumonia; California sea lion

Jensen, A., J. L. Neilson, C. M. Gabriele and J. M. Straley (2010). Summary of reported whale -vessel collisions in Alaskan waters: 1978-2008. Alaska Marine Science Symposium. Hotel Captain Cook, Anchorage, Alaska: 76.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry and P. Clapham (2011). Fishing gear involved in entanglements of right and humpback whales: A summary and implications for management. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 149.

Karpovich, S., J. Herreman and G. Blundell (2011). Use of stable carbon and nitrogen isotopes in harbor seal vibrissae to detect seasonal changes in diet. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 152.

Kersh, G. J., D. M. Lambourn, S. A. Raverty, K. A. Fitzpatrick, J. S. Self, A. M. Akmajian, S. J. Jeffries, J. Huggins, C. P. Drew, S. R. Zaki and R. F. Massung (2012). "Coxiella burnetii infection of marine mammals in the Pacific Northwest, 1997-2010." Journal of Wildlife Diseases 48(1): 201-206.

Q fever is a zoonotic disease caused by the bacterium Coxiella burnetii. Humans are commonly exposed via inhalation of aerosolized bacteria derived from the waste products of domesticated sheep and goats, and particularly from products generated during parturition. However, many other species can be infected with C. burnetii, and the host range and full zoonotic potential of C. burnetii is unknown. Two cases of C. burnetii infection in marine mammal placenta have been reported, but it is not known if this infection is common in marine mammals. to address this issue, placenta samples were collected from Pacific harbor seals (Phoca vitulina richardsi), harbor porpoises (Phocoena phocoena), and Steller sea lions (Eumetopias jubatus). Coxiella burnetii was detected by polymerase chain reaction (PCR) in the placentas of Pacific harbor seals (17/27), harbor porpoises (2/6), and Steller sea lions (1/2) colle cted in the Pacific Northwest. A serosurvey of 215 Pacific harbor seals sampled in inland and outer coastal areas of the Pacific Northwest showed that 34.0% (73/215) had antibodies against either Phase 1 or Phase 2 C. burnetii. These results suggest that C. burnetii infection is common among marine mammals in this region. Keywords: Coxiella burnetii; marine mammals; placenta; Q fever

Kersh, G. J., D. M. Lambourn, J. S. Self, A. M. Akmajian, J. B. Stanton, T. V. Baszler, S. A. Raverty and R. F. Massung (2010). "Coxiella burnetii infection of a Steller sea lion (Eumetopias jubatus) found in Washington state." Journal of Clinical Microbiology 48(9): 3428-3431.

A pregnant sea lion stranded in the State of Washington was found to have placentitis caused by a unique strain of Coxiella burnetii. This is the first description of coxiellosis in a sea lion and suggests that exposure to sea lions may be a risk factor f

Ketten, D. R., T. A. Mooney, C. R. Williams, K. Matassa, K. Patchett, J. Arruda and S. Cramer (2011). Hearing loss in harbor seals: Differential diagnoses of conductive and sensorineural losses via auditory evoked potentials (AEP), otoacoustic emissions (OAE), and computerized tomography (CT). Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 156.

Ketten, D. R., C. R. Williams, T. A. Mooney, K. Matassa and K. Patchett (2011). "In vivo measures of hearing in seals via auditory evoked potentials, otoacoustic emissions, and computerized tomography." Journal of the Acoustical Society of America 129(4): 2431.

Khamas, W. A., H. Smodlaka, J. Leach-Robinson and L. Palmer (2012). "Skin histology and its role in heat dissipation in three pinniped species." Acta Veterinaria Scandinavica 54(1): 10.

Background: Pinnipeds have a thick blubber layer and may have difficulty maintaining their body temperature during hot weather when on land. The skin is the main thermoregulatory conduit which emits excessive body heat.Methods: Thorough evaluation of the skin histology in three pinniped species; the California sea lion-Zalophus californianus, the Pacific harbor seal-Phoca vitulina richardsi, and the Northern elephant seal-Mirounga angustirostris, was conducted to identify the presence, location and distribution of skin structures which contribute to thermoregulation. These structures included hair, adipose tissue, sweat glands, vasculature, and arteriovenous anastomoses (AVA). Thermal imaging was performed on live animals of the same species to correlate histological findings with thermal emission of the skin. Results: The presence and distribution of skin structures directly relates to emissivity of the skin in all three species. Emissivity of skin in phocids (Pacific harbor and Northern elephant seals) follows a different pattern than skin in otariids (California sea lions). The flipper skin in phocids tends to be the most emissive region during hot weather and least emissive during cold weather. On the contrary in otariids, skin of the entire body has a tendency to be emissive during both hot and cold weather.Conclusion: Heat dissipation of the skin directly relates to the presence and distribution of skin structures in all three species. Different skin thermal dissipation patterns were observed in phocid versus otariid seals. Observed thermal patterns can be used for proper understanding of optimum thermal needs of seals housed in research facilities, rescue centers and zoo exhibits.

Kielhorn, C. E., R. M. Dillaman, S. T. Kinsey, W. A. McLellan, D. M. Gay, J. L. Dearolf and D. A. Pabst (2013). "Locomotor muscle profile of a deep (Kogia breviceps) versus shallow (Tursiops truncatus) diving cetacean." Journal of Morphology 274(6): 663-675.

When a marine mammal dives, breathing and locomotion are mechanically uncoupled, and its locomotor muscle must power swimming when oxygen is limited. The morphology of that muscle provides insight into both its oxygen storage capacity and its rate of oxygen consumption. This study investigated the m. longissimus dorsi, an epaxial swimming muscle, in the long duration, deep-diving pygmy sperm whale (Kogia breviceps) and the short duration, shallow-diving Atlantic bottlenose dolphin (Tursiops truncatus). Muscle myoglobin content, fiber type profile (based upon myosin ATPase and succinate dehydrogenase assays), and fiber size were measured for five adult specimens of each species. In addition, a photometric analysis of sections stained for succinate dehydrogenase was used to create an index of mitochondrial density. The m. longissimus dorsi of K. breviceps displayed significantly a) higher myoglobin content, b) larger proportion of Type I (slow oxidative) fibers by area, c) larger mean fiber diameters, and d) lower indices of mitochondrial density than that of T. truncatus. Thus, this primary swimming muscle of K. breviceps has greater oxygen storage capacity, reduced ATP demand, and likely a reduced rate of oxygen consumption relative to that of T. truncatus. The locomotor muscle of K. breviceps appears able to ration its high onboard oxygen stores, a feature that may allow this species to conduct relatively long duration, deep dives aerobically.Keywords: skeletal muscle; morphology; histochemistry; cetaceans.

Kielhorn, C. E., W. A. McLellan, S. T. Kinsey, R. M. Dillaman and M. Gay (2011). Locomotor muscle of cetaceans: A comparison of deep vs. shallow divers. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 157.

Kielhorn, C. E., W. A. McLellan and D. A. Pabst (2011). "Locomotor muscle profiles of cetaceans: A comparison of deep- vs. shallow-diving cetaceans." Integrative and Comparative Biology 51(Supplement 1): E212.

Kingston, S. E., L. D. Adams and P. E. Rosel (2009). "Testing mitochondrial sequences and anonymous nuclear markers for phylogeny reconstruction in a rapidly radiating group: Molecular systematics of the Delphininae (Cetacea: Odontoceti: Delphinidae)." BMC Evolutionary Biology 9(245): 19.

Background: Many molecular phylogenetic analyses rely on DNA sequence data obtained from single or multiple loci, particularly mitochondrial DNA loci. However, phylogenies for taxa that have undergone recent, rapid radiation events often remain unresolved. Alternative methodologies for discerning evolutionary relationships under these conditions are desirable. The dolphin subfamily Delphininae is a group that has likely resulted from a recent and rapid radiation. Despite several efforts, the evolutionary relationships among the species in the subfamily remain unclear. Results: Here, we compare a phylogeny estimated using mitochondrial DNA (mtDNA) control region sequences to a multi-locus phylogeny inferred from 418 polymorphic genomic markers obtained from amplified fragment length polymorphism (AFLP) analysis. The two sets of phylogenies are largely incongruent, primarily because the mtDNA tree provides very poor resolving power; very few species' nodes in the tree are supported by bootstrap resampling. The AFLP phylogeny is considerably better resolved and more congruent with relationships inferred from morphological data. Both phylogenies support paraphyly for the genera Stenella and Tursiops. The AFLP data indicate a close relationship between the two spotted dolphin species and recent ancestry between Stenella clymene and S. longirostris. The placement of the Lagenodelphis hosei lineage is ambiguous: phenetic analysis of the AFLP data is consistent with morphological expectations but the phylogenetic analysis is not. Conclusion: For closely related, recently diverged taxa, a multi-locus genome-wide survey is likely the most comprehensive approach currently available for phylogenetic inference.

Knowlton, A., S. Landry, J. Robbins and T. Werner (2011). Breaking strength and diameter of rope taken off entangled North Atlantic right whales in relation to wound severity and age. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 161.

Koopman, H. (2013). The evolution of acoustic lipids in odontocetes. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 117.

Koopman, H. N. and A. J. Westgate (2012). "Solubility of nitrogen in marine mammal blubber depends on its lipid composition." Journal of Experimental Biology 215(21): 3856-3863.

Understanding the solubility of nitrogen gas in tissues is a crucial aspect of diving physiology, especially for air-breathing tetrapods. Adipose tissue is of particular interest because of the high solubility of nitrogen in lipids. Surprisingly, nothing is known about nitrogen solubility in the blubber of any marine mammal. We tested the hypothesis that N-2 solubility is dependent on the lipid composition of blubber; most blubber is composed of triacylglycerols, but some toothed whales deposit large amounts of waxes in blubber instead. The solubility of N-2 in the blubber of 13 toothed whale species ranged from 0.062 to 0.107. ml N(2)ml(-1) oil. Blubber with high wax ester content had higher N-2 solubility, observed in the beaked (Ziphiidae) and small sperm (Kogiidae) whales, animals that routinely make long, deep dives. We also measured nitrogen solubility in the specialized cranial acoustic fat bodies associated with echolocation in a Risso's dolphin; values (0.087. ml N(2)ml(-1) oil) were 16% higher here than in its blubber (0.074. ml N(2)ml(-1) oil). As the acoustic fats of all Odontocetes contain waxes, even if the blubber does not, these tissues may experience greater interaction with N-2. These data have implications for our understanding and future modeling of diving physiology in Odontocetes, as our empirically derived values for nitrogen solubility in toothed whale adipose were up to 40% higher than the numbers traditionally assumed in marine mammal diving models.Keywords: Odontocetes; decompression sickness; wax ester.

Kretzmann, M., L. Rohrbach, K. Durham, R. Digiovanni and S. Sanudo-Wilhelmy (2010). "Trace metal burdens in stranded seals from Long Island, New York: Potential evidence for species differences in foraging." Aquatic Mammals 36(2): 178-187.

Toxic (e.g., Hg, Ag, Cd, and Pb) and essential (e.g., Se, Cu, and Fe) trace element levels were determined in liver samples from four seal species (harp seal [Phoca groenlandica], n = 35; hooded seal [Cystophora cristata], n = 7; harbor seal [Phoca vitulina], n = 34; gray seal [Halichoerus grypus], n = 10) stranding in Long Island waters between 1988 and 2004 to examine temporal and species-specific patterns in these top marine carnivores. There was no obvious trend in trace metal burdens in seal livers over this time period. Harp and hooded seals are Arctic species that have only appeared in Long Island waters in recent years. Their diets are believed to include more invertebrate prey, and this was reflected in significantly higher cadmium (Cd) concentrations (mean = 5.5 to 6.3 ?g g?1 dry weight vs. 0.5 to 1.4 ?g g?1 for harbor and gray seals, p = 0.007). The highest mercury (Hg) burdens (> 100 ?g g?1 dry weight) were seen in seven of the eight adult harbor seals and the only adult gray seal; four of five adult harp seals did not show elevated levels. This suggests that migratory harp seals are feeding on prey with a lower Hg burden compared to resident harbor seals that forage in the coastal environment. Copper (Cu) levels were high (70 to 105?g g?1) in a few juvenile harbor seals as predicted based on Cu-incorporating enzymes essential for growth. A few elevated silver (Ag) values (1.5 to 3.0 ?g g?1) were seen in the same adult harbor seals with high Hg burdens. These values may not reflect metal burdens in healthy populations as our samples were obtained from stranded animals, but there was no evidence that any of these seals died as a result of metal toxicity. Keywords: HARP SEAL; PHOCA GROENLANDICA; HARBOR SEAL; PHOCA VITULINA; STRANDING; MERCURY; CADMIUM; METAL BURDENS

Kucklick, J., L. Schwacke, R. Wells, A. Hohn, A. Guichard, J. Yordy, L. Hansen, E. Zolman, R. Wilson, J. Litz, D. Nowacek, T. Rowles, R. Pugh, B. Balmer, C. Sinclair and P. Rosel (2011). "Bottlenose dolphins as indicators of persistent organic pollutants in the western North Atlantic Ocean and northern Gulf of Mexico." Environmental Science and Technology 45(10): 4270-4277.

Persistent organic pollutants (POPs) including legacy POPs (PCBs, chlordanes, mirex, DDTs, HCB, and dieldrin) and polybrominated diphenyl, ether (PBDE) flame retardants were determined in 300 blubber biopsy samples from coastal and near shore/estuarine male bottlenose dolphins (Tursiops truncatus) sampled along the U.S. East and Gulf of Mexico coasts and Bermuda. Samples were from 14 locations including urban and rural estuaries and near a Superfund site (Brunswick, Georgia) contaminated with the PCB formulation Aroclor 1268. All classes of legacy POPs in estuarine stocks varied significantly ($p < 0.05$) among sampling locations. POP profiles in blubber varied by location with the most characteristic profile observed in bottlenose dolphins sampled near the Brunswick and Sapelo estuaries along the Georgia coast which differed significantly ($p < 0.001$) from other sites. Here and in Sapelo, PCB congeners from Aroclor 1268 dominated indicating widespread food web contamination by this PCB mixture. PCB 153, which is associate non-Aroclor 1268 PCB formulations, correlated significantly to human population indicating contamination from a general urban PCB source. Factors influencing regional differences of other POPs were less clear and warrant further study. This work puts into geographical context POP contamination in dolphins to help prioritize efforts examining health effects from POP exposure in bottlenose dolphins.

Kucklick, J. R., M. M. Schantz, R. S. Pugh, B. J. Porter, D. L. Poster, P. R. Becker, T. K. Rowles, S. Leigh and S. A. Wise (2010). "Marine mammal blubber reference and control materials for use in the determination of halogenated organic compounds and fatty acids." Analytical and Bioanalytical Chemistry 397(2): 423-432.

The National Institute of Standards and Technology (NIST) has a diverse collection of control materials derived from marine mammal blubber, fat, and serum. Standard Reference Material (SRM)

1945 Organics in Whale Blubber was recertified for polychlorinated biphenyl (PCB) congeners, organochlorine pesticides, and polybrominated diphenyl ether (PBDE) congeners. SRM 1945 has also been assigned mass fraction values for compounds not frequently determined in marine samples including toxaphene congeners, coplanar PCBs, and methoxylated PBDE congeners which are natural products. NIST also has assigned mass fraction values, as a result of interlaboratory comparison exercises, for PCB congeners, organochlorine pesticides, PBDE congeners, and fatty acids in six homogenate materials produced from marine mammal blubber or serum. The materials are available from NIST upon request; however, the supply is very limited for some of the materials. The materials include those obtained from pilot whale blubber (Homogenates III and IV), Blainville's beaked whale blubber (Homogenate VII), polar bear fat (Homogenate VI), and California sea lion serum (Marine Mammal Control Material-1 Serum) and blubber (Homogenate V).Keywords: Persistent organic pollutants; Reference materials; Marine mammal; Fatty acids

Lambourn, D. M., M. Garner, D. Ewalt, S. Raverty, I. Sidor, S. J. Jeffries, J. Rhyan and J. K. Gaydos (2013). "Brucella pinnipedialis infections in Pacific harbor seals (Phoca vitulina richardsi) from Washington State, USA." Journal of Wildlife Diseases 49(4): 802-815.

In 1994 a novel Brucella sp., later named B. pinnipedialis, was identified in stranded harbor seals (Phoca vitulina). This Brucella sp. is a potential zoonotic pathogen and is capable of causing disease in domestic animals. Serologic, microbiologic, and p

Lammers, M. O., A. A. Pack, E. G. Lyman and L. Espiritu (2013). "Trends in collisions between vessels and North Pacific humpback whales (Megaptera novaeangliae) in Hawaiian waters (1975-2011)." Journal of Cetacean Research and Management 13(1): 73-80.

Injury from collisions with vessels is a growing threat worldwide for many species of whales. Thirty seven years of historical records were examined for evidence of vessel collisions with humpback whales in the main Hawaiian Islands. Between 1975 and 2011

Lane, S. M., B. C. Balmer, J. G. Moore, T. K. Rowles, J. R. Stewart, F. I. Townsend and L. H. Schwacke (2011). Bacterial pathogens in bottlenose dolphins of Brunswick and Sapelo, GA, USA. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 169-170.

Lebling, T., B. Long and C. E. C. Goertz (2010). Satellite tracking of rehabilitated marine mammals released by the Alaska SeaLife Center. Alaska Marine Science Symposium. Hotel Captain Cook, Anchorage, Alaska: 84.

Lee, K., D. Duffield and J. Rice (2013). Primary drivers of sea lion mortality in Oregon and southern Washington: GIS analysis of ecological correlates and anthropogenic impacts. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 122.

Lefebvre, K., E. Frame, P. Kendrick, F. Farin, T. Bammler, R. Beyer, J. Hansen and D. Marcinek (2012). "A novel biomarker for chronic domoic acid exposure identified in a zebrafish model and validated in sea lions." Journal of Shellfish Research 31(1): 311.

Lefebvre, K. A., E. R. Frame, F. Gulland, J. D. Hansen, P. S. Kendrick, R. P. Beyer, T. K. Bammler, F. M. Farin, E. M. Hiolski, D. R. Smith and D. J. Marcinek (2012). "A novel antibody-based biomarker for chronic algal toxin exposure and sub-acute neurotoxicity." PLoS ONE 7(5): e36213.

The neurotoxic amino acid, domoic acid (DA), is naturally produced by marine phytoplankton and presents a significant threat to the health of marine mammals, seabirds and humans via transfer of

the toxin through the foodweb. In humans, acute exposure causes a neurotoxic illness known as amnesic shellfish poisoning characterized by seizures, memory loss, coma and death. Regular monitoring for high DA levels in edible shellfish tissues has been effective in protecting human consumers from acute DA exposure. However, chronic low-level DA exposure remains a concern, particularly in coastal and tribal communities that subsistence harvest shellfish known to contain low levels of the toxin. Domoic acid exposure via consumption of planktivorous fish also has a profound health impact on California sea lions (Zalophus californianus) affecting hundreds of animals yearly. Due to increasing algal toxin exposure threats globally, there is a critical need for reliable diagnostic tests for assessing chronic DA exposure in humans and wildlife. Here we report the discovery of a novel DA-specific antibody response that is a signature of chronic low-level exposure identified initially in a zebrafish exposure model and confirmed in naturally exposed wild sea lions. Additionally, we found that chronic exposure in zebrafish caused increased neurologic sensitivity to DA, revealing that repetitive exposure to DA well below the threshold for acute behavioral toxicity has underlying neurotoxic consequences. The discovery that chronic exposure to low levels of a small, water-soluble single amino acid triggers a detectable antibody response is surprising and has profound implications for the development of diagnostic tests for exposure to other pervasive environmental toxins.

Lefebvre, K. A. and A. Robertson (2010). "Domoic acid and human exposure risks: A review." Toxicon 56(2): 218-230.

Domoic acid is a potent neurotoxin that is naturally produced by several diatom species of the genus Pseudo-nitzschia. The toxin acts as a glutamate agonist and is excitotoxic in the vertebrate central nervous system and other glutamate receptor-rich organs. Human exposure to domoic acid occurs via the consumption of contaminated shellfish that have accumulated the toxin while filter feeding on toxigenic phytoplankton during blooms. The first reported human domoic acid poisoning event occurred in Canada in 1987 during which clinical signs of acute toxicity such as gastrointestinal distress, confusion, disorientation, memory loss, coma and death were observed. The illness was named amnesic shellfish poisoning (ASP) and due to effective seafood monitoring programs there have been no documented ASP cases since 1987. However, domoic acid poisoning has a significant effect on marine wildlife and multiple poisoning events have occurred in marine birds and mammals over the last few decades. Currently, domoic acid producing diatom blooms are thought to be increasing in frequency world wide, posing an increasing threat to wildlife and human health. Of particular concern are the potential impacts of long-term low-level exposure in at risk human populations. The impacts of repetitive low-level domoic acid exposure are currently unknown. This review provides a basic description of the mechanism of action of domoic acid as well as a synthesis of information pertaining to domoic acid exposure routes, toxin susceptibility, and the importance of effective monitoring programs. The importance of investigating the potential human health impacts of long-term low-level domoic acid exposure in at risk human populations is also discussed.Keywords: Harmful algal blooms; Amnesic shellfish poisoning; Domoic acid; Seafood safety; Chronic exposure; Excitotoxicity; Review

Lefebvre, K. A., A. Robertson, E. R. Frame, K. M. Colegrove, S. Nance, K. A. Baugh, H. Wiedenhoft and F. M. D. Gulland (2010). "Clinical signs and histopathology associated with domoic acid poisoning in northern fur seals (Callorhinus ursinus) and comparison of toxin detection methods." Harmful Algae 9(4): 374-383.

Between July 2005 and March 2009, 33 northern fur seals (Callorhinus ursinus) were collected after stranding along the central California coast between Sonoma and San Luis Obispo counties. Of these, 26 were collected live and could be observed for signs of neuroexcitotoxicity. Approximately half exhibited the classic clinical signs of domoic acid (DA) toxicosis including muscle twitches and ataxia, to seizures and coma, and had lesions in the central nervous system and heart. Several biological fluids

were collected for DA analysis including aqueous humor, serum, stomach contents, feces, urine, abdominal fluid, amniotic fluid and milk. Four analytical methods were employed including receptor binding assay (RBA), enzyme-linked immunosorbent assay (ELISA), high performance liquid chromatography (HPLC-UV) and ultra performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS). The DA concentrations determined by each method were positively correlated. Domoic acid was detected in 83% of fecal samples collected from northern fur seals in the present study and in one animal was calculated to contain up to 18.6 mu g DA/g. Interestingly, DA was detected and confirmed in the aqueous humor of the only animal this sample-type was collected from, suggesting that this may prove to be a useful diagnostic body fluid for algal toxin detection in marine mammal mortality events. These data document for the first time that northern fur seals are impacted by DA-producing harmful algal blooms along the California coast.Keywords: Algal toxin; Biotoxin detection methods; Biotoxin trophic transfer; Callorhinus; Domoic acid; Northern fur seal

Levin, M., D. Joshi, A. Draghi II, F. M. Gulland, D. Jessup and S. d. Guise (2010). "Immunomodulatory effects upon in vitro exposure of California sea lion and southern sea otter peripheral blood leukocytes to domoic acid." Journal of Wildlife Diseases 46(2): 541-550.

During red tide bloom events, the marine diatom Pseudo-nitzschia produces the toxin domoic acid (DA), which has been associated with stranding and mortality events involving California sea lions (Zalophus californianus) and southern sea otters (Enhydra lutris). In addition to these well-documented DA-induced neurotoxic events, there is increasing concern that DA may exert chronic effects, such as immunomodulation, which may potentially increase an individual's susceptibility to a number of opportunistic infections following nonlethal exposure. We investigated the effects of DA on innate (phagocytosis and respiratory burst) and adaptive (mitogen-induced lymphocyte proliferation) immune functions with the use of peripheral blood leukocytes collected from healthy California sea lions and southern sea otters upon in vitro exposure to 0 (unexposed control), 0.0001, 0.001, 0.01, 0.1, 1.0, 10, and 100 µM DA. Domoic acid did not significantly modulate phagocytosis or respiratory burst in either species. For California sea lions, DA significantly increased ConA-induced T-lymphocyte proliferation upon exposure to DA concentrations ranging from 0.0001 to 10 µM, resulting in a nonlinear dose-response curve. There was no effect on lymphocyte proliferation at the highest concentration of DA tested. No effects on lymphocyte proliferation were observed in southern sea otters. Importantly, the in vitro DA concentrations affecting T-cell proliferation were within or below the range of DA in serum measured in free-ranging California sea lions following natural exposure, suggesting a risk for immunomodulation in free-ranging animals. Understanding the risk for immunomodulation upon DA exposure will contribute in the health assessment and management of California sea lions and southern sea otters, as well as guide veterinarians and wildlife rehabilitators in caring for and treating afflicted animals.Keywords: California sea lion, domoic acid, immunomodulation, southern sea otter.

Levin, M., T. Romano, K. Matassa and S. D. Guise (2014). "Validation of a commercial canine assay kit to measure pinniped cytokines." Veterinary Immunology and Immunopathology.

The present study was conducted to assess and validate the cross-reactivity of commercially available multiplex human and canine cytokine kits coupled with the Bio-Plex 200 platform to measure cytokines in three pinniped species, harbor seals (Phoca vitulina), gray seals (Halichoerus grypus), and harp seals (Pagophilus groenlandicus). Cytokines are important small proteins that help direct a proper immune response to pathogens. The human cytokine kit allowed the detection of cytokines in the supernatant of mitogen-stimulated human peripheral blood mononuclear cells, but not in the three pinniped species studied, with the exception of TNF? and GM-CSF. In contrast, the canine cytokine kit appeared to cross-react with the majority of cytokines in the three pinniped species tested, including the pro-inflammatory cytokine TNF?, the Th1 cytokine INF?, and the Th2 cytokine IL-10, an anti-

inflammatory cytokine. In addition, the pro-inflammatory cytokines IL-6 and IL-8 were also measured in all pinniped species. Overall, the Bio-Plex 200 platform and the canine multiplex cytokine kit allowed the successful measurement of potentially clinically important pinniped cytokines. This additional tool may provide veterinarians with additional information to detect sub-clinical signs of inflammation or evidence for immune response, which may not be revealed during regular medical evaluation, eg. physical examination, hematology, and serum chemistryKeywords: Cytokine; Pinniped; Canine; Bio-Plex 200; Immunology

Li, L., T. Shan, C. Wang, C. Cote, J. Kolman, D. Onions, F. M. D. Gulland and E. Delwart (2011). "The fecal viral flora of California sea lions." Journal of Virology 85(19): 9909-9917.

California sea lions are one of the major marine mammal species along the Pacific coast of North America. Sea lions are susceptible to a wide variety of viruses, some of which can be transmitted to or from terrestrial mammals. Using an unbiased viral metagenomic approach, we surveyed the fecal virome in California sea lions of different ages and health statuses. Averages of 1.6 and 2.5 distinct mammalian viral species were shed by pups and juvenile sea lions, respectively. Previously undescribed mammalian viruses from four RNA virus families (Astroviridae, Picornaviridae, Caliciviridae, and Reoviridae) and one DNA virus family (Parvoviridae) were characterized. The first complete or partial genomes of sapeloviruses, sapoviruses, noroviruses, and bocavirus in marine mammals are reported. Astroviruses and bocaviruses showed the highest prevalence and abundance in California sea lion feces. The diversity of bacteriophages was higher in unweaned sea lion pups than in juveniles and animals in rehabilitation, where the phage community consisted largely of phages related to the family Microviridae. This study increases our understanding of the viral diversity in marine mammals, highlights the high rate of enteric viral infections in these highly social carnivores, and may be used as a baseline viral survey for comparison with samples from California sea lions during unexplained disease outbreaks.

Littnan, C., J. Baker, A. Harting, T. Johanos-Kam and T. Wurth (2012). A legacy of enhancement: The benefits accrued from 15 years of monk seal recovery efforts. 2012 Hawai'i Conservation Conference: What Difference Does 20 Years Make? Reflections on Change, Innovation, and the Work that Remains. Honolulu, Hawaii, Hawai'i Conservation Alliance Foundation: 6-7.

Litz, J., S. Venn-Watson, R. Carmichael, K. Colegrove, R. Ewing, E. Fougeres, L. Garrison, M. Kinsel, B. Mase-Guthrie, S. Delphine, S. Shippee, S. Smith, L. Staggs, E. Stratton, K. Terio, M. Tumlin and T. Rowles (2013). An update on the 2010-2013 northern Gulf of Mexico cetacean unusual mortality event: Unprecedented and ongoing. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 125.

Litz, J. A., S. Venn-Watson, R. H. Carmichael, E. Fougeres, M. L. Kelley, B. E. Mase-Guthie, D. Shannon, S. F. Shippee, S. M. Smith, T. Spradlin, L. A. Staggs, E. M. Stratton, M. Tumlin and T. K. Rowles (2011). The Northern Gulf of Mexico Cetacean UME:Comparisons of UME bottlenose dolphin (Tursiops truncatus) strandings with historical data (2000-2011). Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 177.

Lockyer, C. (2010). Report of the Antarctic minke whale ear plug experiment. Agadir, Morocco, International Whaling Commission Scientific Committee: 4.

Lonati, G. L., A. J. Westgate and H. N. Koopman (2013). Variation in lipid chemistry of odontocete acoustic fats may affect gas loading during dives. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 127.

Lonati, G. L., A. J. Westgate and H. N. Koopman (2014). "Nitrogen solubility related to lipid composition in toothed whale fats." Integrative and Comparative Biology 54(Supplement 1): E126.

Lopez, J., D. Boyd, G. M. Ylitalo, C. Littnan and R. Pearce (2012). "Persistent organic pollutants in the endangered Hawaiian monk seal (Monachus schauinslandi) from the main Hawaiian Islands." Marine Pollution Bulletin 64(11): 2588-2598.

Little is known about levels or effects of persistent organic pollutants (POPs) in Hawaiian monk seals (HMS) from the main Hawaiian Islands (MHI) subpopulation. This study examined concentrations of a large suite of POPs in blubber and serum of juvenile and adult HMS from the MHI. Adult females have the lowest blubber levels of most POPs, whereas adult males have highest levels. POPs in serum were significantly different in adult males compared with adult females for chlordanes and summed dichlorodiphenyltrichloroethanes (DDTs). Lipid-normalized concentrations of chlordanes, DDTs, polychlorinated biphenyls, and mirex in paired blubber and serum samples were significantly correlated. Contaminant levels from the MHI were at similar or lower levels than those from remote Northwestern Hawaiian Island populations. Determining initial ranges of POPs is an important step towards assessing one of the many potential health threats to this critically endangered species.Keywords: Hawaiian monk seal; Monachus schauinslandi; Persistent organic pollutants; Endangered species; Hawaii; Contaminants.

Lyman, E., D. K. Mattila, D. Schofield and J. Walters (2011). A summary of ship strikes and the operation of a high speed ferry in Hawai'i. Tromso, Norway, IWC Scientific Committee: 16.

The population of North Pacific humpback whales, Megaptera novaeangliae, that mate and calve in the coastal waters surrounding the Hawaiian Islands each winter, has grown at approximately 6% annually since the cessation of whaling. In 2006 it was estimate

Lyman, E. G., D. K. Mattila, D. Schofield, E. Roberts, L. White, C. Yoshinaga, J. Viezbicke, N. M. Davis, P. B. Wong, J. Souza and B. LaCour (2011). A large whale entanglement response network in Hawaii: The advantages of subtropical seas and effort in a humpback whale (Megaptera novaeangliae) wintering ground towards gaining insight into entanglement threat. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 182-183.

Lynn, B. L., C. Reichmuth, R. J. Schusterman and F. M. D. Gulland (2010). "Filial imprinting in a Steller sea lion (Eumetopias jubatus)." Aquatic Mammals 36(1): 79-83.

The Marine Mammal Center hand reared a male Steller sea lion (Eumetopias jubatus) after it was found abandoned as a neonate in June 2006. Following release in April 2007, the animal repeatedly approached humans on the shore, necessitating long-term captive placement. To evaluate the extent of this preference for human contact, we conducted three behavioral assessments: (1) a stationary preference test, (2) a following test, and (3) a vocal playback test. This sea lion demonstrated an overall penchant for human interaction and a strong preference for the voice of one of his early caretakers. Filial imprinting, a developmental phenomenon extensively studied in birds but less so in mammals, is suggested as the cause of this aberrant social behavior. The long-term effects of imprinting in mammals, including impacts on reproductive success, remain poorly understood. This observation with a Steller sea lion is the first documented case of probable imprinting in this species.Keywords: Steller sea lion, Eumetopias jubatus, imprinting, social recognition, development, pinniped

Lynott, M. C., M. Stolen, T. Mazza, I. Bartol and S. Barco (2011). Age estimation and growth of bottlenose dolphins (Tursiops truncatus) in Virginia: Evidence from strandings. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 183.

Lyons, E. T., R. L. Delong, S. A. Nadler, J. L. Laake, A. J. Orr, B. L. Delong and C. Pagan (2011). "Investigations of peritoneal and intestinal infections of adult hookworms (Uncinaria spp.) in northern fur seal (Callorhinus ursinus) and California sea lion (Zalophus californianus) pups on San Miguel Island, California (2003)." Parasitology Research 109(3): 581-589.

The peritoneal cavity (PNC) and intestine of northern fur seal (Callorhinus ursinus) pups and California sea lion (Zalophus californianus) pups that died in late July and early August, 2003, on San Miguel Island, California, were examined for hookworms. Prevalence and morphometric studies were done with the hookworms in addition to molecular characterization. Based on this and previous molecular studies, hookworms from fur seals are designated as Uncinaria lucasi and the species from sea lions as Uncinaria species A. Adult hookworms were found in the PNC of 35 of 57 (61.4%) fur seal pups and of 13 of 104 (12.5%) sea lion pups. The number of hookworms located in the PNC ranged from 1 to 33 (median = 3) for the infected fur seal pups and 1 to 16 (median = 2) for the infected sea lion pups. In addition to the PNC, intestines of 43 fur seal and 32 sea lion pups were examined. All of these pups were positive for adult hookworms. The worms were counted from all but one of the sea lion pups. Numbers of these parasites in the intestine varied from 3 to 2,344 (median = 931) for the fur seal pups and 39 to 2,766 (median = 643) for the sea lion pups. Sea lion pups with peritoneal infections had higher intensity infections in the intestines than did pups without peritoneal infections, lending some support for the hypothesis that peritoneal infections result from high-intensity infections of adult worms. There was no difference in intestinal infection intensities between fur seal pups with and without peritoneal infections. Female adult hookworms in the intestines of both host species were significantly larger than males, and sea lion hookworms were larger than those in fur seals. Worms in the intestine also were larger than worms found in the PNC. Gene sequencing and (RFLP) analysis of (PCR) amplified (ITS) ribosomal DNA were used to diagnose the species of 172 hookworms recovered from the PNC and intestine of 18 C. ursinus and seven Z. californianus hosts. These molecular data revealed that U. lucasi (hookworm of C. ursinus) and Uncinaria species A (of Z. californianus) infrequently mature in the intestine of the opposite host species in California rookeries. However, there is no support from molecular data for the hypothesis that cross-infection with the wrong Uncinaria species is a contributing factor in these cases of host peritonitis. The major significance of this research is the unusual finding of adult hookworms in the PNC of so many dead pups. No obvious explanation for this occurrence could be determined. Further research, like in the present study, should help understand and monitor the apparent ever changing role of hookworm disease in the health of northern fur seal and California sea lion pups on SMI.

Lyons, E. T., T. R. Spraker, R. L. Delong, M. Ionita, S. R. Melin, S. A. Nadler and S. C. Tolliver (2011). "Review of research on hookworms (Uncinaria lucasi Stiles, 1901) in northern fur seals (Callorhinus ursinus Linnaeus, 1758)." Parasitology Research 109(2): 257-265.

The objective of this article is to review knowledge on the hookworm Uncinaria lucasi Stiles, 1901 in northern fur seals, Callorhinus ursinus Linnaeus, 1758. Emphasis is placed on research on this host-parasite system in the Pribilof Islands, AK, USA where the bulk of the studies has been performed.

Madl, J. E., C. G. Duncan, J. E. Stanhill, P.-Y. Tai, T. R. Spraker and F. M. Gulland (2014). "Oxidative stress and redistribution of glutamine synthetase in California sea lions (Zalophus californianus) with domoic acid toxicosis." Journal of Comparative Pathology 150(2-3): 306-315.

The aim of this study was to test the hypothesis that oxidative stress and glutamine synthetase (GS) redistribution occur in domoic acid (DA) toxicosis in California sea lions (CSLs, Zalophus californianus). Sections of archived hippocampi from seven control and 13 CSLs diagnosed with DA toxicosis were labelled immunohistochemically for GS and for two markers of oxidative stress, malondialdehyde (MDA) and 3-nitrotyrosine (NT). The distribution and intensity of labelling were

compared with the pathological changes seen in haematoxylin and eosin-stained sections. Increased expression of MDA and NT occurred in neurons of the hippocampal formation of CSLs with lesions consistent with DA toxicosis. The degree of oxidative stress was not affected significantly by the chronicity or severity of hippocampal damage. In six out of seven CSLs with chronic effects of DA toxicosis, in addition to the normal glial distribution of GS, GS expression was very strong in some neurons of the subiculum. However, neuronal GS labelling was also seen in one control CSL, an effect that may have been due to previous exposure to DA. GS expression in neurons was associated with decreases in GS labelling in neighbouring glial cell processes. DA toxicosis therefore induces increased expression of markers of oxidative stress in neurons consistent with oxidative stress contributing to the initial DA insult and also the epilepsy that often develops in chronic DA toxicosis. GS redistribution occurred primarily in chronic DA toxicosis, perhaps leading to alterations of the glutamine–glutamate–GABA (gamma-aminobutyric acid) cycle and contributing to the excitotoxicity and seizures often seen in DA toxicosisKeywords: California sea lion; domoic acid; glutamine synthetase; oxidative stress

Mallette, S. D., D. A. Pabst, W. A. McLellan and S. G. Barco (2013). "Investigation of growth in a coastal apex predator, the bottlenose dolphin (Tursiops truncatus)." Integrative and Comparative Biology 53(Supplement 1): E323.

Mancia, A., J. Baatz, J. Kucklick, T. Rowles, R. Wells, P. Rosel, L. Wilcox, J. Ryan, A. Aleta Hohn and L. Schwacke (2011). Wild dolphin transcriptomes: Identification of ocean health risk through gene expression information. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 187.

Mancia, A., J. C. Ryan, R. W. Chapman, Q. Wu, G. W. Warr, F. M. D. Gulland and F. M. V. Dolah (2012). "Health status, infection and disease in California sea lions (Zalophus californianus) studied using a canine microarray platform and machine-learning approaches." Developmental and Comparative Immunology 36(4): 629-637.

Conservation biologists face many challenges in assessing health, immune status and infectious diseases in protected species. These challenges include unpredictable sample populations, diverse genetic and environmental backgrounds of the animals, as well as the practical, legal and ethical issues involved in experimentation. The use of whole genome scale transcriptomics with animal samples obtained in a minimally invasive manner is an approach that shows promise for health assessment. In this study we assessed the utility of a microarray to identify changes in gene expression predictive of health status by interrogating blood samples from California sea lions (Zalophus californianus) in rehabilitation. A custom microarray was developed from the commercially available dog microarray (Canis familiaris) by selecting probes that demonstrated reliable cross-hybridization with RNA in sea lion blood. This custom microarray was used for the analysis of RNA from 73 sea lion blood samples, from animals with a broad spectrum of health changes. Both traditional classifying techniques and newer artificial neural network approaches correctly classified sea lions with respect to health status, primarily distinguishing between leptospirosis infection and domoic acid exposure. Real time PCR validation for a small set of genes, followed by sequencing, showed good correlation with array results and high identity (96–98%) between the dog and sea lion sequences. This approach to health status classification shows promise for disease identification in a clinical setting, and assessment of health status of wildlife.Keywords: California sea lion; Cross-hybridization; Microarray; Domoic acid toxicity; Leptospirosis; Blood transcriptomics

Mancia, A., J. C. Ryan, F. M. V. Dolah, J. R. Kucklick, T. K. Rowles, R. S. Wells, P. E. Rosel, A. A. Hohn and L. Schwacke (2014). "Machine learning approaches to investigate the impact of PCBs on the transcriptome of the common bottlenose dolphin (Tursiops truncatus)." Marine Environmental Research.

As top-level predators, common bottlenose dolphins (Tursiops truncatus) are particularly sensitive to chemical and biological contaminants that accumulate and biomagnify in the marine food chainThis work investigates the potential use of microarray technology and gene expression profile analysis to screen common bottlenose dolphins for exposure to environmental contaminants through the immunological and/or endocrine perturbations associated with these agents. A dolphin microarray representing 24,418 unigene sequences was used to analyze blood samples collected from 47 dolphins during capture-release health assessments from five different US coastal locations (Beaufort, NC, Sarasota Bay, FL, Saint Joseph Bay, FL, Sapelo Island, GA and Brunswick, GA). Organohalogen contaminants including pesticides, polychlorinated biphenyl congeners (PCBs) and polybrominated diphenyl ether congeners were determined in blubber biopsy samples from the same animals. A subset of samples (n = 10, males; n = 8, females) with the highest and the lowest measured values of PCBs in their blubber was used as strata to determine the differential gene expression of the exposure extremes through machine learning classification algorithms. A set of genes associated primarily with nuclear and DNA stability, cell division and apoptosis regulation, intra- and extra-cellular traffic, and immune response activation was selected by the algorithm for identifying the two exposure extremes. In order to test the hypothesis that these gene expression patterns reflect PCB exposure, we next investigated the blood transcriptomes of the remaining dolphin samples using machine-learning approaches, including K-nn and Support Vector Machines classifiers. Using the derived gene sets, the algorithms worked very well (100% success rate) at classifying dolphins according to the contaminant load accumulated in their blubber. These results suggest that gene expression profile analysis may provide a valuable means to screen for indicators of chemical exposureKeywords: Machine learning; Transcriptome; Bottlenose dolphin; Ecogenomics; Environmental contaminant exposure; Biotoxin exposure

Mancia, A., D. D. Spyropoulos, W. E. McFee, D. A. Newton and J. E. Baatz (2011). "Cryopreservation and in vitro culture of primary cell types from lung tissue of a stranded pygmy sperm whale (Kogia breviceps)." Comparative Biochemistry and Physiology C Toxicology and Pharmacology 155(1).

Current models for in vitro studies of tissue function and physiology, including responses to hypoxia or environmental toxins, are limited and rely heavily on standard 2-dimensional (2-D) cultures with immortalized murine or human cell lines. To develop a new more powerful model system, we have pursued methods to establish and expand cultures of primary lung cell types and reconstituted tissues from marine mammals. What little is known about the physiology of the deep-sea diving pygmy sperm whale (PSW), Kogia breviceps, comes primarily from stranding events that occur along the coast of the southeastern United States. Thus, development of a method for preserving live tissues and retrieving live cells from deceased stranded individuals was initiated. This report documents successful cryopreservation of PSW lung tissue. We established in vitro cultures of primary lung cell types from tissue fragments that had been cryopreserved several months earlier at the stranding event. Dissociation of cryopreserved lung tissues readily provides a variety of primary cell types that, to varying degrees, can be expanded and further studied/manipulated in cell culture. In addition, PSW-specific molecular markers have been developed that permitted the monitoring of fibroblast, alveolar type II, and vascular endothelial cell types. Reconstitution of 3-D cultures of lung tissues with these cell types is now underway. This novel system may facilitate the development of rare or disease-specific lung tissue models (e.g., to test causes of PSW stranding events and lead to improved treatments for pulmonary hypertension or reperfusion injury in humans). Also, the establishment of a living tissue bank biorepository for rare/endangered species could serve multiple purposes as surrogates for freshly isolated samples.Keywords: Marine mammal; Pygmy sperm whale; Cryopreservation; Lung; Cell culture

Mann, D., M. Hill-Cook, C. Manire, D. Greenhow, E. Montie, J. Powell, R. Wells, G. Bauer, P. Cunningham-Smith, R. Lingenfelser, R. Digiovanni Jr., A. Stone, M. Brodsky, R. Stevens, G. Kieffer and P. Hoetjes (2010). "Hearing loss in stranded odontocete dolphins and whales." PLoS ONE 5(11): e13787.

Full author list: MANN, DAVID; MANDY HILL-COOK; CHARLES MANIRE; DANIELLE GREENHOW; ERIC MONTIE; JESSICA POWELL; RANDALL WELLS; GORDON BAUER; PETRA CUNNINGHAM-SMITH; ROBERT LINGENFELSER; ROBERT DIGIOVANNI, JR.; ABIGALE STONE; MICAH BRODSKY; ROBERT STEVENS; GEORGE KIEFFER and PAUL HOETJES.The causes of dolphin and whale stranding can often be difficult to determine. Because toothed whales rely on echolocation for orientation and feeding, hearing deficits could lead to stranding. We report on the results of auditory evoked potential measurements from eight species of odontocete cetaceans that were found stranded or severely entangled in fishing gear during the period 2004 through 2009. Approximately 57% of the bottlenose dolphins and 36% of the rough-toothed dolphins had significant hearing deficits with a reduction in sensitivity equivalent to severe (70–90 dB) or profound (.90 dB) hearing loss in humans. The only stranded short-finned pilot whale examined had profound hearing loss. No impairments were detected in seven Risso's dolphins from three different stranding events, two pygmy killer whales, one Atlantic spotted dolphin, one spinner dolphin, or a juvenile Gervais' beaked whale. Hearing impairment could play a significant role in some cetacean stranding events, and the hearing of all cetaceans in rehabilitation should be tested.

Martinez, A., K. Barry, K. D. Mullin and L. P. Garrison (2011). Assessing the potential impact of the Deepwater Horizon oil spill on continental shelf and oceanic species of marine mammals in the north-central Gulf of Mexico. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 191.

Mattila, D. K. and T. Rowles (2010). A review of large whale entanglement. Agadir, Morocco, International Whaling Commission Scientific Committee: 8.

Entanglements of large whales in manmade materials have been documented in virtually all regions of the world where the two overlap. While large whales have been reported entangled in a variety of materials, the majority of entanglements documented to date have involved stationary or drifting, as opposed to actively towed, fishing gear. Estimating the extent and impact of these occurrences has been difficult as the most common method used to measure levels of bycatch is through observer programs aboard vessels that are actively fishing. However, growing evidence indicates that many large whales drag all or part of the gear away from the location where the fisherman expects to retrieve it. Therefore various other methods have been used to estimate the species, numbers of individuals, gear and impacts involved in these events. These include: the examination of stranded animals, the collection of opportunistic reports, the collection of data while releasing entangled whales; and the examination of diagnostic scarring on survivors. Here we provide a review of some of we know currently about the species, numbers, impacts and entangling gear, based on these efforts.

Mazzoil, M., M. Stolen, W. Noke Durden, T. Mazza, E. Howells, E. Murdoch Titcomb and G. O'Corry-Crowe (2011). Live here - die here! Life history inference from carcass recovery in bottlenose dolphins (Tursiops truncatus). Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 195.

McAlarney, R., W. A. McLellan, D. A. Pabst, E. W. Cummings, K. W. Urian, P. B. Nilsson, D. Waples, J. Dunn, D. J. Johnston and A. J. Read (2011). Cetacean species diversity observed during four years of

survey effort in Onslow Bay, NC, USA. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 195-196.

McClelland, S. J., M. Gay, D. A. Pabst, R. Dillaman, A. J. Westgate and H. N. Koopman (2012). "Microvascular patterns in the blubber of shallow and deep diving odontocetes." Journal of Morphology 273(8): 932-942.

Blubber, a specialized form of subdermal adipose tissue, surrounds marine mammal bodies. Typically, adipose tissue is perfused by capillaries but information on blubber vascularization is lacking. This study's goals were to: 1) describe and compare the microvasculature (capillaries, microarterioles, and microvenules) of blubber across odontocete species; 2) compare microvasculature of blubber to adipose tissue; and 3) examine relationships between blubber's lipid composition and its microvasculature. Percent microvascularity, distribution, branching pattern, and diameter of microvessels were determined from images of histochemically stained blubber sections from shallow-diving bottlenose dolphins (Tursiops truncatus), deeper-diving pygmy sperm whales (Kogia breviceps), deep-diving beaked whales (Mesoplodon densirostris; Ziphius cavirostris), and the subdermal adipose tissue of domestic pigs (Sus scrofa). Tursiops blubber showed significant stratification in percent microvascularity among the superficial, middle, and deep layers and had a significantly higher percent microvascularity than all other animals analyzed, in which the microvasculature was more uniformly distributed. The percent microvasculature of Kogia blubber was lower than that of Tursiops but higher than that of beaked whales and the subdermal adipose tissue of domestic pigs. Tursiops had the most microvascular branching. Microvessel diameter was relatively uniform in all species. There were no clear patterns associating microvascular and lipid characteristics. The microvascular characteristics of the superficial layer of blubber resembled the adipose tissue of terrestrial mammals, suggesting some conservation of microvascular patterns in mammalian adipose tissue. The middle and deep layers of blubber, particularly in Tursiops, showed the greatest departure from typical mammalian microvascular arrangement. Factors such as metabolics or thermoregulation may be influencing the microvasculature in these layers.Keywords: blubber; adipose; vasculature; whale

McCulloch, S. D. and J. D. Goldstein (2011). Collaborative response to intervene and evaluate bottlenose dolphins (Tursiops truncatus) entangled in commercial and recreational fishing gear within the southeastern United States. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 198.

McFee, W. and S. Arnott (2011). Winter cold water anomalies and bottlenose dolphin strandings in South Carolina, USA. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 199.

McFee, W. E. and T. P. Lipscomb (2009). "Major pathologic findings and probable causes of mortality in bottlenose dolphins stranded in South Carolina from 1993 to 2006." Journal of Wildlife Diseases 45(3): 575-593.

Although cause-of-death information on bottlenose dolphins (Tursiops truncatus) can be located in the literature, few citations include mortality data over a long period of time covering a broad geographic region. This study describes major pathologic findings and probable causes of death of bottlenose dolphins over a 14-yr period (1993–2006) for the coastal region of South Carolina. Probable causes of death for 97 cases were determined based on gross pathology and histopathology. In an additional 30 cases, probable cause of death was apparent from gross pathology alone, and carcass condition precluded histopathology. Of the 97 dolphins examined grossly and histologically, 30 (31%) likely died of infectious disease and 46 (47%) of noninfectious disease; the cause of death was unknown

in 21 (22%). Bacterial infections accounted for the large majority of fatal infections and emaciation was the leading cause of noninfectious mortality. Twelve dolphins were killed by human interactions. Of the 30 dolphins diagnosed from gross examination alone, 23 likely died from human interaction and seven were killed by stingray-spine inflictions. Although the absence of consistent use of microbiology, biotoxin analysis and contaminant testing decreases the conclusiveness of the findings, this study has broad implications in establishing baseline data on causes of death of bottlenose dolphins for future studies and for the detection of emerging diseases. Key words: Bottlenose dolphin, cause of death, mortality, South Carolina, strandings, Tursiops truncatus.

McHugh, K. A., G. N. Lovewell, A. A. Barleycorn, S. L. Brenneman, J. B. Allen and R. S. Wells (2013). Interactions between bottlenose dolphins (Tursiops truncatus) and crab fisheries near Sarasota, Florida, USA. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 140-141.

McHuron, E. A., D. J. Greig, K. M. Colegrove, M. Fleetwood, T. R. Spraker, F. M. D. Gulland, J. T. Harvey, K. A. Lefebvre and E. R. Frame (2013). "Domoic acid exposure and associated clinical signs and histopathology in Pacific harbor seals (Phoca vitulina richardii)." Harmful Algae 23: 28-33.

Domoic acid (DA) is a potent neurotoxin that has caused strandings and mortality of seabirds and marine mammals off the California coast. Pacific harbor seals (Phoca vitulina richardii) are an abundant, nearshore species in California; however, DA exposure and toxicosis have not been documented for harbor seals in this region. To investigate DA exposure in harbor seals, samples were collected from free-ranging and stranded seals off California to assess exposure, clinical signs of toxicosis, and brain lesions in harbor seals exposed to DA. Domoic acid was detected in 65% (17/26) of urine samples collected from apparently healthy free-ranging seals, with concentrations of 0.4–11.7 ng/ml. Domoic acid also was detected in feces (2.4–2887 ng/g), stomach contents (1.4 ng/g; stranded only), milk (2.2 ng/ml; stranded only), amniotic fluid (9.7 ng/ml; free-ranging only), fetal meconium (14.6–39.8 ng/g), and fetal urine (2.0–10.2 ng/ml). Clinical signs indicative of DA toxicosis were observed in two live-stranded seals, and included disorientation, seizures, and uncoordinated movements. Histopathology revealed the presence of brain lesions consistent with DA toxicosis in two live-stranded seals, and one free-ranging seal that died during capture. Results indicated that harbor seals were exposed to DA, exhibited clinical signs and histological lesions associated with DA exposure, and that pups were exposed to DA in utero and during lactation via milk. Future investigation is required to determine the magnitude of impact that DA has on the health and mortality of harbor seals.Keywords: Harmful algal bloom; Domoic acid; Neurological signs; Mortality; Pseudo-nitzschia; Phoca vitulina.

McLeland, S., C. Duncan, T. Spraker, E. Wheeler, S. R. Lockhart and F. Gulland (2012). "Cryptococcus albidus infection in a California sea lion (Zalophus californianus)." Journal of Wildlife Diseases 48(4): 1030-1034.

Sporadic cases of cryptococcosis have been reported in marine mammals, typically due to Cryptococcus neoformans and, more recently, to Cryptococcus gattii in cetaceans. Cryptococcus albidus, a ubiquitous fungal species not typically considered to be pathogenic, was recovered from a juvenile California sea lion (Zalophus californianus) rescued near San Francisco Bay, California. Yeast morphologically consistent with a Cryptococcus sp. was identified histologically in a lymph node and C. albidus was identified by an rDNA sequence from the lung. Infection with C. albidus was thought to have contributed to mortality in this sea lion, along with concurrent bacterial pneumonia. Cryptococcus albidus should be considered as a potential pathogen with a role in marine mammal morbidity and mortality. Keywords: California sea lion; Cryptococcus albidus; fungal infection; pinniped.

McLellan, W. A. (2011). Necropsy report-EgNEFL1103. Wilmington, North Carolina, University of North Carolina Wilmington.

McLellan, W. A., S. A. Rommel and D. A. Pabst (2011). Species specific necropsy data sheets for large whale necropsies. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 201.

Meegan, J., W. T. Collard, G. S. Grover, N. Pussini, W. G. Van Bonn and F. M. D. Gulland (2013). "Pharmacokinetics of ceftiofur crystalline-free acid (Excede sterile suspension®) administered via intramuscular injection in wild California sea lions (Zalophus californianus)." Journal of Zoo and Wildlife Medicine 44(3): 714-720.

The pharmacokinetics of ceftiofur crystalline-free acid (EXCEDE Sterile Suspension, 200 mg ceftiofur equivalents/ml) were determined for the California sea lion (Zalophus californianus). A single dose of
EXCEDE was administered intramuscularly at 6.6 mg/kg to 12 wild California sea lions during rehabilitation.
The first 10 animals were each assigned to two blood collection time points, with a total of 10 time points at: 6, 12,
24, 48, 72, 96, 120, 144, 168, and 192 hr after administration of the drug. An additional two animals were sampled
1, 2, 3, 4, 5, and 6 hr postinjection. Plasma was separated within 10 min of blood collection and stored at 208C
until analysis. Plasma concentrations of ceftiofur, desfuroylceftiofur, and related metabolites, were determined
using liquid chromatography with tandem mass spectrometry (MS). Maximum plasma concentrations of ceftiofur
and related metabolites were observed 24 hr postdosing with a mean concentration of 3.6 lg/ml. The half life (60
hr) and area under the curve (270 lg hr/ml) were also determined. These data indicate that a single dose of
EXCEDE at 6.6 mg/kg i.m. would likely maintain a mean plasma drug level .0.6 lg/ml for 5 days and .0.5 lg/ml
for 8 days.

Meegan, J., C. Field, I. Sidor, T. Romano, S. Casinghino, C. R. Smith, L. Kashinsky, P. A. Fair, G. Bossart, R. Wells and J. L. Dunn (2010). "Development, validation, and utilization of a competitive enzyme-linked immunosorbent assay for the detection of antibodies against Brucella species in marine mammals." Journal of Veterinary Diagnostic Investigation 22(6): 856-862.

A competitive enzyme-linked immunosorbent assay (cELISA) was developed by using a whole-cell antigen from a marine Brucella sp isolated from a harbor seal (Phoca vitulina) The assay was designed to screen sera from multiple marine mammal species for the presence of antibodies against marine-origin Brucella Based on comparisons with culture confirmed cases specificity and sensitivity for cetacean samples tested were 73% and 100%, respectively For pinniped samples, specificity and sensitivity values were 77% and 67%, respectively Hawaiian monk seal (Monachus schauinslandi, n = 28) and bottlenose dolphin (Turstops truncatus, n = 48) serum samples were tested, and the results were compared with several other assays designed to detect Brucella abortus antibodies The comparison testing revealed the marine-origin cELISA to be more sensitive than the B abortus tests by the detection of additional positive serum samples The newly developed cELISA is an effective serologic method for

detection of the presence of antibodies against marine-origin Brucella sp in marine mammals.Keywords: Brucella; competitive enzyme-linked; immunosorbent; assay; marine; mammals; validation

Melin, S. R., A. J. Orr, J. D. Harris, J. L. Laake, R. L. Delong, F. M. D. Gulland and S. Stoudt (2010). "Unprecedented mortality of California sea lion pups associated with anomalous oceanographic conditions along the central California coast in 2009." California Cooperative Oceanic Fisheries Investigations Reports 51: 182-194.

Between May and August 2009, an anomalous oceanographic event occurred along the central California coast. The event was characterized by the strongest negative upwelling observed in 40 years and uncharacteristically warm sea surface temperatures. The timing of the event coincided with the weaning and reproduction of California sea lions in the California Current System. We documented the effects of the event on sea lion pup production, pup mortality, female attendance, and diet at San Miguel Island, California. Simultaneous with the oceanographic event, we also documented a record number of strandings along the California coast of emaciated weaned pups born in 2008. We conclude that the response of California sea lions to the anomalous oceanographic conditions in 2009 was mediated through warmer SSTs that likely reduced availability of their usual summer prey and resulted in the high mortality of the 2008 and 2009 cohorts due to starvation.

Miller, C. A., P. B. Best, W. L. Perryman, M. F. Baugartner and M. J. Moore (2012). "Body shape changes associated with reproductive status, nutritive condition and growth in right whales Eubalaena glacialis and E. australis." Marine Ecology Progress Series 459: 135-156.

Mammalian reproduction is metabolically regulated; therefore, the endangered status and high variability in reproduction of North Atlantic right whales Eubalaena glacialis necessitate accurate assessments at sea of the nutritional condition of living individuals. Aerial photogrammetry was used to measure dorsal body width at multiple locations along the bodies of free-swimming right whales at different stages of the female reproductive cycle (E. glacialis) and during the initial months of lactation (mother and calf Eubalaena australis) to quantify changes in nutritional condition during energetically demanding events. Principal components analyses indicated that body width was most variable at 60% of the body length from the snout. Thoracic, abdominal and caudal body width of E. australis thinned significantly during the initial months of lactation, especially at 60% of body length from the snout, while their calves' widths and width-to-length ratios increased. The body shape of E. glacialis that had been lactating for 8 mo was significantly thinner than non-lactating, non-pregnant E. glacialis. Body shape of E. glacialis measured in the eighth month of lactation was significantly thinner than that of E. australis in the first month, but did not differ from that of E. australis in the third and fourth months. Body width was comparable with diameter calculated from girth of carcasses. These results indicate that mother right whales rely on endogenous nutrient reserves to support the considerable energy expenditure during the initial months of lactation; therefore, photogrammetric measurements of body width, particularly at 60% of body length from the snout, are an effective way to quantitatively and remotely assess nutritional condition of living right whales. Keywords: Right whale; Body shape; Body condition; Aerial photogrammetry; Reproduction; Energetics; Eubalaena.

Mongillo, T. M., E. E. Holmes, D. P. Noren, G. R. Vanblaricom, A. E. Punt, S. M. O'Neill, G. M. Ylitalo, M. B. Hanson and P. S. Ross (2012). "Predicted polybrominated diphenyl ether (PBDE) and polychlorinated biphenyl (PCB) accumulation in southern resident killer whales." Marine Ecology Progress Series 453: 263-277.

Persistent organic pollutants (POPs) are anthropogenic contaminants that bioaccumulate in upper trophic level species. Polybrominated diphenyl ethers (PBDEs) and polychlorinated biphenyls (PCBs) are POPs of particular concern because they can induce immunotoxicity, neurotoxicity, and

reproductive impairment. Killer whales Orcinus orca can accumulate high concentrations of POPs because they are long-lived apex predators. Southern resident killer whales (SRKWs) are an endangered fish-eating population that consists of 3 pods (J, K, and L) with a geographic range from central California, USA, to the Queen Charlotte Islands, Canada. An individual-based modeling approach was used to predict the accumulation of sum PBDEs (?PBDEs) and sum PCBs (?PCBs) in specific individuals in the SRKW population. Model predictions for the current concentrations corresponded closely to the concentrations measured in biopsies collected from known individuals. The predicted ?PBDE concentrations over the life-span of individual killer whales were consistent with a doubling time of ~3 to 4 yr, highlighting the rapid emergence of PBDEs as a priority concern in these animals. J pod individuals had the highest predicted ?PBDE and ?PCB concentrations, likely due to their increased residence time near industrial centers. Modeled historical ?PCB concentrations did not increase substantially over time or with age in males born after 1970, whereas the ?PBDE concentrations increased over time and with age. In general, modeled future projections indicated that the average male and female had similar ?PBDE trends with age, time, and diet scenario. Future ?PCBs are predicted to slowly decline; however, SRKWs will continue to be exposed for several generations.Keywords: PCB; PBDE; Bioaccumulation; Killer whale; Model; Contaminants; Persistent organic pollutants

Montes, N., R. Swatt, C. Sidman, T. Fik, S. Cameron and B. Zoodsma (2011). Modeling recreational boating off the coast of northeast Florida and its implications for the North Atlantic right whale. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 209.

Montie, E. W., N. Pussini, G. E. Schneider, T. W. K. Battey, S. Dennison, J. Barakos and F. Gulland (2009). "Neuroanatomy and volumes of brain structures of a live California sea lion (Zalophus californianus) from magnetic resonance images." Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology 292(10): 1523-1547.

Montie, E. W., C. M. Reddy, W. A. Gebbink, K. E. Touhey, M. E. Hahn and R. J. Letcher (2009). "Organohalogen contaminants and metabolites in cerebrospinal fluid and cerebellum gray matter in short-beaked common dolphins and Atlantic white-sided dolphins from the western North Atlantic." Environmental Pollution 157(8-9): 2345-2358.

Concentrations of several congeners and classes of orgamohalogen contaminants (OHCs) and/or their metabolites, namely organochlorine pesticides (OCs), polychlorinated biphenyls (PCBs), hydroxylated-PCBs (OH-PCBs), methylsulfonyl-PCBs (MeSO2-PCBs), polybrominated diphenyl ether (PBDE) flame retardants, and OH-PBDEs, were measured in cerebrospinal fluid (CSF) of short-beaked common dolphins (n = 2), Atlantic white-sided dolphins (n = 8), and gray seal (n = 1) from the western North Atlantic. In three Atlantic white-sided dolphins, cerebellum gray matter (GM) was also analyzed. The levels of OCs, PCBs, MeSO2-PCBs, PBDEs, and OH-PBDEs in cerebellum GM were higher than the concentrations in CSF. 4-OH-2,3,3',4',5-pentachlorobiphenyl (4-OH-CB107) was the only detectable OH-PCB congener present in CSF. The sum (Sigma) OH-PCBs/Sigma PCB concentration ratio in CSF was approximately two to three orders of magnitude greater than the ratio in cerebellum GM for dolphins. Keywords: Dolphin; Brain; PCB; OH-PCB; PBDE

Montie, E. W., E. Wheeler, N. Pussini, T. W. K. Battey, J. Barakos, S. Dennison, Kathleen and F. Gulland (2010). "Magnetic resonance imaging quality and volumes of brain structures from live and postmortem imaging of California sea lions with clinical signs of domoic acid toxicosis." Diseases of Aquatic Organisms 91(3): 243-256.

Our goal in this study was to compare magnetic resonance images and volumes of brain structures obtained alive versus postmortem of California sea lions Zalophus californianus exhibiting clinical signs of domoic acid (DA) toxicosis and those exhibiting no

Montie, E. W., E. Wheeler, N. Pussini, T. W. K. Battey, W. V. Bonn and F. Gulland (2012). "Magnetic resonance imaging reveals that brain atrophy is more severe in older California sea lions with domoic acid toxicosis." Harmful Algae 20: 19-29.

In 1998, domoic acid (DA) toxicosis was first documented in marine mammals, when more than 400 California sea lions (Zalophus californianus) were determined to have been exposed to DA through contaminated prey that was linked to a bloom of toxin-producing diatoms. Over the last fifteen years, these blooms have increased in frequency and distribution, and DA toxicosis has become a more complex disease. Evidence with laboratory animals show that DA can cause epilepsy, may affect brain development, and may have synergistic effects with some pollutants. Detecting these effects in marine mammals requires quantitative methods to evaluate brain morphology in live animals. In this study, our goal was to employ magnetic resonance imaging (MRI) to examine the morphologic effects of DA toxicosis on the brain in live, wild California sea lions admitted to a rehabilitation center. We performed MRIs and volumetrics of brain structures of 53 sea lions that exhibited clinical signs of acute or chronic DA intoxication. We found that the volumes of the hippocampi and parahippocampal gyri of sea lions with chronic DA toxicosis were less than the volumes of these structures in non-DA intoxicated animals. In addition, adult sea lions with chronic DA toxicosis had more structural damage to the brain than younger animals. This pattern may be explained by one or more of the following possibilities: (i) repetitive, sublethal exposure; (ii) increased susceptibility of adults to DA compared to younger animals; and/or (iii) initial exposure to the toxin followed by the progressive effects of ongoing seizure activity. Of these three possibilities, increased susceptibility and progressive effects of ongoing seizure activity most likely explain why atrophy of the hippocampus and thinning of the parahippocampal gyrus is most severe in adults.Keywords: Domoic acid; California sea lion; Magnetic resonance imaging; MRI; Brain; Hippocampus; Parahippocampal gyrus; Marine mammal.

Moore, C., A. Fahlman, M. Moore, M. Niemeyer, B. Lentell, S. Oakes and S. Trumble (2011). Histological investigation of the “slip” in marine mammal tracheas. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 210.

Moore, C., M. Moore, S. Trumble, M. Niemeyer, B. Lentell, W. McLellan, A. Costidis and A. Fahlman (2014). "A comparative analysis of marine mammal tracheas." Journal of Experimental Biology 217(Part 7): 1154-1166.

In 1940, Scholander suggested that stiffened upper airways remained open and received air from highly compressible alveoli during marine mammal diving. There are few data available on the structural and functional adaptations of the marine mammal respiratory system. The aim of this research was to investigate the anatomical (gross) and structural (compliance) characteristics of excised marine mammal tracheas. Here, we defined different types of tracheal structures, categorizing pinniped tracheas by varying degrees of continuity of cartilage (categories 1-4) and cetacean tracheas by varying compliance values (categories 5A and 5B). Some tracheas fell into more than one category along their length; for example, the harbor seal (Phoca vitulina) demonstrated complete rings cranially, and as the trachea progressed caudally, tracheal rings changed morphology. Dolphins and porpoises had less stiff, more compliant spiraling rings while beaked whales had very stiff, less compliant spiraling rings. The pressure-volume (P-V) relationships of isolated tracheas from different species were measured to assess structural differences between species. These findings lend evidence for pressure-induced collapse and

re-inflation of lungs, perhaps influencing variability in dive depth or ventilation rates of the species investigated.

Moore, C. D., A. Fahlman, M. Moore, M. Niemeyer, B. Lentell, S. Oakes and S. Trumble (2012). "Histological investigations of the slip in marine mammal tracheas." FASEB Journal 26: 886.823.

Moore, E., S. Lyday, J. Roletto, K. Litle, J. K. Parrish, H. Nevins, J. Harvey, J. Mortenson, D. Greig, M. Piazza, A. Hermance, D. Lee, D. Adams, S. Allen and S. Kell (2009). "Entanglements of marine mammals and seabirds in central California and the north-west coast of the United States 2001-2005." Marine Pollution Bulletin 58(7): 1045-1051.

Entanglement records for seabirds and marine mammals were investigated for the period 2001-2005. The entanglement records were extracted from databases maintained by seven organizations operating along the west coast of the United States of America. Their programmes included beach monitoring survey, rescue and rehabilitation and regional pinniped censuses. Records of 454 entanglements were documented, in live animals and in carcasses for 31 bird species and nine marine mammal species. The most frequently entangled species were Common Murres, Western Gulls and California sea lions. The entanglement materials identified were primarily fishing related. Entanglements were recorded every year suggesting that although the incidence level differs annually, entanglement is a persistent problem. It is recommended that each programme records details in standardized categories to determine entanglement material sources. Numbers of entanglements observed during these surveys are likely to be a conservative view of the actual entanglement rate taking place at sea. Keywords: Entanglement; Fishing gear; Marie debris; Marine mammals; Seabirds; West Coast of the United States

Moore, K. M., S. M. Sharp, C. T. Harry, J. M. Hoppe, M. J. Moore, M. E. Niemeyer, J. J. Finneran and D. S. Houser (2011). Field use of auditory evoked potential technology to acquire audiograms from stranded odontocetes. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 211.

Moore, M., R. Andrews, T. Austin, J. Bailey, A. Costidis, C. George, K. Jackson, T. Pitchford, S. Landry, A. Ligon, W. McLellan, D. Morin, J. Smith, D. Rotstein, T. Rowles, C. Slay and M. Walsh (2012). "Rope trauma, sedation, disentanglement, and monitoring-tag associated lesions in a terminally entangled North Atlantic right whale (Eubalaena glacialis)." Marine Mammal Science: n/a-n/a.

Moore, M. and A. Fahlman (2013). Markers of decompression stress of mass stranded/live caught and released vs. single stranded marine mammals, Office of Naval Research: 5.

Moore, M., A. Fahlman and Y. B. D. Quiros (2013). Measuring compartment size and gas solubility in marine mammals, Office of Naval Research: 4.

Moore, M., A. Fahlman, S. Thom, K. Moore, R. Wells, A. Trites, D. Rosen and M. Haulena (2012). Markers of decompression stress of mass stranded/live caught and released vs. single stranded marine mammals, Office of Naval Research: 6.

Moore, M., D. R. Ketten and A. Fahlman (2010). An experimental model for bubble formation in diving seals and porpoises, Office of Naval Research: 10.

Moore, M., D. R. Ketten, A. Fahlman and S. Dennison (2009). An experimental model for bubble formation in diving seals and porpoises, Office of Naval Research: 11.

Moore, M., M. Walsh, J. Bailey, D. Brunson, F. Gulland, S. Landry, D. Mattila, C. Mayo, C. Slay, J. Smith and T. Rowles (2010). "Sedation at sea of entangled North Atlantic right whales (Eubalaena glacialis) to enhance disentanglement." PLoS ONE 5(3).

Background: The objective of this study was to enhance removal of fishing gear from right whales (Eubalaena glacialis) at sea that evade disentanglement boat approaches. Titrated intra muscular injections to achieve sedation were undertaken on two free swimming right whales. Methodology/Principal Findings: Following initial trials with beached whales, a sedation protocol was developed for right whales. Mass was estimated from sighting and necropsy data from comparable right whales. Midazolam (0.01 to 0.025 mg/ kg) was first given alone or with meperidine (0.17 to 0.25 mg/kg) either once or four times over two hours to whale #1102 by cantilevered pole syringe. In the last attempt on whale #1102 there appeared to be a mild effect in 20–30 minutes, with duration of less than 2 hours that included exhalation before the blowhole fully cleared the water. Boat avoidance, used as a measure of sedation depth, was not reduced. A second severely entangled animal in 2009, whale #3311, received midazolam (0.03 mg/kg) followed by butorphanol (0.03 mg/kg) an hour later, delivered ballistically. Two months later it was then given midazolam (0.07 mg/kg) and butorphanol (0.07 mg/kg) simultaneously. The next day both drugs at 0.1 mg/kg were given as a mixture in two darts 10 minutes apart. The first attempt on whale #3311 showed increased swimming speed and boat avoidance was observed after a further 20 minutes. The second attempt on whale #3311 showed respiration increasing mildly in frequency and decreasing in strength. The third attempt on whale #3311 gave a statistically significant increase in respiratory frequency an hour after injection, with increased swimming speed and marked reduction of boat evasion that enabled decisive cuts to entangling gear. Conclusions/Significance: We conclude that butorphanol and midazolam delivered ballistically in appropriate dosages and combinations may have merit in future refractory free swimming entangled right whale cases until other entanglement solutions are developed.

Moore, M. J. (2009). "Current issues facing North Atlantic right whales and stakeholders." Boston College Environmental Affairs Law Review 36(2): 309-317.

At the beginning of the Symposium sessions at the Massachusetts Institute of Technology and at Boston College Law School, Dr. Michael Moore provided a narrative and photographic ntrpduction to current threats to whale survival, with particular reference to North Atlantic waters off the eastern coast of the United States and the most endangered whale species, the North Atlantic right whale, Eubalaena glacialis. The conditions experienced by North Atlantic right whales reflect conditions faced by all the great whales of the North Atlantic. Given the 1935 absolute moratorium on hunting right whales in any waters, there are three major areas of current concern for whale conservation and survival noted in Dr. Moore's presentation and addressed in legal terms by subsequent contributors to the Symposium: (1) entanglement in commercial fishing gear; (2) vessel strikes; and (3) ambient and episodic marine noise. Each of these is generated by human activities on the oceans.

Moore, M. J. (2010). Overview of euthanasia of large whales. Agadir, Morocco, International Whaling Commission Scientific Committee: 13.

Large whales are not infrequently entangled in fishing gear. When unable to disentangle themselves, or be disentangled by humans, these cases can become protracted, with constriction of multiple body parts, soft tissue laceration, embedment in bone, and hemorrhage. This can lead to failure to feed, infection and emaciation. Euthanasia might be considered for such terminal cases in the interests of animal welfare. This paper reviews possible methods that have been used at sea in native and commercial whaling, and on the beach in the management of large whale strandings. It strives to

review pertinent literature and data on the topic and lay out the advantages and disadvantages of each method and its potential applicability to euthanasia of such cases at sea and on the beach. None of this obviates the over-riding need for better entanglement avoidance measures.Keywords: Whael; entanglement; euthanasia

Moore, M. J. (2014). "How we all kill whales." ICES Journal of Marine Science 71(4): 760-763.

Today there is enormous popular interest in marine mammals. Western media tend to dwell on the ongoing debate about commercial whaling by Japan, Norway and Iceland. There is, however, relative silence as to how the shipping and fishing industries of many if not all maritime countries are also catching and sometimes killing whales, albeit unintentionally. Thus, western countries have, through the development and increase in fishing and shipping in continental shelf waters, essentially resumed whaling as vessel speeds and fishing gear strength have increased in recent decades. The ways in which these animals die, especially in fixed fishing gear that they become entangled in and swim off with, would raise substantial concern with consumers of seafood were they to be aware of what they were enablingKeywords: animal welfare; bycatch; entanglement; mortality; whaling

Moore, M. J., A. L. Bogomolni, S. E. Dennison, G. Early, M. M. Gamer, B. A. Hayward, B. J. Lentell and D. S. Rotstein (2009). "Gas bubbles in seals, dolphins, and porpoises entangled and drowned at depth in gillnets." Veterinary Pathology 46(3): 536-547.

Gas bubbles were found in 15 of 23 gillnet-drowned bycaught harp (Pagophilus groenlandicus), harbor (Phoca vitulina) and gray (Halichoerus grypus) seals, common (Delphinus delphis) and white-sided (Lagenorhyncus acutus) dolphins, and harbor porpoises (Phocaena phocaena) but in only I of 41 stranded marine mammals. Cases with minimal scavenging and bloating were chilled as practical and necropsied within 24 to 72 hours of collection. Bubbles were commonly visible grossly and histologically in bycaught cases. Affected tissues included lung, liver, heart, brain, skeletal muscle, gonad, lymph nodes, blood, intestine, pancreas, spleen, and eye. Computed tomography performed on 4 animals also identified gas bubbles in various tissues. Mean +/- SD net lead line depths (m) were 92 +/- 44 and ascent rates (ms(-1)) 0.3 +/- 0.2 for affected animals and 76 +/- 33 and 0.2 +/- 0.1, respectively, for unaffected animals. The relatively good carcass condition of these cases, comparable to 2 stranded cases that showed no gas formation on computed tomography (even after 3 days of refrigeration in one case), along with the histologic absence of bacteria and autolytic changes, indicate that peri- or postmortem phase change of supersaturated blood and tissues is most likely. Studies have suggested that under some circumstances, diving mammals are routinely supersaturated and that these mammals presumably manage gas exchange and decompression anatomically and behaviorally. This study provides a unique illustration of such supersaturated tissues. We suggest that greater attention be paid to the radiology and pathology of bycatch mortality as a possible model to better understand gas bubble disease in marine mammals.Keywords: Bubbles; computed tomography; dolphins; histopathology; necropsy; porpoises; seals

Moore, M. J., T. Hammar, J. Arruda, S. Cramer, S. Dennison, E. Montie and A. Fahlman (2011). "Hyperbaric computed tomographic measurement of lung compression in seals and dolphins." Journal of Experimental Biology 214(14): 2390-2397.

Lung compression of vertebrates as they dive poses anatomical and physiological challenges. There has been little direct observation of this. A harbor and a gray seal, a common dolphin and a harbor porpoise were each imaged post mortem under pressure using a radiolucent, fiberglass, water-filled pressure vessel rated to a depth equivalent of 170 m. The vessel was scanned using computed tomography (CT), and supported by a rail and counterweighted carriage magnetically linked to the CT table movement. As pressure increased, total buoyancy of the animals decreased and lung tissue CT

attenuation increased, consistent with compression of air within the lower respiratory tract. Thre e-dimensional reconstructions of the external surface of the porpoise chest showed a marked contraction of the chest wall. Estimation of the volumes of different body compartments in the head and chest showed static values for all compartments except the lung, which showed a pressure-related compression. The depth of estimated lung compression ranged from 58 m in the gray seal with lungs inflated to 50% total lung capacity (TLC) to 133 m in the harbor porpoise with lungs at 100% TLC. These observations provide evidence for the possible behavior of gas within the chest of a live, diving mammal. The estimated depths of full compression of the lungs exceeds previous indirect estimates of the depth at which gas exchange ceases, and concurs with pulmonary shunt measurements. If these results are representative for living animals, they might suggest a potential for decompression sickness in diving mammals.Keywords: experimental hyperbaric lung compression; dolphin; seal; diving physiology

Moore, M. J. and J. M. V. D. Hoop (2012). "The painful side of trap and fixed net fisheries: Chronic entanglement of large whales." Journal of Marine Biology: 230653.

Concern over the well-being of marine mammals at sea has focused on intentional harvests, both in terms of individual welfare and population sustainability. Unintentional mortalities from fishing gear entanglement are primarily seen as a risk to population viability. Additionally, larger whales breaking free of, and subsequently carrying, fixed trap and net gear are subject to a very slow demise, averaging 6 months in the case of the North Atlantic right whale (Eubalaena glacialis). Chronic cases can involve impaired foraging, increased drag, infection, hemorrhage, and severe tissue damage. The individual suffering of these cases appears to be extreme. Thus management measures should go beyond legally mandated conservation measures to include avoidance of such scenarios. Seafood consumers could succeed, where laws have failed, to demand fishing practices that do not kill whales in this manner. The effective absence of such demands would seem to reflect the cryptic nature of these cases to most consumers.

Moore, M. J., J. V. D. Hoop, S. G. Barco, A. M. Costidis, F. M. Gulland, P. D. Jepson, K. T. Moore, S. Raverty and W. A. McLellan (2013). "Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma." Diseases of Aquatic Organisms 103(3): 229-264.

Post-mortem examination of dead and live stranded beach-cast pinnipeds and cetaceans for determination of a cause of death provides valuable information for the management, mitigation and prosecution of unintentional and sometimes malicious human impacts, such as vessel collision, fishing gear entanglement and gunshot. Delayed discovery, inaccessibility, logistics, human safety concerns, and weather make these events challenging. Over the past 3 decades, in response to public concern and federal and state or provincial regulations mandating such investigations to inform mitigation efforts, there has been an increasing effort to objectively and systematically investigate these strandings from a diagnostic and forensic perspective. This Theme Section provides basic investigative methods, and case definitions for each of the more commonly recognized case presentations of human interactions in pinnipeds and cetaceans. Wild animals are often adversely affected by factors such as parasitism, anthropogenic contaminants, biotoxins, subclinical microbial infections and competing habitat uses, such as prey depletion and elevated background and episodic noise. Understanding the potential contribution of these subclinical factors in predisposing or contributing to a particular case of trauma of human origin is hampered, especially where putrefaction is significant and resources as well as expertise are limited. These case criteria descriptions attempt to acknowledge those confounding factors to enable an appreciation of the significance of the observed human-derived trauma in that broader context where possible.Keywords: Seal; Dolphin; Whale; Marine mammal; Entrapment; Entanglement; Vessel strike; Gunshot.

Moors, A. J., R. S. Pugh, L. Schwacke and P. R. Becker (2013). An implementation system for barcoding in a marine environmental specimen bank. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 148-149.

Morgan, L. W., J. L. Jakush, A. Simpson, M. M. Norman, A. Pabst and S. Simmons (2009). "Evaluation of hematologic and biochemical values for convalescing seals from the coast of Maine." Journal of Zoo and Wildlife Medicine 40(3): 421-429.

Marine mammal researchers and veterinarians evaluate the health of individuals and populations by using observed ranges for blood values. The goal of this study was to establish observed ranges for dependent (0-4 week) and weanling (>4 week) harbor seal (Phoca vitulina) pups that were admitted for rehabilitation at the Marine Animal Lifeline in Portland, Maine from 1998-2003 and to record changes in hematologic and biochemical values as they convalesced. Blood values, measured both at admission to and release from rehabilitation, were quantitatively compared between these two groups. Of the 29 blood analytes measured in this study between dependent and weanling PUPS Up on admission to rehabilitation, 14 were significantly different including white blood cell (WBC), red blood cell (RBC), hemoglobin (Hb), hematocrit (HCT), platelets, lymphocytes, monocytes, potassium, chloride, CO2, total bilirubin, calcium, alanine transaminase (ALT), and alkaline phosphatase. Between admission and release, 14 analytes had significantly changed for dependent pups including RBC, Hb, HCT, mean cell volume (MCV), mean corpuscular hemoglobin (MCH), platelets, lymphocytes, monocytes, potassium, blood urea nitrogen (BUN), total protein, total bilirubin, alkaline phosphatase, and ALT. Between admission and release, 10 analytes had significantly changed for weanlings including RBC, MCV, neutrophils, eosinophils, potassium, chloride, anion gap, total protein, total bilirubin, and calcium. At the time of release, six parameters were significantly different between pups admitted as dependent and those admitted as weanlings including MCV, neutrophils, eosinophils, total protein, globulin, and albumin. Keywords: blood biochemical; harbor seal; Gulf of Maine; Phoca vitulina; rehabilitation

Morin, D., K. Koyama, J. Kenney and J. Smith (2010). 2008 large whale entanglement and ship strike report. Gathersburg, Maryland, U.S. Department of Commerce, National Institute of Standards and Technology: 114.

Mueller, M., J. G. Ortega-Ortiz and B. Zoodsma (2011). Vessel compliance with right whale protection measures in the southeast U.S. seasonal management area: Trends from 5 years of monitoring. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 213.

Mulsow, J., C. Reichmuth, F. Gulland, D. A. S. Rosen and J. J. Finneran (2011). "Aerial audiograms of several California sea lions (Zalophus californianus) and Steller sea lions (Eumetopias jubatus) measured using single and multiple simultaneous auditory steady-state response methods." Journal of Experimental Biology 214(7): 1138-1147.

Measurements of the electrophysiological auditory steady-state response (ASSR) have proven to be efficient for evaluating hearing sensitivity in odontocete cetaceans. In an effort to expand these methods to pinnipeds, ASSRs elicited by single and multiple simultaneous tones were used to measure aerial hearing thresholds in several California sea lions (Zalophus californianus) and Steller sea lions (Eumetopias jubatus). There were no significant differences between thresholds measured using the single and multiple ASSR methods, despite the more rapid nature of data collection using the multiple ASSR method. There was a high degree of variability in ASSR thresholds among subjects; thresholds covered a range of ~40?dB at each tested frequency. As expected, ASSR thresholds were elevated relative to previously reported psychophysical thresholds for California and Steller sea lions. The

features of high-frequency hearing limit and relative sensitivity of most ASSR audiograms were, however, similar to those of psychophysical audiograms, suggesting that ASSR methods can be used to improve understanding of hearing demographics in sea lions, especially with respect to high-frequency hearing. Thresholds for one Steller sea lion were substantially elevated relative to all other subjects, demonstrating that ASSR methods can be used to detect hearing loss in sea lions. Keywords: pinniped, sea lion, hearing, audiogram, evoked potential, auditory steady-state response.

Neely, B. A., J. L. Soper, D. J. Greig, K. P. Carlin, E. G. Favre, F. M. D. Gulland, J. S. Almeida and M. G. Janech (2012). "Serum profiling by MALDI-TOF mass spectrometry as a diagnostic tool for domoic acid toxicosis in California sea lions." Proteome Science 10: 18.

Background: There are currently no reliable markers of acute domoic acid toxicosis (DAT) for California sea lions. We investigated whether patterns of serum peptides could diagnose acute DAT. Serum peptides were analyzed by MALDI-TOF mass spectrometry from 107 sea lions (acute DAT n = 34; non-DAT n = 73). Artificial neural networks (ANN) were trained using MALDI-TOF data. Individual peaks and neural networks were qualified using an independent test set (n = 20). Results: No single peak was a good classifier of acute DAT, and ANN models were the best predictors of acute DAT. Performance measures for a single median ANN were: sensitivity, 100%; specificity, 60%; positive predictive value, 71%; negative predictive value, 100%. When 101 ANNs were combined and allowed to vote for the outcome, the performance measures were: sensitivity, 30%; specificity, 100%; positive predictive value, 100%; negative predictive value, 59%. Conclusions: These results suggest that MALDI-TOF peptide profiling and neural networks can perform either as a highly sensitive (100% negative predictive value) or a highly specific (100% positive predictive value) diagnostic tool for acute DAT. This also suggests that machine learning directed by populations of predictive models offer the ability to modulate the predictive effort into a specific type of error.Keywords: Serum peptides; Neural network; Zalophus californianus; Neurotoxin

Ng, T. F. F., E. Wheeler, D. Greig, T. B. Waltzek, F. Gulland and M. Breitbart (2011). "Metagenomic identification of a novel anellovirus in Pacific harbor seal (Phoca vitulina richardsii) lung samples and its detection in samples from multiple years." Journal of General Virology 92(6): 1318-1323.

To investigate viral pathogens potentially involved in a mortality event of 21 Pacific harbor seals (Phoca vitulina richardsii) in California in 2000, viral metagenomics was performed directly on lung samples from five individuals. Metagenomics revealed a novel seal anellovirus (SealAV), which clusters phylogenetically with anelloviruses from California sea lions and domestic cats. Using specific PCR, SealAV was identified in lung tissue from two of five animals involved in the 2000 mortality event, as well as one of 20 harbor seal samples examined post-mortem in 2008. The identification of SealAV in multiple years demonstrates that this virus is persistent in the harbor seal population. SealAV is the second anellovirus reported in the lungs of pinnipeds, suggesting that anellovirus infections may be common amongst marine mammals and that more research is needed to understand the roles of these viruses in marine mammal health and disease.

Nielsen, N. H., E. Garde, M. P. Heide-Jorgensen, C. H. Lockyer, D. Olafsdottir and S. H. Hansen (2013). "Application of a novel method for age estimation of a baleen whale and a porpoise." Marine Mammal Science 29(2): E1-E23.

Eyeballs from 121 fin whales (Balaenoptera physalus) and 83 harbor porpoises (Phocoena phocoena) were used for age estimation using the aspartic acid racemization (AAR) technique. The racemization rate (kAsp) for fin whales was established from 15 fetuses (age 0) and 15 adult whales where age was estimated by reading growth layer groups (GLGs) in the earplugs. The (kAsp) for harbor porpoises was derived from 15 porpoises (two calves and 13 > 1 yr old) age-estimated by counting GLGs

in the teeth and two calves classified to age based on length. The (kAsp) values were estimated by regression of GLGs against D/L ratios. For the fin whales an (kAsp) of 1.15 9 10–3/yr (SE ± 0.00005) and a D/L ratio at birth [(D/L)0] of 0.028 (SE ± 0.0012) were estimated, which is in agreement with rates for other mysticeti. For the harbor porpoises a (kAsp) of 3.10 9 10–3/yr (SE ± 0.0004) and a (D/L)0 value of 0.023 (SE ± 0.0018) were estimated, which is considerably higher than found for other cetaceans. Correlation between chosen age estimates from AAR and GLG counts indicated that AAR might be an alternative method for estimating age in marine mammals.Keywords: aspartic acid racemization, age estimation, growth layer groups, Balaenoptera physalus, fin whale, Phocoena phocoena, harbor porpoise.

Noke Durden, W., J. S. Leger, M. Stolen, T. Mazza and C. Londono (2009). "Lacaziosis in bottlenose dolphins (Tursiops truncatus) in the Indian River Lagoon, Florida, USA." Journal of Wildlife Diseases 45(3): 849-856.

The objective of this study was to document the presence of the fungal granulomatous skin disease lacaziosis in stranded Indian River Lagoon (IRL) bottlenose dolphins (Tursiops truncatus). From 1 January 2007 through 31 December 2007, stranded dolphins from the northern part of the IRL were thoroughly examined, and appropriate tissue samples were collected. The intralesional fungal agent (Lacazia loboi) was identified histologically in three bottlenose dolphins. Histologically, lacaziosis has been previously documented in IRL dolphins inhabiting the southern portion of the lagoon. Our findings suggest that the disease occurs throughout the lagoon. Enhanced monitoring of the prevalence of lacaziosis in dolphins throughout the IRL is needed to assess changes in population health. Key words: Bottlenose dolphin, Indian River Lagoon, lacaziosis, Lacazia loboi, Tursiops truncatus.

Nollens, H. H., J. F. X. Wellehan, L. Archer, L. J. Lowenstine and F. M. D. Gulland (2010). "Detection of a respiratory coronavirus from tissues archived during a pneumonia epizootic in free-ranging Pacific harbor seals Phoca vitulina richardsii." Diseases of Aquatic Organisms 90(2): 113-120.

In June 2000, 21 adult harbor seals Phoca vitulina richardsii were found dead along a localized section of the central California coast. Necropsy of 5 fresh carcasses revealed pulmonary congestion, consolidation, and hemorrhage. Histopathological changes in lungs from 2 of these seals included a necrotizing lymphocytic and histocytic lobar pneumonia with intra-lesional bacteria. A coronavirus (CoV) was detected in archived tissues from 1 of the 5 seals via a degenerate PCR for nidoviral RNA-dependent RNA polymerase (RdRp), and was subsequently confirmed via specific PCR. Based on the partial RdRp sequence, the CoV was identified as a novel, divergent member of the CoV group 1a. The virus is tentatively named harbor seal coronavirus (HSCoV). The clinical significance of HSCoV and its involvement in the etiology of the epizootic pneumonia and deaths of the harbor seals is uncertain. Keywords: Harbor seal, Phoca vitulina richardsii, Coronavirus, Pneumonia

Norman, S. A., J. Huggins, T. E. Carpenter, J. T. Case, D. M. Lambourn, J. Rice, J. Calambokidis, J. K. Gaydos, M. B. Hanson, D. A. Duffield, S. Dubpernell, S. Berta and M. Klope (2012). "The application of GIS and spatiotemporal analyses to investigations of unusual marine mammal strandings and mortality events." Marine Mammal Science 28(3): E251-E266.

In 2006-2007, an unusually high number of harbor porpoises (Phocoena phocoena) stranded along the Washington and Oregon coastlines. Spatiotemporal analyses were used to examine their ability to detect clusters of porpoise strandings during an unusual mortality event (UME) in the Pacific Northwest using stranding location data. Strandings were evaluated as two separate populations, outer coast and inland waters. The presence of global clustering was evaluated using the Knox spatiotemporal test, and the presence of local clusters was investigated using a spatiotemporal scan statistic (space – time permutation). There was evidence of global clustering, but no local clustering, supporting the

hypothesis that strandings were due to more varied etiologies instead of localized causes. Further analyses at subregional levels, and concurrently assessing environmental factors, might reveal additional geographic distribution patterns. This article describes the spatial analytical tools applied in this study and how they can help elucidate the spatiotemporal epidemiology of other UMEs and assist in determining their causes. More than one spatial analytical technique should be used if the study objective is to detect and describe clustering in time and space and to generate hypotheses regarding causation of marine mammal disease and stranding events.Keywords: epidemiology, harbor porpoise, GIS, Phocoena phocoena, spatiotemporal analyses, unusual mortality event.

Norris, T. A., C. L. Littnan and F. M. D. Gulland (2011). "Evaluation of the captive care and post-release behavior and survival of seven juvenile female Hawaiian monk seals (Monachus schauinslandi)." Aquatic Mammals 37(3): 342-353.

Extremely poor juvenile survival in the endan-gered Hawaiian monk seal (Monachus schauin-slandi) is primarily caused by prey limitation and continues to drive the population decrease in the Northwestern Hawaiian Islands (NWHI). In 2006-2007, a pilot project was conducted to deter-mine whether temporarily providing nutritional supplementation and protection from predation would enhance the survival of juvenile monk seals. Seven female seals, two of which were rare fraternal twins, were included in the captive care (CC) project. Six weanling seals gained weight commensurate with their duration in captivity, 89 to 297 d, with weight gains of 31 to 143% initial body weight, and were released at Midway Atoll. The seventh seal, a female yearling, died 23 d after being admitted from complications associated with malnutrition and stress. The CC and three control seals were instrumented with satellite-linked GPS dive recorders to monitor post-release behavior and survival as part of an assessment of the project's success. Satellite tags transmitted between 37 and 311 d. Initially, the CC seals for-aged closer to shore, used less of the atoll, and dove to shallower depths (< 20 m) and for shorter durations (< 4 min) relative to the controls (> 60 m and > 4 min). Over the course of several weeks, most of the CC and control seals were foraging in a similar fashion. These results demonstrate that following a brief acclimation period, captive-fed monk seals are capable of foraging normally post-release. However, none of the CC seals were alive as 2-y-olds, whereas two of the control seals were alive in 2010 as 4-y-olds. Although post-release survival was poor in the current study, with a more suitable release location, an expanded captive-feeding program could be a useful tool to salvage the reproductive potential of Hawaiian monk seals in the future.Keywords: captive care, post-release monitoring, juvenile survival, foraging behavior, Hawaiian monk seal, Monachus schauinslandi

Oremland, M. S., B. M. Allen, P. J. Clapham, M. J. Moore, C. Potter and J. G. Mead (2010). "Mandibular fractures in short-finned pilot whales, Globicephala macrorhynchus." Marine Mammal Science 26(1): 1-16.

This study's objective was to investigate mandibular fractures in 50 short-finned pilot whales, Globicephala macrorhynchus, from two mass strandings. Based on current theories that this species is sexually dimorphic and polygynous, hypotheses were: (1) males should suffer more frequent or more substantial mandibular fractures than should females, and (2) fracture occurrence should increase with male reproductive maturity and potential correlates of maturity, such as age and length. Fractures were described and correlated with physical characteristics to infer possible explanations for injuries. Mandibular fractures were surprisingly common in males and females, being found in more than half of the animals examined (27/50, or 54% overall; 17/36 or 47% of females and 10/14 or 71% of males). Length was the only correlate of fracture presence; the proportion of animals showing evidence of fracture increased with length. These results offer some support to initial hypotheses, but there must be another set of consequences that contribute to mandibular fractures in females. A combination of intra- and interspecific interactions and life history characteristics may be responsible for fractures. Further

research from a larger sample of this and other cetacean species are suggested to help elucidate both the causes and implications of mandibular fractures. Keywords: fracture • mandible • pilot whale • Globicephala macrorhynchus • stranding • trauma • competition • injury • cetaceans

Pacewicz, M. B., D. Goley, C. Brainerd, B. Carrothers, K. McClurg, T. Plencer and C. Zourdos (2013). Establishing a protocol for systematic surveys of stranded marine mammals in Humboldt County, California. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 165.

Pacini, A. F., P. E. Nachtigall, C. T. Quintos, T. D. Schofield, D. A. Look, G. A. Levine and J. P. Turner (2011). "Audiogram of a stranded Blainville's beaked whale (Mesoplodon densirostris) measured using auditory evoked potentials." Journal of Experimental Biology 214(14): 2409-2415.

Quantifying and understanding the impact of anthropogenic sound on marine mammals has been the focus of many researchers both in laboratory settings as well as in the field. This study presents the audiogram of a sub-adult Blainville's beaked whale that stranded in Hawaii. The hearing measurements were conducted using the non-invasive auditory brainstem response technique. A total of 11 sinusoidally amplitude modulated tones were tested ranging from 5.6 to 160?kHz. The audiogram data indicated that the region of best hearing was found between 40 and 50?kHz with thresholds below 50?dB. This frequency range partially overlaps with the frequency modulated upsweep that Blainville's beaked whales have been reported to use during echolocation. These results match the frequency range obtained from the hearing measurements of a Gervais' beaked whale previously tested using contact acoustic stimulation and emphasize the importance of obtaining rapid hearing measurements on live stranded animals to improve the understanding of poorly known species.KeyWords: Blainville's beaked whale, hearing, marine mammal, acoustics, auditory evoked potential.

Pacini, A. F., P. E. Nachtigall, C. T. Quintos, T. D. Schofield, D. A. Look, G. A. Levine and J. P. Turner (2011). Audiogram of a stranded Blainville's beaked whale (Mesoplodon densirostris) measured using auditory evoked potentials. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 228.

Palacios, G., J. F. X. Wellehan Jr., S. Raverty, A. V. Bussetti, J. Hui, N. Savji, H. H. Nollens, D. Lambourn, C. Celone, S. Hutchison, C. H. Calisher, O. Nielsen and W. I. Lipkin (2011). "Discovery of an orthoreovirus in the aborted fetus of a Steller sea lion (Eumetopias jubatus)." Journal of General Virology 92(11): 2558-2565.

An aborted mid-gestational male Steller sea lion fetus with an attached placenta was recovered on the floor of an open floating capture trap located off Norris Rock near Denman Island, British Columbia. Viral culture of the placenta demonstrated cytopathic effect. Although no specific signal was obtained in microarray experiments using RNA obtained from viral culture, elution and sequence analysis revealed the presence of a reovirus. Complete genome pyrosequencing led to the identification of an orthoreovirus that we have tentatively named Steller sea lion reovirus (SSRV). Phylogenetic analysis revealed similarities between SSRV and orthoreoviruses of birds, bats and other mammals that suggests potential for interspecies transmission.

Parks, S. E., J. D. Warren, K. Stamieszkin, C. A. Mayo and D. Wiley (2011). "Dangerous dining: Surface foraging of North Atlantic right whales increases risk of vessel collisions." Biology Letters 8(1): 57-60.

North Atlantic right whales are critically endangered and, despite international protection from whaling, significant numbers die from collisions with ships. Large groups of right whales migrate to the

coastal waters of New England during the late winter and early spring to feed in an area with large numbers of vessels. North Atlantic right whales have the largest per capita record of vessel strikes of any large whale population in the world. Right whale feeding behaviour in Cape Cod Bay (CCB) probably contributes to risk of collisions with ships. In this study, feeding right whales tagged with archival suction cup tags spent the majority of their time just below the water's surface where they cannot be seen but are shallow enough to be vulnerable to ship strike. Habitat surveys show that large patches of right whale prey are common in the upper 5 m of the water column in CCB during spring. These results indicate that the typical spring-time foraging ecology of right whales may contribute to their high level of mortality from vessel collisions. The results of this study suggest that remote acoustic detection of prey aggregations may be a useful supplement to the management and conservation of right whales.Keywords: foraging ecology; endangered species; vessel collision; right whale

Pate, S. M. and W. E. McFee (2012). "Prey species of bottlenose dolphins (Tursiops truncatus) from South Carolina waters." Southeastern Naturalist 11(1): 1-22.

We describe the diet composition of Tursiops truncatus (Bottlenose Dolphin) from South Carolina waters. Stomach contents of 136 dolphins stranded dead between 2000 and 2006 were examined. Eighty-two dolphin stomachs contained food items and formed the basis for this study. The emphasis of this study was to compare the stomach contents of dolphins that bore evidence of human interaction but were otherwise healthy with those that appeared to die of natural causes. Forty-two prey species representing 24 families were identified. Dolphins fed predominantly on smaller-sized benthic and demersal fish species. Diets were primarily comprised of members of the family Sciaenidae, with Stellifer lanceolatus (Star Drum) being the most abundant species quantitatively. Lolliguncula brevis (Brief Squid) was the most frequently observed prey item. Overall, dolphins that appeared to have died from natural causes consumed similar species of fish and squid to those that exhibited signs of human interaction. This study represents the first quantitative analysis of prey species comprising the diet of Bottlenose Dolphins found in South Carolina waters.

Piscitelli, M., M. Lillie, S. Raverty and R. Shadwick (2013). Comparative pulmonary mechanics of diving cetaceans. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 170.

Piscitelli, M. A., M. A. Lillie, S. A. Raverty and R. E. Shadwick (2013). "A comparative study of cetacean respiratory mechanics: Implications for diving and health assessment." Integrative and Comparative Biology 53(Supplement 1): E168.

Piscitelli, M. A., W. A. McLellan, S. A. Rommel, J. E. Blum, S. G. Barco and D. A. Pabst (2010). "Lung size and thoracic morphology in shallow- and deep-diving cetaceans." Journal of Morphology 271(6): 654-673.

Shallow-diving, coastal bottlenose dolphins (Tursiops truncatus) and deep-diving, pelagic pygmy and dwarf sperm whales (Kogia breviceps and K. sima) will experience vastly different ambient pressures at depth, which will influence the volume of air within their lungs and potentially the degree of thoracic collapse they experience. This study tested the hypotheses that lung size will be reduced and/or thoracic mobility will be enhanced in deeper divers. Lung mass (T truncatus, n = 106; kogiids, n = 18) and lung volume (T truncatus, n = 5; kogiids, n = 4), relative to total body mass, were compared. One T truncatus and one K sima were cross-sectioned to calculate lung, thoracic vasculature, and other organ volumes. Excised thoraxes (T truncatus, n = 3; kogiids, n = 4) were mechanically manipulated to compare changes in thoracic cavity shape and volume. Kogiid lungs were half the mass and one-fifth the volume of those

of similarly sized T truncatus. The lungs occupied only 15% of the total thoracic cavity volume in K. sima and 37% in T truncatus. The kogiid and dolphin thoraxes underwent similar changes in shap e and volume, although the width of the thoracic inlet was relatively constrained in kogiids. A broader phylogenetic comparison demonstrated that the ratio of lung mass to total body mass in kogiids, physeterids, and ziphiids was similar to that of terrestrial mammals, while delphinids and phocoenids possessed relatively large lungs. Thus, small lung size in deep-diving odontocetes may be a plesiomorphic character. The relatively large lung size of delphinids and phocoenids appears to be a derived condition that may permit the lung to function as a site of respiratory gas exchange throughout a dive in these rapid breathing, short-duration, shallow divers.Keywords: lung; thorax; mass; diving; cetaceans

Piscitelli, M. A., W. A. McLellan, S. A. Rommel and D. A. Pabst (2009). Comparing lung size in shallow (Tursiops truncatus) and deep (Kogia spp.) diving cetaceans. Annual Meeting of the Society for Integative and Comparative Biology. Boston, Massachusetts.

Piscitelli, M. A., S. A. Raverty, M. A. Lillie and R. E. Shadwick (2013). "A review of cetacean lung morphology and mechanics." Journal of Morphology 274(12): 1425-1440.

Cetaceans possess diverse adaptations in respiratory structure and mechanics that are highly specialized for an array of surfacing and diving behaviors. Some of these adaptations and air management strategies are still not completely understood despite ov

Piwetz, S., H. R. Whitehead, L. R. Godlove and D. F. Cowan (2011). "An underwater recording stethoscope based on an omnidirectional hydrophone for use in dolphin rehabilitation and diagnosis." Aquatic Mammals 37(2): 202-204.

Polanowski, A. M., J. Robbins, D. Chandler and S. N. Jarman (2014). "Epigenetic estimation of age in humpback whales." Molecular Ecology Resources.

Age is a fundamental aspect of animal ecology, but is difficult to determine in many species. Humpback whales exemplify this as they have a lifespan comparable to humans, mature sexually as early as 4 years and have no reliable visual age indicators after their first year. Current methods for estimating humpback age cannot be applied to all individuals and populations. Assays for human age have recently been developed based on age-induced changes in DNA methylation of specific genes. We used information on age-associated DNA methylation in human and mouse genes to identify homologous gene regions in humpbacks. Humpback skin samples were obtained from individuals with a known year of birth and employed to calibrate relationships between cytosine methylation and age. Seven of 37 cytosines assayed for methylation level in humpback skin had significant age-related profiles. The three most age-informative cytosine markers were selected for a humpback epigenetic age assay. The assay has an R2 of 0787 (P = 304e?16) and predicts age from skin samples with a standard deviation of 2991 years. The epigenetic method correctly determined which of parent–offspring pairs is the parent in more than 93% of cases. To demonstrate the potential of this technique, we constructed the first modern age profile of humpback whales off eastern Australia and compared the results to population structure 5 decades earlier. This is the first epigenetic age estimation method for a wild animal species and the approach we took for developing it can be applied to many other nonmodel organismsKeywords: age; cetacean; DNA methylation; epigenetics; population

Powell, J. W. and W. E. McFee (2011). Management of marine mammal stranding information and data. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 241-242.

Powell, J. W. B., R. T. Archibald, C. A. Cross, D. S. Rotstein, V. M. Soop and W. E. McFee (2009). "Multiple congenital cardiac abnormalities in an Atlantic bottlenose dolphin (Tursiops truncatus)." Journal of Wildlife Diseases 45(3): 839-842.

Necropsy of an Atlantic bottlenose dolphin (Tursiops truncatus) neonate that stranded dead on Folly Beach, Charleston County, South Carolina, USA, on 17 November 2007, revealed multiple congenital heart malformations. Cardiac anomalies included a hypertrophic right ventricle, ventricular septal defect (VSD), aortic dilation, atrial septal defect (ASD) between a functionally common atrium and a left atrial remnant, subvalvular pulmonic stenosis, and a hypoplastic pulmonary artery and mitral valve. Few incidences of abnormal cardiac development in cetaceans have been published. The case study serves to document a novel congenital heart malformation not previously reported, to our knowledge, in free-ranging bottlenose dolphins. Key words: Atlantic bottlenose dolphin, cardiac anomalies, congenital, heart, malformations, Tursiops truncatus.

Powell, J. W. B., J. J. Kaufman, W. E. McFee and D. A. Duffield (2013). Establishing a primary bone density dataset for the common bottlenose dolphin. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 172-173.

Powell, J. W. B., D. S. Rotstein and W. E. McFee (2012). "First records of the melon-headed whale (Peponocephala electra) and the Atlantic white-sided dolphin (Lagenorhynchus acutus) in South Carolina." Southeastern Naturalist 11(1): 23-34.

From January to May 2008, the first historical strandings of Peponocephala electra Gray (Melon-headed Whale) and Lagenorhynchus acutus Gray (Atlantic White-sided Dolphin) were recorded in South Carolina. A mass stranding of three Melon-headed Whales (2 males, 1 female) was recorded on 11 January 2008 along the Horry County coast in the cities of Myrtle Beach and North Myrtle Beach. Three additional Melon-headed Whales (1 male, 1 female, and 1 unknown sex) stranded as single individuals over the next two months at locations along the South Carolina coast. Lengths of the animals ranged from 161 to 250 cm, and the ages ranged from 1 to 24 years. On 4 May 2008, a single 263cm, 17-year-old, male Atlantic White-sided Dolphin stranded in Horry County. The most striking commonalities observed during the Melon-headed Whale and Atlantic White-sided Dolphin necropsies were severe pulmonary distress and reactive lymphadenopathy. The strandings reported herein are the first records of Melon-headed Whales and Atlantic White-sided Dolphins in South Carolina.

Prager, K. C., D. J. Greig, D. P. Alt, R. L. Galloway, R. L. Hornsby, L. J. Palmer, J. Soper, Q. Wu, R. L. Zuerner, F. M. D. Gulland and J. O. Lloyd-Smith (2013). "Asymptomatic and chronic carriage of Leptospira interrogans serovar Pomona in California sea lions (Zalophus californianus)." Veterinary Microbiology 164(1-2): 177-183.

Since 1970, periodic outbreaks of leptospirosis, caused by pathogenic spirochetes in the genus Leptospira, have caused morbidity and mortality of California sea lions (Zalophus californianus) along the Pacific coast of North America. Yearly seasonal epizootics of varying magnitude occur between the months of July and December, with major epizootics occurring every 3-5 years. Genetic and serological data suggest that L. interrogans serovar Pomona is the infecting serovar and is enzootic in the California sea lion population, although the mechanism of persistence is unknown. We report asymptomatic carriage of Leptospira in 39% (33/85) of wild, free-ranging sea lions sampled during the epizootic season, and asymptomatic seroconversion with chronic asymptomatic carriage in a rehabilitated sea lion. This is the first report of asymptomatic carriage in wild, free-ranging California sea lions and the first example of seroconversion and asymptomatic chronic carriage in a sea lion. Detection of asymptomatic chronic carriage of Leptospira in California sea lions, a species known to suffer significant disease and mortality from the same Leptospira strain, goes against widely-held notions regarding leptospirosis in accidental

versus maintenance host species. Further, chronic carriage could provide a mechanism for persistent circulation of Leptospira in the California sea lion population, particularly if these animals shed infectious leptospires for months to years.Keywords: Sea lion, Leptospira, disease ecology, persistence, asymptomatic/subclinical carrier, maintenance host

Pulster, E. L., K. L. Smalling, E. Zolman, L. Schwacke and K. A. Maruya (2009). "Persistent organochlorine pollutants and toxaphene congener profiles in bottlenose dolphins (Tursiops truncatus) frequenting the turtle/Brunswick River Estuary, Georgia, USA." Environmental Toxicology and Chemistry 28(7): 1390-1399.

Although the Turtle/Brunswick River Estuary (TBRE) in coastal Georgia (USA) is severely contaminated by persistent organochlorine pollutants (POPs), little information regarding POPs in higher-trophic-level biota in this system is available. In the present study, polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs; including DDTs, chlordanes, and mirex), and chlorinated monoterpenes (toxaphene) were measured using gas chromatography with electron-capture detection and gas chromatography with electron-capture negative ion mass spectrometry (GC-ECNI-MS) in blubber of free-ranging and stranded bottlenose dolphins (Tursiops truncatus). Mean total PCBs (78.6 +/- 32.4 mu g/g lipid) and toxaphene (11.7 +/- 9.3 mu g/g lipid) were significantly higher in dolphins sampled in the TBRE than in dolphins stranded near Savannah (GA, USA) 80 to 100 km to the north. Levels of OCPs were several-fold lower than levels of PCBs; moreover, PCBs comprised 81 and 67% of the total POP burden in TBRE and non-TBRE dolphins, respectively. Analyses with GC-ECNI-MS revealed that 2,2,5-endo, 6-exo, 8,8,9,10-octachlorobornane (P-42a), a major component in technical toxaphene and a major residue congener in local estuarine fish species, was the most abundant chlorobornane in both sets of blubber samples. Mean total POP concentrations (sum of PCBs, OCPs, and toxaphene) approached 100 mu g/g lipid for the TBRE animals, well above published total PCB thresholds at which immunosuppresion and/or reproductive anomalies are thought to occur. These results indicate extended utilization of the highly contaminated TBRE as habitat for a group of coastal estuarine dolphins, and they further suggest that these animals may be at risk because of elevated POP concentrations.Keywords: Tursiops truncatus; Toxaphene; Persistent organochlorine pollutants; Polychlorinated biphenyls; Bottlenose dolphins

Quakenbush, L., K. Beckmen and C. D. N. Brower (2009). "Rehabilitation and release of marine mammals in the United States: Concerns from Alaska." Marine Mammal Science 25(4): 994-999.

Reeves, R., C. Rosa, J. C. George, G. Sheffield and M. Moore (2012). "Implications of Arctic industrial growth and strategies to mitigate future vessel and fishing gear impacts on bowhead whales." Marine Policy 36(2): 454-462.

The objective of this paper was to investigate and illustrate how insights gained from experience managing human activities in order to protect North Atlantic right whales (Eubalaena glacialis) along the heavily industrialized east coast of North America might be applied in the Arctic, where bowhead whales (Balaena mysticetus) face some of the same risks as right whales. The reduced extent and thickness of sea ice and the resultant longer open-water season have major, complex implications for the Arctic marine ecosystem. Increased maritime ship traffic and commercial fishing in the Arctic are bound to affect bowheads and Native (indigenous) hunting communities who depend on whales for subsistence and cultural identity. Bowheads and right whales were greatly depleted by commercial whaling in the 19th and early 20th centuries. While the Western Arctic bowhead population has been recovering steadily in recent decades, North Atlantic right whales remain highly endangered because of persistent lethal and sublethal vessel strikes and frequent entanglement in commercial fishing gear. Entanglement can be transitory or persistent, with debilitation lasting for months before the animal finally succumbs.

Vessel strike and fishing gear trauma has been documented in bowheads, but at a much lower rate than in right whales. Initiatives intended to mitigate the impacts of ship traffic on North Atlantic right whales have included speed limits and routing changes. Those meant to reduce the incidence and severity of entanglements include the modification of gear design and gear deployment practices. Management measures need to be considered in advance in the Arctic in order to minimize the risks to bowhead whales as shipping and industrial fishing expand in the Arctic with ice retreat.Keywords: Bowhead whale; Right whale; Ice retreat; Arctic; Vessel strike; Fishing gear entanglement

Rice, J. M., D. A. Duffield and D. D'Alessandro (2011). Dramatic increase in California sea lion strandings along the Oregon coast in 2009 and 2010. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 251.

Robbins, J., S. Landry and D. K. Mattila (2009). Estimating entanglement mortality from scar-based studies Madeira, Portugal, International Whaling Commission Scientific Committee.

Entanglement is one of the largest documented sources of injury and mortality for large whales, including the humpback whale (Megaptera novaeangliae). Impacts are typically assessed from eye-witnessed events, but these represent minimum counts of interactions and deaths. For example, despite well-established reporting and response networks in the Gulf of Maine (GOM), fewer than 10% of humpback whale entanglement events are witnessed and only a fraction of all deaths are detected. More realistic estimates of entanglement frequency and mortality are therefore necessary to accurately assess population level impacts. Since 1997, studies of caudal peduncle scarring have provided an alternate measure of entanglement frequency among GOM humpback whales. Although based on survivors, scar-based entanglement rates can potentially be used to extrapolate total entanglement mortality in combination with other data. We estimated entanglement mortality as ((Nt*E)/S)-(Nt*E), where Nt = population size, E = the non-lethal entanglement rate (from scar-based inference) and S = entanglement survival rate. The latter was the most difficult to quantify, but our best estimate with available data was 76.6%. Assuming a minimum population size of 783 GOM humpback whales in 2003 and an average annual scar-based entanglement rate of 12.1%, approximately 95 individuals survived entanglement annually. By extension, there were 124 total entanglements in this population per year, with approximately 29 likely lethal. Although these estimates were much higher than expected, a 3.7% entanglement mortality rate is not inconsistent with independent survival estimates. This is the first study to estimate unobserved entanglement deaths and an important extension of scar-based research. Estimates exceeded observed cases by an order of magnitude, suggesting that entanglement is having a much greater effect on the population than previously supposed. Under-estimates of this magnitude likely also affect humpback whales in other oceans, as well as other large whale species that interact with fixed fishing gear.Keywords: Incidental catches; mortality rate

Robles-Sikisaka, R., R. Rivera, H. H. Nollens, J. S. Leger, W. N. Durden, M. Stolen, J. Burchell and J. F. X. Wellehan (2012). "Evidence of recombination and positive selection in cetacean papillomaviruses." Virology 427(2): 189-197.

Papillomaviruses (PVs) are small DNA viruses that have been associated with increased epithelial proliferation. Over one hundred PV types have been identified in humans; however, only three have been identified in bottlenose dolphins (Tursiops truncatus) to date. Using rolling circle amplification and degenerate PCR, we identified four novel PV genomes of bottlenose dolphins. TtPV4, TtPV5 and TtPV6 were identified in genital lesions while TtPV7 was identified in normal genital mucosa. Bayesian analysis of the full-length L1 genes found that TtPV4 and TtPV7 group within the Upsilonpapillomavirus genus while TtPV5 and TtPV6 group with Omikronpapillomavirus. However, analysis of the E1 gene did not distinguish these genera, implying that these genes may not share a common history, consistent with recombination. Recombination analyses identified several probable events. Signals of positive selection

were found mostly in the E1 and E2 genes. Recombination and diversifying selection pressures constitute important driving forces of cetacean PV evolution.Keywords: Bottlenose dolphin; Cetacean; Papillomavirus; Genital papilloma; Virus evolution; Genetic diversity

Roess, A. A., R. S. Levine, L. Barth, B. P. Monroe, D. S. Carroll, I. K. Damon and M. G. Reynolds (2011). "Sealpox virus in marine mammal rehabilitation facilities, North America, 2007-2009." Emerging Infectious Diseases 17(12): 2203-2208.

Sealpox, a zoonotic disease affecting pinnipeds (seals and sea lions), can occur among captive and convalescing animals, We surveyed 1 worker each from 11 marine mammal centers and interviewed 31 other marine mammal workers to ascertain their knowledge of and experience with sealpox virus and to identify factors associated with sealpox virus outbreaks among pinnipeds in marine rehabilitation facilities. Demographic and health data were obtained for 1,423 pinnipeds at the 11 facilities. Among the 23 animals in which sealpox was clinically diagnosed, 4 arrived at the facility ill, 11 became ill <5 weeks after arrival, and 2 became ill >= 5 weeks after arrival; the timing of illness onset was unknown for 6 animals. Most infections occurred in pinnipeds <1 year of age. Nine affected animals were malnourished; 4 had additional illnesses. Sealpox had also occurred among workers at 2 facilities. Sealpox is a noteworthy zoonosis of rehabilitating convalescing pinnipeds; workplace education can help to minimize risks for human infection.

Rosa, C. (2009). A summary of dead, stranded bowhead whales reported in the Chukchi and Beaufort Seas over the last twenty-five years. Madeira, Portugal, International Whaling Commission Scientific Committee: 3.

Five dead, stranded bowhead whales were reported in the Chukchi and Beaufort Seas during the open water season of 2008. Prior to this, there had been a total of five bowhead whales reported stranded dead in this area over the past 25 years. This report summarizes these earlier reports, presents a 2008 case report and discusses the marine mammal stranding response plan developed by the North Slope Borough Department of Wildlife Management to deal with increasing detection and response ability to incidents such as these.Keywords: ARCTIC; BALAENA MYSTICETUS; BOWHEAD WHALE; CLIMATE CHANGE; OFFSHORE DEVELOPMENT; STRANDING RESPONSE; WHALING-ABORIGINAL

Rose, J. M., R. J. Gast, A. Bogomolni, J. C. Ellis, B. J. Lentell, K. Touhey and M. Moore (2009) . "Occurrence and patterns of antibiotic resistance in vertebrates off the Northeastern United States coast." FEMS Microbiology Ecology 67(3): 421-431.

The prevalence of antibiotic-resistant bacteria in the marine environment is a growing concern, but the degree to which marine mammals, seabirds and fish harbor these organisms is not well documented. This project sought to identify the occurrence and patterns of antibiotic resistance in bacteria isolated from vertebrates of coastal waters in the northeastern United States. Four hundred and seventy-two isolates of clinical interest were tested for resistance to a suite of 16 antibiotics. Fifty-eight percent were resistant to at least one antibiotic, while 43% were resistant to multiple antibiotics. A multiple antibiotic resistance index value 22650.2 was observed in 38% of the resistant pathogens, suggesting exposure of the animals to bacteria from significantly contaminated sites. Groups of antibiotics were identified for which bacterial resistance commonly co-occurred. Antibiotic resistance was more widespread in bacteria isolated from seabirds than marine mammals, and was more widespread in stranded or bycaught marine mammals than live marine mammals. Structuring of resistance patterns based on sample type (live/stranded/bycaught) but not animal group (mammal/bird/fish) was observed. These data indicate that antibiotic resistance is widespread in marine vertebrates, and they may be important reservoirs of antibiotic-resistant bacteria in the marine environment.

Rotstein, D. S., L. G. Burdett, W. McLellan, L. Schwacke, T. Rowles, K. A. Terio, S. Schultz and A. Pabst (2009). "Lobomycosis in offshore bottlenose dolphins (Tursiops truncatus), North Carolina." Emerging Infectious Diseases 15(4): 588-590.

Lacazia loboi, a cutaneous fungus, is found in humans and dolphins from transitional tropical (Florida) and tropical (South America) regions. We report 2 cases of lobomycosis in stranded bottlenose dolphins (Tursiops truncatus), and 1 case of lobomycosis-like disease in 1 free-swimming, pelagic, offshore bottlenose dolphin from North Carolina, where no cases have previously been observed.

Rotstein, D. S., K. West, G. Levine, S. R. Lockhart, S. Raverty, M. G. Morshed and T. Rowles (2010). "Cryptococcus gattii VGI in a spinner dolphin (Stenella longirostris) from Hawaii." Journal of Zoo and Wildlife Medicine 41(1): 181-183.

A spinner dolphin (Stenella longirostris) was found stranded in Hawaii with cutaneous nodules and enlarged lymph nodes. Numerous Cryptococcus gattii VGI yeast were observed in multiple organs with minimal inflammation. This case represents the first reported infection of C. gattii in a dolphin from Hawaii.Keywords: cryptococcosis; Cryptococcus; gattii; VGI; granulomatous; Hawaii; Stenella longiro stris

Rowles, T., S. Wilkin, E. Fougeres, E. Strutton, B. Mase-Guthrie and M. Ziccardi (2011). Response activities for marine mammals during the Deepwater Horizon oil spill 2010-2011. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 259.

Rowles, T. K., L. S. Schwacke, R. S. Wells, J. T. Saliki, L. Hansen, A. Hohn, F. Townsend, R. A. Sayre and A. J. Hall (2011). "Evidence of susceptibility to morbillivirus infection in cetaceans from the United States." Marine Mammal Science 27(1): 1-19.

Cetacean morbilliviruses (CeMV) are viruses that can cause mass mortalities among various odontocete species. In this study levels of herd immunity in cetaceans from the U.S. coast are described from the distribution and prevalence of antibodies against morbilliviruses. Neutralizing antibody titers against dolphin morbillivirus (DMV), porpoise morbillivirus (PMV), phocine distemper (PDV), and canine distemper viruses (CDV) were measured. Positive samples had higher titers against the CeMV th an against the other morbilliviruses tested, indicating that although PDV or CDV can be used to investigate exposure their use may result in a higher false negative rate. The results suggest that morbillivirus did not persist in coastal populations of bottlenose dolphins (Tursiops truncatus) after the major outbreaks that occurred in the 1980s and 1990s. Bottlenose dolphins from Beaufort, North Carolina; St. Joseph Bay, Florida; and Cape May, New Jersey had anti-DMV seroprevalences ranging from between 15% and 33% but those from Charleston, South Carolina and Sarasota Bay, Florida, sampled in recent years were largely negative. These latter groups are therefore now vulnerable to infection and could experience high mortality if exposed to CeMV. Sero-surveys of this kind are therefore vital for assessing the risk of new and recurring viral outbreaks in coastal cetaceans.Keywords: infectious disease, bottlenose dolphin, Tursiops truncatus, serology, Atlantic Ocean.

Ryan, C., B. McHugh, B. Boyle, E. McGovern, M. Berube, P. Lopez-Suarez, C. T. Elfes, D. T. Boyd, G. M. Ylitalo, G. R. V. Blaricom, P. J. Clapham, J. Robbins, P. J. Palsboll, I. O'Connor and S. Berrow (2014). "Levels of persistent organic pollutants in eastern North Atlantic humpback whales." Endangered Species Research 22(3): 213-223.

Blubber lipid concentrations of 14 organochlorine compounds and 10 polychlorinated biphenyls (PCB) were measured by gas chromatography with electron-capture detection in eastern North Atlantic humpback whales Megaptera novaeangliae from Cape Verde (n = 20

Saez, L., D. Lawson, M. DeAngelis, S. Wilkin, E. Petras and C. Fahy (2011). Co-occurrence of large whales and fixed commercial fishing gear: California, Oregon, and Washington. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 261.

Sampson, K., C. Merigo, K. Lagueux, J. Rice, R. Cooper, E. S. Weber III, P. Kass, J. Mandelman and C. Innis (2012). "Clinical assessment and postrelease monitoring of 11 mass stranded dolphins on Cape Cod, Massachusetts." Marine Mammal Science 28(4): E404-E425.

The health, postrelease movements, and behavior of mass stranded Atlantic white-sided dolphins (Lagenorhynchus acutus) and short-beaked common dolphins(Delphinus delphis) from Cape Cod, Massachusetts, were evaluated. Health was assessed through physical examination and blood analysis. Eleven dolphins (eightwhite-sided dolphins and three common dolphins) were relocated, outfitted with satellite transmitters, and released during seven mass stranding events. Fivetransmitters recorded only location, and six also included a time-depth recorder. Transmission duration ranged from 8 h to 218 d, with a mean of 117 d (median = 118 d, SD = 82 d), after release. All dolphins demonstrated extensive movement throughout the Gulf of Maine. The distribution of tagged dolphins was considered normal based on comparisons with published data for these species. Excluding the dolphin that transmitted for only 8 h, mean minimum speeds for individual dolphins ranged from 3.4 to 6.6 km/h; overall mean for all dolphins was 5.4 km/h (SD = 0.9 km/h). The five dolphins with time-depth recorders had mean dive depths of 8.6–40.3 m and mean dive durations of 46–296 s. Hematologic and biochemical data revealed only minor abnormalities. Data suggest that at least 10 of the 11 dolphins were likely successfully reintroduced into the wild.Keywords: dolphin, Delphinus, Lagenorhynchus, cetacean, mass stranding, satellite tag, health, hematology, biochemistry.

Schofield, T. D., G. Levine, F. M. D. Gulland, C. L. Littnan and C. M. H. Colitz (2011). "The first successful hand-rearing of a neonate Hawaiian monk seal (Monachus schauinslandi) and post-release management challenges." Aquatic Mammals 37(3): 354-359.

Schultz, J. K. (2011). "Population genetics of the monk seals (genus Monachus): A review." Aquatic Mammals 37(3): 227-235.

Monk seals (genus Monachus) are among the most endangered mammals in the world, with all species sharing a similar history of anthropo-genic overexploitation. Reductions in population abundance have been accompanied by the loss of genetic diversity in Mediterranean (M. monachus) and Hawaiian (M. schauinslandi) monk seals. Both species are characterized by extremely low variability at all genetic markers tested to date, including microsatellite loci, the mitochondrial control region, and major histocompatibility com-plex class I genes. Genetic variation is partitioned differently in the two species. The Hawaiian monk seal does not exhibit spatial population structure throughout its range in the Hawaiian Archipelago (FST = 0.00); therefore, it is unlikely that the trans-location of monk seals will result in genetic incom-patibilities. In contrast, Eastern Mediterranean and Western Saharan M. monachus populations are reproductively isolated (FST = 0.56), though the distribution of alleles likely signifies a once con-tiguous range sundered by the extirpation of geo-graphically intermediate subpopulations. Given the magnitude of genetic differentiation, moving Mediterranean monk seals between eastern and western populations could result in reduced over-all fitness; additional data is required to assess the risk of moving monk seals within a population (e.g., the Eastern Mediterranean). Recent advances in genomics will facilitate future investigation into the reproductive success of both species and guide managers in their quest to recover Mediterranean and Hawaiian monk seal populations.Keywords: monk seal, conservation, DNA, genetic diversity, pinniped, stock structure

Schwacke, L. (2011). The bottlenose dolphin (Tursiops truncatus) as a model to understand variation in stress and reproductive hormone measures in relation to sampling matrix, demographics, and environmental factors, Office of Naval Research: 4.

Schwacke, L., L. Garrison, S. Lane, R. Melancon, K. Mullin, P. Rosel, C. Sinclair, T. Rowles, T. Speakman and E. Zolman (2011). Assessment of bay, sound and estuarine bottlenose dolphin stocks in the Northern Gulf of Mexico following the Deepwater Horizon oil spill. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 266-267.

Schwacke, L. H., A. J. Hall, F. I. Townsend, R. S. Wells, L. J. Hansen, A. A. Hohn, G. D. Bossart, P. A. Fair and T. K. Rowles (2009). "Hematologic and serum biochemical reference intervals for free-ranging common bottlenose dolphins (Tursiops truncatus) and variation in the distributions of clinicopathologic values related to geographic sampling site." American Journal of Veterinary Research 70(8): 973-985.

Schwacke, L. H., C. R. Smith, F. I. Townsend, R. S. Wells, L. B. Hart, B. C. Balmer, T. K. Collier, S. De Guise, M. M. Fry, L. J. Guillette, S. V. Lamb, S. M. Lane, W. E. McFee, N. J. Place, M. C. Tumlin, G. M. Ylitalo, E. S. Zolman and T. K. Rowles (2013). "Health of common bottlenose dolphins (Tursiops truncatus) in Barataria Bay, Louisiana, following the Deepwater Horizon oil spill." Environmental Science and Technology.

The oil spill resulting from the explosion of the Deepwater Horizon drilling platform initiated immediate concern for marine wildlife, including common bottlenose dolphins in sensitive coastal habitats. To evaluate potential sublethal effects on dolphins, health assessments were conducted in Barataria Bay, Louisiana, an area that received heavy and prolonged oiling, and in a reference site, Sarasota Bay, Florida, where oil was not observed. Dolphins were temporarily captured, received a veterinary examination, and were then released. Dolphins sampled in Barataria Bay showed evidence of hypoadrenocorticism, consistent with adrenal toxicity as previously reported for laboratory mammals exposed to oil. Barataria Bay dolphins were 5 times more likely to have moderate–severe lung disease, generally characterized by significant alveolar interstitial syndrome, lung masses, and pulmonary consolidation. Of 29 dolphins evaluated from Barataria Bay, 48% were given a guarded or worse prognosis, and 17% were considered poor or grave, indicating that they were not expected to survive. Disease conditions in Barataria Bay dolphins were significantly greater in prevalence and severity than those in Sarasota Bay dolphins, as well as those previously reported in other wild dolphin populations. Many disease conditions observed in Barataria Bay dolphins are uncommon but consistent with petroleum hydrocarbon exposure and toxicity.

Schwacke, L. H., C. R. Smith, F. I. Townsend, R. S. Wells, L. B. Hart, B. C. Balmer, T. K. Collier, S. D. Guise, M. M. Fry, L. J. Guillette Jr., S. V. Lamb, S. M. Lane, W. E. McFee and N. J. Place (2014). "Health of common bottlenose dolphins (Tursiops truncatus) in Barataria Bay, Louisiana, following the Deepwater Horizon oil spill." Environmental Science and Technology 48(1): 93-103.

Schwacke, L. H., C. R. Smith, F. I. Townsend, R. S. Wells, L. B. Hart, B. C. Balmer, T. K. Collier, S. D. Guise, M. M. Fry, L. J. Guillette Jr., S. V. Lamb, S. M. Lane, W. E. McFee and N. J. Place (2014). "Response to

comment on Health of common bottlenose dolphins (Tursiops truncatus) in Barataria Bay, Louisiana following the Deepwater Horizon oil spill." Environmental Science and Technology 48(7): 4209-4211.

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Schwacke, L. H., M. J. Twiner, S. d. Guise, B. C. Balmer, R. S. Wells, F. I. Townsend, D. C. Rotstein, R. A. Varela, L. J. Hansen, E. S. Zolman and T. R. Spradlin (2010). "Eosinophilia and biotoxin exposure in bottlenose dolphins (Tursiops truncatus) from a coastal area impacted by repeated mortality events." Environmental Research 110(6): 548-555.

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Schwacke, L. H., E. S. Zolman, B. C. Balmer, S. d. Guise, R. C. George, J. Hoguet, A. A. Hohn, J. R. Kucklick, S. Lamb, M. Levin, J. A. Litz, W. E. McFee, N. J. Place, F. I. Townsend, R. S. Wells and T. K. Rowles (2012). "Anaemia, hypothyroidism and immune suppression associated with polychlorinated biphenyl exposure in bottlenose dolphins (Tursiops truncatus)." Proceedings of the Royal Society of London Series B Biological Sciences 279(1726): 48-57.

Full authors list: SCHWACKE, LORI H.; ERIC S. ZOLMAN; BRIAN C. BALMER; SYLVAIN DE GUISE; R. CLAY GEORGE; JENNIFER HOGUET; ALETA A. HOHN; JOHN R. KUCKLICK; STEVE LAMB; MILTON LEVIN; JENNY A. LITZ; WAYNE E. MCFEE; NED J. PLACE; FORREST I. TOWNSEND; RANDALL S. WELLS and TERESA K. ROWLESPolychlorinated biphenyls (PCBs), persistent chemicals widely used for industrial purposes, have been banned in most parts of the world for decades. Owing to their bioaccumulative nature, PCBs are still found in high concentrations in marine mammals, particularly those that occupy upper trophic positions. While PCB-related health effects have been well-documented in some mammals, studies among dolphins and whales are limited. We conducted health evaluations of bottlenose dolphins (Tursiops truncatus) near a site on the Georgia, United States coast heavily contaminated by Aroclor 1268, an uncommon PCB mixture primarily comprised of octa- through deca-chlorobiphenyl congeners. A high proportion (26%) of sampled dolphins suffered anaemia, a finding previously reported from primate laboratory studies using high doses of a more common PCB mixture, Aroclor 1254. In addition, the dolphins showed reduced thyroid hormone levels and total thyroxine, free thyroxine and triiodothyronine negatively correlated with PCB concentration measured in blubber ($p = 0.039$, < 0.001, 0.009, respectively). Similarly, T-lymphocyte proliferation and indices of innate immunity decreased with blubber PCB concentration, suggesting an increased susceptibility to infectious disease. Other persistent contaminants such as DDT which could potentially confound results were similar in the Georgia dolphins when compared with previously sampled reference sites, and therefore probably did not contribute to the observed correlations. Our results clearly demonstrate that dolphins are vulnerable to PCB-related toxic effects, at least partially mediated through the endocrine system. The severity of the effects suggests that the PCB mixture to which the Georgia dolphins were exposed has substantial toxic potential and further studies are warranted to elucidate mechanisms and potential impacts on other top-level predators, including humans, who regularly consume fish from the same marine waters.Keywords: endocrine disruptors; polychlorinated biphenyls; immune suppression; thyroid; marine mammals

Sharp, S. M., C. T. Harry, J. M. Hoppe, S. Landry, M. J. Moore, M. E. Niemeyer, I. Robinson, W. B. Sharp and K. M. T. Moore (2011). Solitary release of healthy social odontocetes. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 270.

Sharp, S. P. and T. H. Clutton-Brock (2010). "Reproductive senescence in a cooperatively breeding mammal." Journal of Animal Ecology 79(1): 176-183.

P>1. Senescence (or 'ageing') is a widespread and important process in wild animal populations, but variation in ageing patterns within and between species is poorly understood. 2. In cooperatively breeding species, the costs of reproduction are shared between breeders and one or more helpers. The effects of ageing in breeders may therefore be moderated by the presence of helpers, but there have been very few studies of senescence patterns in natural populations of cooperative breeders. 3. Here, we use 13 years of data from a long-term study population of wild meerkats (Suricata suricatta) to investigate age-related changes in several traits known to be key components of reproductive success in females of this species. 4. Four of the six traits studied exhibited significant declines with age, indicating senescence. Litter size, the number of litters produced per year and the number of pups that survived to emergence from the natal burrow per year all increased with female age up to a peak at c. 4 years, and declined steeply thereafter; the mean pup weight at emergence in a given litter declined steadily from age zero. 5. These results provide the first evidence of reproductive senescence in a wild population of a cooperatively breeding vertebrate. Breeding success declined with age despite the sharing of reproductive costs in this species, but further study is needed to investigate whether helping affects other aspects of senescence, including survival.

Sharp, W. B., S. Landry and L. A. Sette (2011). The projectile broadhead cutter: A novel tool to diversify and enhance whale disentanglement efforts. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 270.

Shippee, S. F., R. S. Wells, J. F. Luebke and T. K. Kirby (2011). Evaluation of harmful interactions between bottlenose dolphins and sport fishing in northwest Florida and Alabama. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 271-272.

Smith, J., J. Van der Hoop, T. Pitchford, C. George, D. Morin, J. Kenney and M. Moore (2011). Additional drag forces and associated energetic requirements of an entangled right whale. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 277.

Smith, J. M. and T. Rowles (2010). Development of a decision tree for large whale entanglements. Agadir, Morocco, International Whaling Commission Scientific Committee: 4.

Entanglement in fishing gear and marine debris is a significant global concern for large whales. Oftentimes, there is a sense of urgency to respond to the report of an entanglement based on the perceived need to do something rather than responding based on criteria of the entanglement. Multiple nationality entanglement response programs were consulted in order to determine suitable criteria, i.e. human safety, resources available, risk assessment, distance from shore, entanglement configuration and level of constriction, etc. that were considered prior to launching a response. If human intervention was deemed appropriate, what types of responses were available, i.e. Monitor, Satellite Tag Deployment, Disentanglement, or Euthanize, based on critical decision points. Determination of suitable response options is critical in order to identify, understand and mitigate risks associated with launching a directed response.Keywords: Large whales; entanglement respones; disentanglement; euthanasia; decision criteria tree

Southall, B. L., T. Rowles, F. Gulland, R. W. Baird and P. D. Jepson (2013). Final report of the independent scientific review panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (Peponocephala electra) in Antsohihy, Madagascar.

St. Leger, J., K. Danil, S. Dennison, M. Scadeng, Y. Bernaldo de Quirós Miranda, A. Fernandez, T. Cranford, S. Wilkin and T. Rowles (2011). Pathology of barotrauma in long-beaked common dolphins (Delphinus capensis). Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 281.

Staudinger, M. D., R. J. McAlarney, W. A. McLellan and D. A. Pabst (2013). "The feeding ecology of the pygmy (K. breviceps) and dwarf (K. sima) sperm whale inferred from diet and stable isotope analyses." Integrative and Comparative Biology 53(Supplement 1): E375.

Staudinger, M. D., R. J. McAlarney, W. A. McLellan and D. A. Pabst (2014). "Foraging ecology and niche overlap in pygmy (Kogia breviceps) and dwarf (Kogia sima) sperm whales from waters of the U.S. mid-Atlantic coast." Marine Mammal Science 30(2): 626-655.

A complementary approach of stomach content and stable isotope analyses was used to characterize the foraging ecology and evaluate niche overlap between pygmy (Kogia breviceps) and dwarf (K. sima) sperm whales stranded on the US. mid-Atlantic coast between 1998 and 2011. Food habits analysis demonstrated both species were primarily teuthophagous, with 35 species of cephalopods, and 2 species of mesopelagic fishes represented in their overall diets. Pianka's Index of niche overlap suggested high overlap between whale diets (On = 092), with squids from the families Histioteuthidae, Cranchidae, and Ommastrephidae serving as primary prey. Pygmy sperm whales consumed slightly larger prey sizes (mean mantle length [ML] = 108 cm) than dwarf sperm whales (mean ML = 78 cm). Mean prey sizes consumed by pygmy sperm whales increased with growth, but showed no trend in dwarf sperm whales. Significant differences were not detected in ?15N and ?13C values of muscle tissues from pygmy (108‰ ± 05‰, ?171‰ ± 06‰), and dwarf sperm whales (107‰ ± 05‰, ?170‰ ± 04‰), respectively. Isotopic niche widths also did not differ significantly and dietary overlap was high between the two species. Results suggest the feeding ecologies of the pygmy and dwarf sperm whales are similar and both species occupy equivalent trophic niches in the regionKeywords: pygmy sperm whale; Kogia breviceps; dwarf sperm whale; Kogia sima; food habits; stable isotope analysis; Cephalopoda; Atlantic Ocean; predator-prey body size; niche overlap; foraging ecology

Stavros, H.-C. W., M. Stolen, W. N. Durden, W. McFee, G. D. Bossart and P. A. Fair (2011). "Correlation and toxicological inference of trace elements in tissues from stranded and free-ranging bottlenose dolphins (Tursiops truncatus)." Chemosphere 82(11): 1649-1661.

The significance of metal concentrations in marine mammals is not well understood and relating concentrations between stranded and free-ranging populations has been difficult. In order to predict liver concentrations in free-ranging dolphins, we examined concentrations of trace elements (Al, As, Ba, Be, Cd, Co, Cu, Fe, Li, Mn, Ni, Pb, Sb, Se, Sn, total Hg (THg), V, Zn) in skin and liver of stranded bottlenose dolphins (Tursiops truncatus) from the South Carolina (SC) coast and the Indian River Lagoon, Florida (FL) during 2000-2008. Significantly higher concentrations of Zn, Fe, Se, Al, Cu and THg were found in skin while liver exhibited significantly higher Cu, Fe, Mn and THg concentrations for both study sites. Mean skin concentrations of Cu and Mn were significantly higher in SC dolphins while higher concentrations of THg and V were found in FL dolphins. In addition, liver tissues in SC dolphins exhibited significantly higher As concentrations while higher Fe, Pb, Se, THg, and V levels were found in FL dolphins. Two elements (Cu and THg) showed significant age-related correlations with skin concentration while five elements (Cu. Se, THg, Zn and V) showed age-related correlations with liver

concentrations. Geographic location influenced age-related accumulation of several trace elements and age-related accumulation of THg in hepatic tissue was observed for both sites to have the highest correlations (r(2)=0.90SC; r(2)=0.69FL). Mean THg concentration in liver was about 10 times higher in FL dolphins (330 mu g g(-1) dw) than those samples from SC dolphins (34.3 mu g g(-1) dw). The mean molar ratio of Hg to Se was 0.93 +/- 0.32 and 1.08 +/- 0.38 for SC and FL dolphins, respectively. However, the Hg:Se ratio varied with age as much lower ratios (0.2-0.4) were found in younger animals. Of the 18 measured elements, only THg was significantly correlated in skin and liver of stranded dolphins and skin of free-ranging dolphins from both sites suggesting that skin may be useful in predicting Hg concentrations in liver tissue of free-ranging dolphins. Results indicate that 33% of the stranded and 15% of the free-ranging dolphins from FL exceed the minimum 100 mu g g(-1) wet weight (ww) (similar to 400 dw) Hg threshold for hepatic damage while none from SC reached this level. Hepatic concentrations of As in SC dolphins and V in FL dolphins were also highly correlated with skin concentrations which may have some regional specificity predictive value. The present study provides the first application of trace element concentrations derived from stranded bottlenose dolphins to predict liver concentrations in free-ranging populations.Keywords: Trace metals; Marine mammals; Bottlenose dolphins; Tursiops truncatus; Mercury

Steiger, G. H., J. Calambokidis, J. L. Huggins, D. M. Lambourn, S. J. Jeffries, A. B. Douglas, S. A. Norman, S. Raverty, G. Ylitalo and B. Norberg (2013). Long term patterns in strandings and human-caused mortality in gray whales and other large cetaceans in Washington State. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 199.

Stewart, J. R., F. I. Townsend, S. M. Lane, E. Dyar, A. A. Hohn, T. K. Rowles, L. A. Staggs, R. S. Wells, B. C. Balmer and L. H. Schwacke (2014). "Survey of antibiotic-resistant bacteria isolated from bottlenose dolphins Tursiops truncatus in the southeastern USA." Diseases of Aquatic Organisms 108(2): 91-102.

Contamination of coastal waters can carry pathogens and contaminants that cause diseases in humans and wildlife, and these pathogens can be transported by water to areas where they are not indigenous. Marine mammals may be indicators of potential health effects from such pathogens and toxins. Here we isolated bacterial species of relevance to humans from wild bottlenose dolphins Tursiops truncatus and assayed isolated bacteria for antibiotic resistance. Samples were collected during capture-release dolphin health assessments at multiple coastal and estuarine sites along the US mid-Atlantic coast and the Gulf of Mexico. These samples were transported on ice and evaluated using commercial systems and aerobic culture techniques routinely employed in clinical laboratories. The most common bacteria identified were species belonging to the genus Vibrio, although Escherichia coli, Shewanella putrefaciens, and Pseudomonas fluorescens/putida were also common. Some of the bacterial species identified have been associated with human illness, including a strain of methicillin-resistant Staphylococcus aureus (MRSA) identified in 1 sample. Widespread antibiotic resistance was observed among all sites, although the percentage of resistant isolates varied across sites and across time. These data provide a baseline for future comparisons of the bacteria that colonize bottlenose dolphins in the southeastern USAKeywords: Marine mammals; MRSA; Vibrios; Coastal waters; Zoonosis; Anthropogenic impacts; Microbiology; Screening

Stoddard, R. A., E. R. Atwill, P. A. Conrad, B. A. Byrne, S. Jang, J. Lawrence, B. McCowan and F. M. D. Gulland (2009). "The effect of rehabilitation of northern elephant seals (Mirounga angustirostris) on antimicrobial resistance of commensal Escherichia coli." Veterinary Microbiology 133(3): 264-271.

The aim of this study was to determine if antimicrobial drug use increases resistance of commensal gastrointensinal Escherichia coli of wild northern elephant seals (Mirounga angustirostris) treated in rehabilitation, and, if so, identify the risk factors involved. Minimum inhibitory concentration

(MIC) levels of twelve antimicrobial drugs were determined for 289 E. coli isolates from 99 seals sampled at admission and 277 isolates obtained at release from rehabilitation using broth microdilution. Prevalence of E. coli antimicrobial resistance, MIC50, MIC90, and clustering of MIC values were determined for seals and the data were analyzed using Fisher's exact test, ordinal logistic regression and negative binomial regression. At release from rehabilitation 77.8% of the seals had antimicrobial resistant E. coli compared to 38.4% of the seals at admission. The MIC90 for amoxicillin-clavulanic acid, chloramphenicol, enrofloxacin, ticarcillin-clavulanic acid, and trimethoprim-saulfamethoxazole were at levels considered to be sensitive at admission but they increased to levels of resistance at release. E coli were grouped into four clusters by their MIC values, with increasing levels of resistance going from Cluster 1 to 4. A primary risk factor associated with the probability of a seal having E. coli in Clusters 3 and 4 was time in rehabilitation, regardless of whether the animal received treatment with antimicrobial drugs, suggesting nosocomial infection. The results of this study provide evidence that increased levels of hygiene and appropriate use of antimicrobial therapy might be important in the rehabilitation of wild animals to prevent rise in the prevalence of antimicrobial resistant bacteria.Keywords: Escherichia coli; Antimicrobial drug resistance; Northern elephant seal; Mirounga angustirostris

Stolen, M., W. N. Durden, T. Mazza, N. Barros and J. St. Leger (2013). "Effects of fishing gear on bottlenose dolphins (Tursiops truncatus) in the Indian River Lagoon system, Florida." Marine Mammal Science 29(2): 356-364.

Stolen, M., W. N. Durden, T. Mazza and C. Dold (2011). The fate of live stranded and "at risk" marine mammals from the east coast of Florida. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 283-284.

Stone, B. M., D. J. Blyde, J. T. Saliki, U. Blas-Machado, J. Bingham, A. Hyatt, J. Wang, J. Payne and S. Crameri (2011). "Fatal cetacean morbillivirus infection in an Australian offshore bottlenose dolphin (Tursiops truncatus)." Australian Veterinary Journal 89(11): 452-457.

A juvenile offshore bottlenose dolphin (Tursiops truncatus) was found stranded with neurological signs and unable to swim or float unassisted. It subsequently died, succumbing to a combination of severe pneumonia and encephalitis. Morbillivirus serum neutralisation test serology was positive (titre 1:16) for cetacean morbillivirus and negative for both phocine distemper virus and canine distemper virus. There was concurrent thymic and lymph node lymphoiddepletion and necrosis, together with intranuclear and intracytoplasmic acidophilic viral inclusion bodies and multinucleate syncytia within multiple organs. Paramyxovirus capsids were identified in lung sections via electron microscopy and morbillivirus antigen was demonstrated within sections of lung, thymus and brain by immunohistochemistry. Reverse transcription-polymerase chain reaction formorbillivirus nucleoprotein (N) and phosphoprotein (P) genes were positive and phylogenetic gene product sequence analysis revealed 98% and 94% sequence identity to dolphin morbillivirus, respectively. To the authors' knowledge, this is the first report of a cetacean mortality due to morbillivirus infection occurring in the southern hemisphere. Morbillivirus infection should be included in the differential diagnosis of stranded live or dead cetaceans in Australian waters, particularly if animals displayneurological signs.Keywords: Australia; cetacean; cetacean morbillivirus; morbillivirus; mortality

Stone, B. M., D. J. Blyde, J. T. Saliki and J. M. Morton (2012). "Morbillivirus infection in live stranded, injured, trapped, and captive cetaceans in southeastern Queensland and northern New South Wales, Australia." Journal of Wildlife Diseases 48(1): 47-55.

We report serologic evidence of cetacean morbillivirus (CMV) infection in five of eight cetacean species found live stranded, injured, or trapped along the coast of southeastern Queensland and

northern New South Wales, Australia between December 2005 and January 2011 Antibody to CMV was detected in 13 of 27 (48%) wild cetaceans sampled. Antibody prevalence was significantly higher in clinically diseased (69%) compared to nondiseased (18%) animals (P=0.018). There was high antibody prevalence (83%, n=6) in melon-headed whales (Peponocephala electra). Two of 13 (15%) captive cetaceans sampled between November 2005 and January 2011. had CMV antibodies and, as infection was unlikely to have occurred while in captivity, CMV infection appears to have been present in Australian wild cetaceans since at least 1985. These results indicate that morbillivirus infection is occurring without widespread cetacean mortality in this region. However, as the deaths of two immature Australian offshore bottlenose dolphins (Tursiops truncatus) were attributed to CMV infection, morbillivirus infection should be included in the differential diagnosis of disease in cetaceans in Australia. Captive cetacean populations may be prone to significant mortality as a result of CMV introduction, so strict quarantine procedures should be enforced when injured or stranded cetaceans are hospitalized and rehabilitated at Australian zoos and marine parks.Keywords: Australia; cetacean; CMV; epidemiology; morbillivirus; New South Wales; Queensland; serology

Stringer, E. M., W. V. Bonn, S. K. Chinnadurai and F. M. D. Gulland (2012). "Risk factors associated with perianesthetic mortality of stranded free-ranging California sea lions (Zalophus californianus) undergoing rehabilitation." Journal of Zoo and Wildlife Medicine 43(2): 233-239.

The objective of this study was to identify risk factors associated with perianesthetic mortality of stranded free-ranging California sea lions (Zalophus californianus) undergoing rehabilitation. Hospital records of California sea lions that underwent heavy sedation or general anesthesia from 2004 through 2008 were reviewed, including records from 419 anesthetic events. Procedures that resulted in death during or in the subsequent 72 hr of anesthesia were classified as cases (n = 15). Procedures in which the animal survived were classified as controls (n = 334). Procedures that resulted in euthanasia (n = 70) were removed from subsequent analysis. The following risk factors were reviewed: gender, age class, health status, duration of anesthetic period, atropine premedication, induction protocols, maintenance protocols, and history of prior anesthesia. The prevalence of fatalities during anesthesia was 3.4% (n = 12) over the 5-yr period. With the inclusion of animals that died within 72 hr after anesthesia, the total mortality prevalence rose to 4.3% (n = 15). The most common time of death was during anesthetic maintenance. Health status was the single best predictor of anesthetic outcome, and sea lions premedicated with atropine had increased odds of anesthetic-related death.Keywords: Anesthesia, atropine, California sea lion, perianesthetic death, Zalophus californianus

Sturgeon, N. B., J. Powell, T. Speakman and W. McFee (2011). Bottlenose dolphins and the Atlantic blue crab fishery: A study of co-occurence and interaction in Charleston, SC, USA. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 284.

Swingle, W. M., C. M. Trapani and M. L. Cook (2010). Marine mammal and sea turtle stranding response 2009 grant report. Virginia Beach, Virginia Aquarium Foundation Stranding Response Program.

Swingle, W. M., C. M. Trapani and M. L. Cook (2011). Marine mammal and sea turtle stranding response 2010 grant report. Virginia Beach, Virginia Aquarium Foundation Stranding Response Program.

Swingle, W. M., C. M. Trapani, L. R. D'Eri and M. C. Lynott (2012). Marine mammal and sea turtle stranding response 2011 grant report. Virginia Beach, Virginia Aquarium Foundation Stranding Response Program.

Swingle, W. M., C. M. Trapani, L. R. D'Eri and M. C. Lynott (2013). Marine mammal and se a turtle stranding response 2012 grant report, Virginia Aquarium Foundation Stranding Response Program.

Taylor, J. K. D., J. W. Mandelman, W. A. McLellan, M. J. Moore, G. B. Skomal, D. S. Rotstein and S. D. Kraus (2013). "Shark predation on North Atlantic right whales (Eubalaena glacialis) in the southeastern United States calving ground." Marine Mammal Science 29(1): 204-212.

Testa, J. W., G. P. Adams, D. R. Bergfelt, D. S. Johnson, R. R. Ream and T. S. Gelatt (2010). "Replicating necropsy data without lethal collections: Using ultrasonography to understand the decline in northern fur seals." Journal of Applied Ecology 47(6): 1199-1206.

1. Many valuable contributions to the biology and conservation of harvested or previously harvested species have come from examination of specimens obtained by lethal collections. The northern fur seal Callorhinus ursinus on the Pribilof Islands, Alaska, has a long history of exploitation, including a large (> 320 000) experimental harvest of females from 1955 to 1968 when the population was at a peak (similar to 2 million seals). The decline caused by this harvest was followed in 1977 by another major decline, apparently unrelated to harvest, that has recently accelerated.2. To obtain current reproductive data that could be compared directly with historic estimates, we used imaging ultrasonography to estimate pregnancy rate in 171 adult fur seals captured on St. Paul Island, Alaska, in November, near the end of embryonic diapause. A modified logistic regression of pregnancy by date was used to estimate asymptotic pregnancy rate; a Bayesian hierarchical model based on date and size of embryonic vesicle was also used to account for pregnancies that were not detectable on the date of examination.3. Pregnancy rate was high [0.85 (SE = 0.05), 0.88 (SE = 0.05) or 0.92 (SE = 0.04), depending on method] and there was little statistical support for the hypothesis that the current pregnancy rate is lower than the pre-decline rate (0.84, SE = 0.012) or contributing significantly to the present decline.4. Synthesis and applications. Further study on intrauterine losses and pupping rates is necessary and ongoing, but reproductive ultrasonography provided an early comparative assessment important for the conservation management of this fur seal stock. It narrows the search for demographic and ecological causes of the population decline and allows research priorities to evolve in response to the likelihood of those causes. The field and analytic methods described have application to populatio n assessments of other mammalian species, including those considered threatened or serving as ecosystem indicators.Keywords: Alaska; Bering Sea; Callorhinus ursinus; embryonic diapause; fecundity; Pribilof Islands; St. Paul Island

Thayer, V. G., K. A. Rittmaster, D. A. Pabst, S. W. Thornton, M. A. Piscitelli, K. L. Clarke, M. M. Piatak, P. K. Doshkov, G. N. Lovewell, C. A. Harms and W. A. McLellan (2011). Neonatal bottlenose dolphin (Tursiops truncatus) strandings in North Carolina from 1992 to 2011. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 290.

Thewissen, J. G. M., J. D. Sensor, J. C. George, R. S. Suydam and M. C. Liberman (2011). assessment of auditory trauma in the inner ear of Arctic whales. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 291.

Thomas, K., J. T. Harvey, T. Goldstein, J. Barakos and F. Gulland (2010). "Movement, dive behavior, and survival of California sea lions (Zalophus californianus) posttreatment for domoic acid toxicosis." Marine Mammal Science 26(1): 36-52.

Domoic acid (DA) is a neuroexcitatory toxin increasingly causing strandings and mortality of marine mammals. The hippocampus of mammalian brains, associated with learning, memory, and

spatial navigation, is one of the predominant regions affected by DA exposure. California sea lions stranding from 2003 to 2006 as a result of DA toxicosis were classified as having acute (n= 12) or chronic neurologic (n= 22) clinical signs. Chronic neurologic cases were examined by magnetic resonance imaging to determine the extent of brain damage related to DA exposure. Brain damage included hippocampal and parahippocampal atrophy, temporal horn enlargement, and pathological T2 hyperintensity. Posttreatment, animals were fitted with satellite transmitters and their movement and dive behaviors compared with those of a control group. The only significant difference between acute and chronic animals was distance traveled per day. There were, however, significant differences between chronic neurologic cases and controls: chronic neurologic cases dove shallower for shorter durations, traveled further from shore, and spent less time hauled out and more time surface swimming than control animals. There was no relationship between severity of brain damage and behavioral patterns for chronic neurologic cases. Sea lions with chronic neurologic changes had a poor prognosis for survival following release. Keywords: domoic acid • California sea lions • Zalophus californianus • magnetic resonance imaging (MRI) • harmful algal blooms • hippocampal atrophy • Pseudo-nitzschia

Thornton, S. W., W. A. McLellan, S. A. Rommel and D. A. Pabst (2013). "Functional morphology of dorsal acoustic structures in pygmy (Kogia breviceps) and dwarf (K. sima) sperm whales." Integrative and Comparative Biology 53(Supplement 1): E381.

Thornton, S. W. M., S. Rommel, R. Dillaman, D. Nowacek, H. Koopman and D. A. Pabst (2013). Functional morphology of pygmy (Kogia breviceps) and dwarf (K. sima) sperm whale dorsal acoustic structures. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 208.

Toms, C. N., S. F. Shippee and G. A. J. Worthy (2011). Potential impacts of the Deep Water Horizon oil spill on bottlenose dolphin reproductive success; Preliminary observations. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida.

Torres de la Riva, G., C. K. Johnson, F. M. D. Gulland, G. W. Langlois, J. E. Heyning, T. K. Rowles and J. A. K. Mazet (2009). "Association of an unusual marine mammal mortality event with Pseudo-nitzschia spp. blooms along the southern California coastline." Journal of Wildlife Diseases 45(1): 109-121.

During 2002, 2,239 marine mammals stranded in southern California. This unusual marine mammal stranding event was clustered from April to June and consisted primarily of California sea lions (Zalophus californianus) and long-beaked common dolphins (Delphinus capensis) with severe neurologic signs. Intoxication with domoic acid (DA), a marine neurotoxin produced during seasonal blooms of Pseudo-nitzschia spp., was suspected. Definitively linking harmful algal blooms to large-scale marine mammal mortalities presents a substantial challenge, as does determining the geographic extent, species composition, and potential population impacts of marine mammal die-offs. For this reason, time series cross-correlation analysis was performed to test the temporal correlations of Pseudo-nitzschia blooms with strandings occurring along the southern California coastline. Temporal correlations were identified between strandings and blooms for California sea lions, long-beaked common dolphins, and short-beaked common dolphins (Delphinus delphis). Similar correlations were identified for bottlenose dolphins (Tursiops truncatus) and gray whales (Eschrichtius robustus), but small sample sizes for these species made associations more speculative. The timing of the blooms and strandings of marine mammals suggested that both inshore and offshore foraging species were affected and that marine biotoxin programs should include offshore monitoring sites. In addition, California sea lionstrandings appear to be a very sensitive indicator of DA in the marine environment, and their monitoring should be included in public health surveillance plans.

Touhey Moore, K. and S. G. Barco (2013). Handbook for recognizing, evaluating, and documenting human interaction in stranded cetaceans and pinnipeds, NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center: 102.

Trumble, S. J., D. O'Neil, L. A. Cornick, F. M. D. Gulland, M. A. Castellini and S. Atkinson (2012). "Endocrine changes in harbor seal (Phoca vitulina) pups undergoing rehabilitation." Zoo Biology 32(2): 134-141.

Rehabilitating pinniped pups are often admitted to care centers as neonates and generally lack maternal investment and are in poor body condition. Upon admittance to a rehabilitation facility, pups are typically fed a milk replacement formula via gavage, which is switched to frozen fish upon weaning. While rehabilitation has been successful in terms of recovery and release, preweaning growth rates in captivity are consistently lower than in the wild. Indicators of stress (cortisol and total thyroxine; TT4), and standard morphometrics, of harbor seal pups in rehabilitation (n = 20) were determined for both preweaned and weaned pups. Hormone concentrations and standard morphometrics from pups in care were compared with free-ranging harbor seal pups (n = 59). Pups in rehabilitation gained mass on both milk and fish diets. Preweaned pups had greater mean serum cortisol and similar TT4 concentrations than weaned pups. Free-ranging harbor seal pups were heavier and longer than preweaned and weaned pups in rehabilitation. The free-ranging pups had the lowest cortisol and highest TT4 concentrations of any of the pups. These results suggest that weaned pups that have undergone rehabilitation are not physiologically equivalent to free-ranging weaned pups. Additional research is needed regarding physiological changes in endocrine values during early development under captive care conditions. This information should be useful to marine mammal rehabilitation centers in their development of care protocols and release criteria for rehabilitating harbor seal pups.Keywords: harbor seal; stress hormones; cortisol; thyroxine

Trumble, S. J., E. M. Robinson, M. Berman-Kowalewski, C. W. Potter and S. Usenko (2013). "Blue whale earplug reveals lifetime contaminant exposure and hormone profiles." Proceedings of the National Academy of Sciences 110(42): 16922-16926.

Lifetime contaminant and hormonal profiles have been reconstructed for an individual male blue whale (Balaenoptera musculus, Linnaeus 1758) using the earplug as a natural aging matrix that is also capable of archiving and preserving lipophilic compounds. These unprecedented lifetime profiles (i.e., birth to death) were reconstructed with a 6-mo resolution for a wide range of analytes including cortisol (stress hormone), testosterone (developmental hormone), organic contaminants (e.g., pesticides and flame retardants), and mercury. Cortisol lifetime profiles revealed a doubling of cortisol levels over baseline. Testosterone profiles suggest this male blue whale reached sexual maturity at approximately 10 y of age, which corresponds well with and improves on previous estimates. Early periods of the reconstructed contaminant profiles for pesticides (such as dichlorodiphenyltrichloroethanes and chlordanes), polychlorinated biphenyls, and polybrominated diphenyl ethers demonstrate significant maternal transfer occurred at 0–12 mo. The total lifetime organic contaminant burden measured between the earplug (sum of contaminants in laminae layers) and blubber samples from the same organism were similar. Total mercury profiles revealed reduced maternal transfer and two distinct

pulse events compared with organic contaminants. The use of a whale earplug to reconstruct lifetime chemical profiles will allow for a more comprehensive examination of stress, development, and contaminant exposure, as well as improve the assessment of contaminant use/emission, environmental noise, ship traffic, and climate change on these important marine sentinels.

Tsukrov, I., J. C. DeCew, K. Baldwin, R. Campbell-Malone and M. J. Moore (2009). "Mechanics of the right whale mandible: Full scale testing and finite element analysis." Journal of Experimental Marine Biology and Ecology 374(2): 93-103.

In an effort to better understand the mechanics of ship-whale collision and to reduce the associated mortality of the critically endangered North Atlantic right whale, a comprehensive biomechanical study has been conducted by the Woods Hole Oceanographic Institution and the University of New Hampshire. The goal of the study is to develop a numerical modeling tool to predict the forces and stresses during impact and thereby the resulting mortality risk to whales from ship strikes.

Based on post-mortem examinations, jaw fracture was chosen as a fatal endpoint for the whales hit by a vessel. In this paper we investigate the overall mechanical behavior of a right whale mandible under transverse loading and develop a finite element analysis model of the bone. The equivalent elastic modulus of the cortical component of right whale mandible is found by comparing full-scale bending tests with the results of numerical modeling. The finite element model of the mandible can be used in conjunction with a vessel-whale collision event model to predict bone fracture for various ship strike scenarios.

Twiner, M. J., S. Fire, L. Schwacke, L. Davidson, Z. Wang, S. Morton, S. Roth, B. Balmer, T. K. Rowles and R. S. Wells (2011). "Concurrent exposure of bottlenose dolphins (Tursiops truncatus) to multiple algal toxins in Sarasota Bay, Florida, USA." PLoS ONE 6(3): e17394.

Sentinel species such as bottlenose dolphins (Tursiops truncatus) can be impacted by large-scale mortality events due to exposure to marine algal toxins. In the Sarasota Bay region (Gulf of Mexico, Florida, USA), the bottlenose dolphin population is frequently exposed to harmful algal blooms (HABs) of Karenia brevis and the neurotoxic brevetoxins (PbTx; BTX) produced by this dinoflagellate. Live dolphins sampled during capture-release health assessments performed in this region tested positive for two HAB toxins; brevetoxin and domoic acid (DA). Over a ten-year study period (2000-2009) we have determined that bottlenose dolphins are exposed to brevetoxin and/or DA on a nearly annual basis (i.e., DA: 2004, 2005, 2006, 2008, 2009; brevetoxin: 2000, 2004, 2005, 2008, 2009) with 36% of all animals testing positive for brevetoxin ($n = 118$) and 53% positive for DA ($n = 83$) with several individuals (14%) testing positive for both neurotoxins in at least one tissue/fluid. To date there have been no previously published reports of DA in southwestern Florida marine mammals, however the May 2008 health assessment coincided with a Pseudo-nitzschia pseudodelicatissima bloom that was the likely source of DA observed in seawater and live dolphin samples. Concurrently, both DA and brevetoxin were observed in common prey fish. Although no Pseudo-nitzschia bloom was identified the following year, DA was identified in seawater, fish, sediment, snails, and dolphins. DA concentrations in feces were positively correlated with hematologic parameters including an increase in total white blood cell ($p = 0.001$) and eosinophil ($p < 0.001$) counts. Our findings demonstrate that dolphins within Sarasota Bay are commonly exposed to two algal toxins, and provide the impetus to further explore the potential long-term impacts on bottlenose dolphin health.

Twiner, M. J., L. J. Flewelling, S. E. Fire, S. R. Bowen-Stevens, J. K. Gaydos, C. K. Johnson, J. H. Landsberg, T. A. Leighfield, B. Mase-Guthrie, L. Schwacke, F. M. V. Dolah, Z. Wang and T. Rowles (2012). "Comparative analysis of three brevetoxin-associated bottlenose dolphin (Tursiops truncatus) mortality events in the Florida Panhandle region (USA)." PLoS ONE 7(8): e42974.

In the Florida Panhandle region, bottlenose dolphins (Tursiops truncatus) have been highly susceptible to large-scale unusual mortality events (UMEs) that may have been the result of exposure to blooms of the dinoflagellate Karenia brevis and its neurotoxin, brevetoxin (PbTx). Between 1999 and 2006, three bottlenose dolphin UMEs occurred in the Florida Panhandle region. The primary objective of this study was to determine if these mortality events were due to brevetoxicosis. Analysis of over 850 samples from 105 bottlenose dolphins and associated prey items were analyzed for algal toxins and have provided details on tissue distribution, pathways of trophic transfer, and spatial-temporal trends for each mortality event. In 1999/2000, 152 dolphins died following extensive K. brevis blooms and brevetoxin was detected in 52% of animals tested at concentrations up to 500 ng/g. In 2004, 105 bottlenose dolphins died in the absence of an identifiable K. brevis bloom; however, 100% of the tested animals were positive for brevetoxin at concentrations up to 29,126 ng/mL. Dolphin stomach contents frequently consisted of brevetoxin-contaminated menhaden. In addition, another potentially toxigenic algal species, Pseudo-nitzschia, was present and low levels of the neurotoxin domoic acid (DA) were detected in nearly all tested animals (89%). In 2005/2006, 90 bottlenose dolphins died that were initially coincident with high densities of K. brevis. Most (93%) of the tested animals were positive for brevetoxin at concentrations up to 2,724 ng/mL. No DA was detected in these animals despite the presence of an intense DA-producing Pseudo-nitzschia bloom. In contrast to the absence or very low levels of brevetoxins measured in live dolphins, and those stranding in the absence of a K. brevis bloom, these data, taken together with the absence of any other obvious pathology, provide strong evidence that brevetoxin was the causative agent involved in these bottlenose dolphin mortality events.

Van Bonn, W., E. Montie, S. Dennison, N. Pussini, P. Cook, D. Greig, J. Barakos, K. Colegrove and F. Gulland (2011). "Evidence of injury caused by gas bubbles in a live marine mammal: Barotrauma in a California sea lion Zalophus californianus." Diseases of Aquatic Organisms 96(2): 89-96.

A yearling male California sea lion Zalophus californianus with hypermetric ataxia and bilateral negative menace reflexes was brought to The Marine Mammal Center, Sausalito, California, USA, in late 2009 for medical assessment and treatment. The clinical signs were due to multiple gas bubbles within the cerebellum. These lesions were intraparenchymal, multifocal to coalescing, spherical to ovoid, and varied from 0.5 to 2.4 cm diameter. The gas composed 21.3% of the total cerebellum volume. Three rib fractures were also noted during diagnostic evaluation and were presumed to be associated with the gas bubbles in the brain. The progression of clinical signs and lesion appearance were monitored with magnetic resonance imaging, cognitive function testing and computed tomography. Gas filled voids in the cerebellum were filled with fluid on follow up images. Clinical signs resolved and the sea lion was released with a satellite tag attached. Post release the animal travelled approximately 75 km north and 80 km south of the release site and the tag recorded dives of over 150 m depth. The animal re-stranded 25 d following release and died of a subacute bronchopneumonia and pleuritis. This is the first instance of clinical injury due to gas bubble formation described in a living pinniped and the first sea lion with quantifiable cerebellar damage to take part in spatial learning and memory testing.Keywords: Gas bubbles; Barotrauma; California sea lion; Zalophus californianus

Van der Hoop, J., M. Moore, A. Fahlman, A. Bocconcelli, C. George, K. Jackson, C. Miller, D. Morin, T. Pitchford, T. Rowles, J. Smith and B. Zoodsma (2013). "Behavioral impacts of disentanglement of a right whale under sedation and the energetic cost of entanglement." Marine Mammal Science.

Protracted entanglement in fishing gear often leads to emaciation through

reduced mobility and foraging ability, and energy budget depletion from the added drag of towing gear for months or years. We examined changes in kinematics of a tagged entangled North Atlantic right whale (Eg 3911), before, during, and after disentanglement on 15 January 2011. To calculate the additional drag forces and energetic demand associated with various gear configurations, we towed three sets of gear attached to a load-cell tensiometer at multiple speeds. Tag analyses revealed significant increases in dive depth and duration; ascent, descent and fluke stroke rates; and decreases in root mean square fluke amplitude (a proxy for thrust) following disentanglement. Conservative drag coefficients while entangled in all gear configurations (mean SD Cd,e,go = 3.4 9 10–3 0.0003, Cd,e,gb = 3.7 9 10–3 0.0003, Cd,e,sl = 3.8 9 10–3 0.0004) were significantly greater than in the nonentangled case (Cd,n = 3.2 9 10–3 0.0003; P = 0.0156, 0.0312, 0.0078, respectively). Increases in total power input (including standard metabolism) over the nonentangled condition ranged from 1.6% to 120.9% for all gear configurations tested; locomotory power requirements increased 60.0%–164.6%. These results highlight significant alteration to swimming patterns, and the magnitude of energy depletion in a chronically entangled whale.

Van Der Hoop, J., M. J. Moore, S. G. Barco, T. V. N. Cole, P.-Y. Daoust, A. G. Henry, D. F. McAlpine, W. A. McLellan, T. Wimmer and A. R. Solow (2013). "Assessment of management to mitigate anthropogenic effects on large whales." Conservation Biology 27(1): 121-133.

United States and Canadian governments have responded to legal requirements to reduce human-induced whale mortality via vessel strikes and entanglement in fishing gear by implementing a suite of regulatory actions. We analyzed the spatial and temporal patterns of mortality of large whales in the Northwest Atlantic (23.5°N to 48.0°N), 1970 through 2009, in the context of management changes. We used a multinomial logistic model fitted by maximum likelihood to detect trends in cause-specific mortalities with time. We compared the number of human-caused mortalities with U.S. federally established levels of potential biological removal (i.e., species-specific sustainable human-caused mortality). From 1970 through 2009, 1762 mortalities (all known) and serious injuries (likely fatal) involved 8 species of large whales. We determined cause of death for 43% of all mortalities; of those, 67% (502) resulted from human interactions. Entanglement in fishing gear was the primary cause of death across all species (n= 323), followed by natural causes (n= 248) and vessel strikes (n= 171). Established sustainable levels of mortality were consistently exceeded in 2 species by up to 650%. Probabilities of entanglement and vessel-strike mortality increased significantly from 1990 through 2009. There was no significant change in the local intensity of all or vessel-strike mortalities before and after 2003, the year after which numerous mitigation efforts were enacted. So far, regulatory efforts have not reduced the lethal effects of human activities to large whales on a population-range basis, although we do not exclude the possibility of success of targeted measures for specific local habitats that were not within the resolution of our analyses. It is unclear how shortfalls in management design or compliance relate to our findings. Analyses such as the one we conducted are crucial in critically evaluating wildlife-management decisions. The results of these analyses can provide managers with direction for modifying regulated measures and can be applied globally to mortality-driven conservation issues.Keywords: Entanglement; evaluation of management/mitigation efforts; human-interaction; large whales; mortality; necropsy; vessel-strike

Van der Hoop, J. M., T. V. N. Cole, P.-Y. Daoust, A. G. Henry, D. McAlpine, W. A. McLellan, Northeast Region Marine Mammal Stranding Network, Southeast Region Marine Mammal Stranding Network, T. Wimmer and M. J. Moore (2011). Spatial and temporal trends in large whale mortality in the Northwest

Atlantic in the context of efforts to mitigate human impacts. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 300.

Van Der Hoop, J. M., M. J. Moore, S. G. Barco, T. V. N. Cole, P.-Y. Daoust, A. G. Henry, D. F. McAlpine, W. A. McLellan, T. Wimmer and A. R. Solow (2012). "Assessment of management to mitigate anthropogenic effects on large whales." Conservation Biology: no-no.

Velten, B. P., W. A. McLellan and D. A. Pabst (2011). A comparative study of the locomotor muscle of extreme deep-diving cetaceans. Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 302.

Venn-Watson, S., C. R. Smith, E. D. Jensen and T. Rowles (2013). "Assessing the potential health impacts of the 2003 and 2007 firestorms on bottlenose dolphins (Tursiops trucatus) in San Diego Bay." Inhalation Toxicology 25(9): 481-491.

Context: Firestorms negatively affected air quality throughout San Diego County during 2003 and 2007, including the San Diego Bay, which houses the Navy's bottlenose dolphins (Tursiops truncatus).Objective: To assess the potential impact of the 2003 and 2007 fires on dolphin health. Materials and methods: Hematology and serum chemistry values were evaluated retrospectively among Navy dolphins the year and month before; during; and the month after the 2003 and 2007 fires.Results: Both 2003 and 2007 fires were associated with lower calcium either during or the month post-fire compared to the control periods. During and the month following the 2003 fire, dolphins had higher serum carbon dioxide compared to the control periods. Dolphins during and the month following the 2007 fire had lower absolute or percent neutrophils and higher chloride. The 2007 fire was also associated with increased percent eosinophils during the fire and higher percent monocytes and bilirubin the month following the fire compared to the control periods.Discussion and conclusion: Consistent with what has been previously reported in humans and other animals, this study supports that fire smoke inhalation may have mild effects on dolphin physiology, including calcium homeostasis, lung function and immune response.Keywords: Calcium homeostasis; dolphin; fire smoke inhalation; lung injury; Tursiops truncatus.

Venn-Watson, S., A. Stamper and T. Rowles (2011). "Thinking outside the terrestrial box: How high-priority, emerging, and zoonotic marine mammal pathogens reflect those of human pathogens." Ecohealth 7(Supplement 1): S26-S27.

Venn-Watson, S., A. Stamper, Working Group on Marine Mammal Unusual Mortality Events and T. Rowles (2010). Pilot pathogen prioritization survey results for cetaceans. Agadir, Morocco, International Whaling Commission Scientific Committee: 8.

Vollmer, N. L. and P. E. Rosel (2013). "A review of common bottlenose dolphins (Tursiops truncatus truncatus) in the northern Gulf of Mexico: Population biology, potential threats, and management." Southeastern Naturalist 12(Monograph 6): 1-43.

Common Bottlenose Dolphins (Tursiops truncatus truncatus) are one of the most abundant marine mammal species in the northern Gulf of Mexico (GOMx), a region where they are exposed to a variety of man-made and natural threats. In order to assess and minimi

Volokhov, D. V., T. Norris, C. Rios, M. K. Davidson, J. B. Messick, F. M. Gulland and V. E. Chizhikov (2011). "Novel hemotrophic mycoplasma identified in naturally infected California sea lions (Zalophus californianus)." Veterinary Microbiology 149(1-2): 262-268.

The hemoplasmas are the trivial name for a group of erythrocyte-parasitizing, non-cultivable in vitro bacteria of the genus Mycoplasma that have been described in several mammalian hosts worldwide. This study is the first report of hemoplasmas in marine mammals. EDTA anticoagulated whole blood samples from 137 California sea lions (Zalophus californianus) and 20 northern elephant seals (Mirounga angustirostris) admitted to the Marine Mammal Center (Sausalito, CA; www.marinemammalcenter.org) or live captured in Oregon were collected during 2008. Hemoplasma-specific genomic DNA was detected in blood samples from 12.4% California sea lions tested using PCR. Hemoplasma PCR positive blood specimens also were tested in reverse transcription polymerase chain reaction (RT-PCR) using the hemoplasma-specific primers for the 16S and 23S rRNA genes. The RT-PCR showed the presence the hemoplasmal rRNA, strongly suggesting the presence of potentially viable hemoplasmas in the bloodstream of the animals. BLAST search and phylogenetic analysis of the 16S rRNA sequences of the hemoplasma from California sea lions revealed that the organism is a novel hemoplasma species with only 92.1% of its nucleotide similarity to the 16S rRNA gene of the previously described hemoplasma species of alpacas, Candidatus Mycoplasma haemolamae. Thus, due to low level of genetic similarity of the hemoplasma to other described hemoplasmas and the mammalian host in which the hemoplasma was detected we propose that this novel hemoplasma species has been given the provisional name Candidatus Mycoplasma haemozalophi sp. nov.Keywords: Hemoplasma; Blood; California sea lions

Wallace, C. C., P. O. Yund, T. E. Ford, K. A. Matassa and A. L. Bass (2013). "Increase in antimicrobial resistance in bacteria isolated from stranded marine mammals of the Northwest Atlantic." Ecohealth 10(2): 201-210.

Studies on marine mammals can inform our understanding of the environmental health of the ocean. To evaluate the potential for changes in antimicrobial resistance, we analyzed a database spanning 2004–2010 that consisted of bacterial isolate identity and antimicrobial sensitivity for stranded pinnipeds in the Northwest Atlantic. Samples (n = 170) from treated animals yielded 310 bacterial isolates representing 24 taxa. We evaluated changes in antimicrobial class resistance from 2004 to 2010 for eight taxa. Escherichia coli displayed a significant increase in resistance to several antimicrobial classes. Other taxa displayed significant increases in resistance to aminoglycosides, and/or fluoroquinolones. In addition, we observed a significant increase in multiple antimicrobial resistance in cultures from untreated animals. These results demonstrate an increase in resistance among common bacterial pathogens of marine mammals over a time span of 6 years.

Ward-Geiger, L., A. Knowlton, A. Amos, T. Pitchford, B. Mase-Guthrie and B. Zoodsma (2011). "Recent sightings of the North Atlantic right whale in the Gulf of Mexico." Gulf of Mexico Science 21(1): 74-78.

Wellehan Jr., J. F. X., R. Rivera, L. L. Archer, C. Benham, J. K. Muller, K. M. Colegrove, F. M. D. Gulland, J. A. St. Leger, S. K. Venn-Watson and H. H. Nollens (2011). "Characterization of California sea lion polyomavirus 1: Expansion of the known host range of the Polyomaviridae to Carnivora." Infection Genetics and Evolution 11(5): 987-996.

The genome of a novel polyomavirus first identified in a proliferative tongue lesion of a California sea lion (Zalophus californianus) is reported. This is only the third described polyomavirus of laurasiatherian mammals, is the first of the three associated with a lesion, and is the first known polyomavirus of a host in the order Carnivora. Predicted large T, small t, VP1, VP2, and VP3 genes were identified based on homology to proteins of known polyomaviruses, and a putative agnoprotein was identified based upon its location in the genome. Phylogenetic analysis of the predicted late region proteins found that the laurasiatherian polyomaviruses, together with Squirrel monkey polyomavirus

and Murine pneumotropic virus, form a monophyletic clade. Phylogenetic analysis of the early region was more ambiguous. The noncoding control region of California sea lion polyomavirus 1 is unusual in that only two apparent large T binding sites are present; this i s less than any other known polyomavirus. The VP1 of this virus has an unusually long carboxy-terminal region. A quantitative polymerase chain reaction was developed and utilized on various samples from 79 additional animals from either managed or wild stranded California sea lion populations, and California sea lion polyomavirus 1 infection was found in 24% of stranded animals. Sequence of additional samples identified four sites of variation in the t antigens, three of which resulted in predicted coding changes.Keywords: California sea lion; Phylogeny; Polyomaviridae; Quantitiative PCR; Rolling circle amplification; Zalophus californianus

Wells, R. S., D. A. Fauquier, F. M. D. Gulland, F. I. Townsend and R. A. Digiovanni Jr. (2013). "Evaluating postintervention survival of free-ranging odontocete cetaceans." Marine Mammal Science 29(4): E463-E483.

Until recently, few data were available for evaluating postintervention survival of free -ranging cetaceans receiving aid from humans through: rescue from stranding, with rehabilitation and release; rescue, rehabilitation and release of debilitated or enta

Wells, R. S., E. M. Fougeres, A. G. Cooper, R. O. Stevens, M. Brodsky, R. Lingenfelser, C. Dold and D. C. Douglas (2013). "Movements and dive patterns of short-finned pilot whales (Globicephala macrorhynchus) released from a mass stranding in the Florida Keys." Aquatic Mammals 39(1): 61-72.

Short-finned pilot whales (Globicephala macrorhynchus) are among the most common cetaceans to engage in mass strandings in the southeastern United States. Because these are primarily pelagic, continental shelf-edge animals, much of what is known about this species has derived from mass stranding events. Post-release monitoring via satellite-linked telemetry was conducted with two adult males determined on-site to be healthy, and released directly from a mass stranding of 23 pilot whales in May 2011, near Cudjoe Key, Florida. Tracking provided an opportunity to evaluate the decision for immediate release vs rehabilitation, and to learn more about the lives of members of this difficult-to-study species in the wild. The two pilot whales remained together for at least 16 d before transmissions from one pilot whale (Y-404) ceased. Dive patterns and travel rates suggested that Y-404's condition deteriorated prior to signal loss. Pilot Whale Y-400 was tracked for another 51 d, moving from the Blake Plateau to the Greater Antilles, remaining in the Windward Passage east of Cuba for the last 17 d of tracking. Once he reached the Antilles, Y-400 remained in high-relief habitat appropriate for the species and made dives within or exceeding the reported range for depth and duration for this species, following expected diel patterns, presumably reflecting continued good health. Telemetry data indicate that he made at least one dive to 1,000 to 1,500 m, and several dives lasted more than 40 min. Although the fates of the two released pilot whales may have been different, the concept of evaluating health and releasing individuals determined to be healthy at the time of stranding appears to have merit as an alternative to bringing all members of mass-stranded pilot whale groups into rehabilitation.Keywords: short-finned pilot whale, Globicephala macrorhynchus, satellite-linked telemetry, dolphin tags, marine mammal rescue and rehabilitation, health assessment, mass stranding.

Wells, R. S., C. A. Manire, L. Byrd, D. R. Smith, J. G. Gannon, D. Fauquier and K. D. Mullin (2009). "Movements and dive patterns of a rehabilitated Risso's dolphin, Grampus griseus, in the Gulf of Mexico and Atlantic Ocean." Marine Mammal Science 25(2): 420-429.

Welsh, T., K. Burek-Huntington, K. Savage, B. Rosenthal and J. P. Dubey (2014). "Sarcocystis canis associated hepatitis in a Steller sea lion (Eumetopias jubatus) from Alaska." Journal of Wildlife Diseases 50(2): 405-408.

Sarcocystis canis infection was associated with hepatitis in a Steller sea lion (Eumetopias jubatus). Intrahepatocellular protozoal schizonts were among areas of necrosis and inflammation. The parasite was genetically identical to S. canis and is the first report in a Steller sea lion, indicating another intermediate host species for S. canis

West, K., G. Levine, J. Jacob, B. Jensen, S. Sanchez, K. Colegrove and D. Rotstein (2013). First report of Brucella and Morbillivirus in a neonate sperm whale. Twentieth Biennial Conference on the Biology of Marine Mammals. Dunedin, New Zealand: 223.

West, K. L., S. Sanchez, D. Rotstein, K. M. Robertson, S. Dennison, G. Levine, N. Davis, D. Schofield, C. W. Potter and B. Jensen (2012). "A Longman's beaked whale (Indopacetus pacificus) strands in Maui, Hawaii, with first case of morbillivirus in the central Pacific." Marine Mammal Science.

Wilkin, S., M. Ziccardi, T. Turk, R. Hoffman, Y. Addassi and B. Schroeder (2012). Integration of sea turtle expertise into oil spill response planning and mitigation: Experiences from Deepwater Horizon. Thirty-First Annual Symposium on Sea Turtle Biology and Conservation. T. T. Jones and B. P. Wallace. San Diego, California, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center. Technical Memorandum NMFS-SEFSC-631: 21.

Wilkin, S. M., J. Cordaro, F. M. D. Gulland, E. Wheeler, R. Dunkin, T. Sigler, D. Casper, M. Berman, M. Flannery, S. Fire, Z. Wang, K. Colegrove and J. Baker (2012). "An unusual mortality event of harbor porpoises (Phocoena phocoena) off central California: Increase in blunt trauma rather than an epizootic." Aquatic Mammals 38(3): 301-310.

In 2007, the apparent increase in the number of harbor porpoises (Phocoena phocoena) stranding along the central California coast compared to the number of strandings the previous year resulted in the declaration of an Unusual Mortality Event by the National Marine Fisheries Service. A statistically significant increase in strandings occurred in 2008 and 2009, with more than twice the mean annual number of strandings documented per year in the previous decade occurring each year, but then strandings decreased in 2010. No single cause of mortality explained all the strandings, and there were no significant changes in age class or sex of strandings in 2008 and 2009. Trauma, including interspecific aggression and fisheries interactions, was the most common cause of death, and blunt force trauma increased significantly in August through October of 2008 and 2009. Domoic acid toxicosis was documented for the first time in this species. Although the cause of death for many strandings was unidentified, the increase in strandings in 2008-2009 reflects an increase in blunt trauma rather than an epizootic of disease.Keywords: mortality, trauma, harbor porpoise, Phocoena phocoena, infanticide, domoic acid, stranding, UME

Wilkin, S. M., E. Wheeler, R. Dunkin, M. Berman-Kowalewski and F. M. Gulland (2011). An unusual mortality event of harbor porpoises off central California–true epizootic or changes in distribution or abundance? Nineteenth Biennial Conference on the Biology of Marine Mammals. Tampa, Florida: 312.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S. D. Kraus, D. Lusseau, A. J. Read and J. Robbins (2011). "Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident." Conservation Letters 4(3): 228-233.

Evaluating impacts of human activities on marine ecosystems is difficult when effects occur out of plain sight. Oil spill severity is often measured by the number of marine birds and mammals killed, but only a small fraction of carcasses are recovered. The Deepwater Horizon/BP oil spill in the Gulf of Mexico was the largest in the U.S. history, but some reports implied modest environmental impacts, in part

because of a relatively low number (101) of observed marine mammal mortalities. We estimate historical carcass-detection rates for 14 cetacean species in the northern Gulf of Mexico that have estimates of abundance, survival rates, and stranding records. This preliminary analysis suggests that carcasses are recovered, on an average, from only 2% (range: 0-6.2%) of cetacean deaths. Thus, the true death toll could be 50 times the number of carcasses recovered, given no additional information. We discuss caveats to this estimate, but present it as a counterpoint to illustrate the magnitude of misrepresentation implicit in presenting observed carcass counts without similar qualification. We urge methodological development to develop appropriate multipliers. Analytical methods are required to account explicitly for low probability of carcass recovery from cryptic mortality events (e.g., oil spills, ship strikes, bycatch in unmonitored fisheries and acoustic trauma).Keywords: Anthropogenic impacts; dolphin; Deepwater Horizon; Gulf of Mexico; mortality; oil; strandings

Williams, T. M., B. Richter, T. Kendall and R. Dunkin (2011). "Metabolic demands of a tropical marine carnivore, the Hawaiian monk seal (Monachus schauinslandi): Implications for fisheries competition." Aquatic Mammals 37(3): 372-376.

Wintle, N. J. P., D. A. Duffield, R. D. Jones and J. M. Rice (2011). "Total mercury in stranded marine mammals from the Oregon and southern Washington coasts." Marine Mammal Science 27(4): E268-E278.

Muscle samples from 105 marine mammals stranded along the Oregon and Washington coasts (2002–2009) were tested for levels of total mercury (THg) by Cold Vapor Atomic Fluorescence Spectrometry. The THg present is in the form of the highly toxic methylmercury. After normalizing tissue to 75% water weight, Steller sea lions and northern elephant seals exhibited the highest mean concentrations of THg followed by harbor seals, harbor porpoises, and California sea lions, 0.34 ± 0.278, 0.34 ± 0.485, 0.21 ± 0.216, 0.17 ± 0.169, and 0.15 ± 0.126 mg/kg normalized wet weight (ww), respectively. The mean normalized values demonstrate limited muscle methylmercury accumulation in these species in the Pacific Northwest. However, actual ww concentrations in some of the stranded carcassesmay pose a risk to scavengers. Normalizingmusclemercury concentrations eliminated the variability from desiccation, and allowed for a clearer indication of the amount of mercury the animal accumulated before stranding.Keywords: mercury, methylmercury, stranding, muscle, heavy metal, Steller sea lion, elephant seal, California sea lion, harbor seal, harbor porpoise.

Yordy, J. E., M. A. M. Mollenhauer, R. M. Wilson, R. S. Wells, A. Hohn, J. Sweeney, L. H. Schwacke, T. K. Rowles, J. R. Kucklick and M. M. Peden-Adams (2010). "Complex contaminant exposure in cetaceans: A comparative e-screen analysis of bottlenose dolphin blubber and mixtures of four persistent organic pollutants." Environmental Toxicology and Chemistry 29(10): 2143-2153.

Cetaceans are federally protected species that are prone to accumulate complex mixtures of persistent organic pollutants (POPs), which individually may exert estrogenic or antiestrogenic effects. In the present study it was assessed whether contaminant mi

Yordy, J. E., D. A. Pabst, W. A. McLellan, R. S. Wells, T. K. Rowles and J. R. Kucklick (2010). "Tissue-specific distribution and whole-body burden estimates of persistent organic pollutants in the bottlenose dolphin (Tursiops truncatus)." Environmental Toxicology and Chemistry 29(6): 1263-1273.

Most exposure assessments for free-ranging cetaceans focus on contaminant concentrations measured in blubber, and few data are available for other tissues or the factors governing contaminant distribution among tissues. The goal of this study was to provide a detailed description of the distribution of persistent organic pollutants (POPs) within the common bottlenose dolphin (Tursiops truncatus) body and assess the role of lipid dynamics in mediating contaminant distribution. Thirteen tissues (brain, blubber, heart, liver, lung, kidney, mammary gland, melon, skeletal muscle, spleen,

thyroid, thymus, and testis/uterus) were sampled during necropsy from bottlenose dolphins (n = 4) and analyzed for lipid and 85 POPs, including polychlorinated biphenyls, organochlorine pesticides, and polybrominated diphenyl ethers. Significant correlations between tissue POP concentrations and lipid suggest that distribution of POPs is generally related to tissue lipid content. However, blubber:tissue partition coefficients ranged widely from 0.753 to 6.25, suggesting that contaminant distribution is not entirely lipid-dependent. Tissue-specific and whole-body contaminant burdens confirmed that blubber, the primary site of metabolic lipid storage, is also the primary site for POP accumulation, contributing >90% to the whole-body burdens. Observations also suggest that as lipid mobilizes from blubber, contaminants may redistribute, leading to elevated tissue concentrations. These results suggest that individuals with reduced blubber lipid may be at increased risk for exposure-related health effects. However, this study also provides evidence that the melon, a metabolically inert lipid-rich structure, may serve as an alternate depot for POPs, thus preventing the bulk of blubber contaminants from being directly available to other tissues. This unique physiological adaptation should be taken into consideration when assessing contaminant-related health effects in wild cetacean populations.Keywords: Persistent organic pollutants • Tissue distribution • Body burden • Bottlenose dolphin

Yordy, J. E., R. S. Wells, B. C. Balmer, L. H. Schwacke, T. K. Rowles and J. R. Kucklick (2010). "Life history as a source of variation for persistent organic pollutant (POP) patterns in a community of common bottlenose dolphins (Tursiops truncatus) resident to Sarasota Bay, FL." Science of the Total Environment 408(9): 2163-2172.

As apex predators within coastal ecosystems, bottlenose dolphins (Tursiops truncatus) are prone to accumulate complex mixtures of persistent organic pollutants (POPs). While substantial variations in POP patterns have been previously observed in dolphin populations separated across regional- and fine-scale geographic ranges, less is known regarding the factors influencing contaminant patterns within localized populations. To assess the variation of POP mixtures that occurs among individuals of a population, polychlorinated biphenyl (PCB), organochlorine pesticide (OCP) and polybrominated diphenyl ether (PBDE) concentrations were measured in blubber and milk of bottlenose dolphins resident to Sarasota Bay, FL, and principal components analysis (PCA) was used to explain mixture variations in relation to age, sex and reproductive maturity. PCA demonstrated significant variations in contaminant mixtures within the resident dolphin community. POP patterns in juvenile dolphins resembled patterns in milk, the primary diet source, and were dominated by lower-halogenated PCBs and PBDEs. A significant correlation between principal component 2 (PC2) and age in male dolphins indicated that juvenile contaminant patterns gradually shifted away from the milk-like pattern over time. Metabolically-refractory PCBs significantly increased with age in male dolphins, whereas PCBs subject to cytochrome p450 1A1 metabolism did not, suggesting that changes in male POP patterns likely resulted from the selective accumulation of persistent POP congeners. Changes to POP patterns were gradual for juvenile females, but changed dramatically at reproductive maturity and gradually shifted back towards pre-parturient profiles thereafter. Congener-specific blubber/milk partition coefficients indicated that lower-halogenated POPs were selectively offloaded into milk and changes in adult female contaminant profiles likely resulted from the offloading of these compounds during the first reproductive event and their gradual re-accumulation thereafter. Overall, these results indicate that significant variations in contaminant mixtures can exist within localized populations of bottlenose dolphins, with life history factors such as age and sex driving individual differences.Keywords: Persistent organic pollutants; POPs; Contaminant mixtures; Life history; Bottlenose dolphin; Tursiops truncatus

Yordy, J. E., R. S. Wells, B. C. Balmer, L. H. Schwacke, T. K. Rowles and J. R. Kucklick (2010). "Partitioning of persistent organic pollutants between blubber and blood of wild bottlenose dolphins: Implications for biomonitoring and health." Environmental Science and Technology 44(12): 4789-4795.

Biomonitoring surveys of wild cetaceans commonly utilize blubber as a means to assess exposure to persistent organic pollutants (POPs), but the relationship between concentrations in blubber and those in blood, a better indicator of target organ exposure, is poorly understood. To define this relationship, matched blubber and plasma samples (n = 56) were collected from free-ranging bottlenose dolphins (Tursiops truncatus) and analyzed for 61 polychlorinated biphenyl (PCB) congeners, 5 polybrominated diphenyl ether (PBDE) congeners, and 13 organochlorine pesticides (OCPs). With the exception of PCB 209, lipid-normalized concentrations of the major POPs in blubber and plasma were positively and significantly correlated (R-2 = 0.828 to 0.976). Plasma concentrations, however, significantly increased with declining blubber lipid content, suggesting that as lipid is utilized, POPs are mobilized into blood. Compound- and homologue-specific blubber/blood partition coefficients also differed according to lipid content, suggesting POPs are selectively mobilized from blubber. Overall, these results suggest that with the regression parameters derived here, blubber may be used to estimate blood concentrations and vice versa. Additionally, the mobilization of lipid from blubber and concomitant increase in contaminants in blood suggests cetaceans with reduced blubber lipid may be at greater risk for contaminant-associated health effects.

Zabka, T. S., T. Goldstein, C. Cross, R. W. Mueller, C. Kreuder-Johnson, S. Gill and F. M. D. Gulland (2009). "Characterization of a degenerative cardiomyopathy associated with domoic acid toxicity in California sea lions (Zalophus californianus)." Veterinary Pathology 46(1): 105-119.

Domoic acid, produced by marine algae, call cause acute and Chronic neurologic sequela in California sea lions (Zalophus californianus) from acute toxicity or sublethal exposure. Eight sea lions, representing acute and chronic cases, both sexes, and all age classes. were selected to demonstrate a concurrent degenerative cardiomyopathy. Critical aspects of characterizing the cardiomyopathy by lesion distribution and morphology were the development of a heart dissection and tissue -trimming protocol and the delineation of the cardiac conducting system by histomorphology and immunohistochemistry for neuron-specific protein gene product 9.5. Histopathologic features and progression of the cardiomyopathy are described, varying from acute to chronic active and mild to severe. The cardiomyopathy is distinguished from other heart lesions in pinnipeds . Based oil histopathologic features, immunopositive staining for cleaved caspase-3, and comparison with known, similar-appearing cardiomyopathies. the proposed pathogenesis for the degenerative cardiomyopathy is the primary or at least initial direct interaction of domoic acid with receptors that are Suspected to exist in the heart. L-Carnitine, measured ill the heart Mid skeletal muscle, and troponin-1. Measured in serum collected at the time of death from additional animals (n = 58), were not predictive of the domoic acid -associated cardiomyopathy. This degenerative cardiomyopathy in California sea lions represents another syndrome beyond central neurologic disease associated With exposure to domoic acid and may contribute to morbidity and mortality.Keywords: Algal blooms; California sea lions; carnitine, caspase; conducting system; heart; immunohistochemistry; troponin-I

Zuemer, R. L., C. E. Cameron, S. Raverty, J. Robinson, K. M. Colegrove, S. A. Norman, D. Lamboum, S. Jeffries, D. P. Alt and F. Gulland (2009). "Geographical dissemination of Leptospira interrogans serovar Pomona during seasonal migration of California sea lions." Veterinary Microbiology 165(1-2): 105-110.

Leptospirosis is one of the most widespread bacterial zoonoses in the world and affects most mammalian species. Although leptospirosis is well documented and characterized in terrestrial species, less information is available regarding the distribution and impact of leptospirosis in marine mammals. Additionally, the role of animal migrations on the geographical spread of leptospirosis has not been

reported. Periodic epizootic outbreaks of acute leptospirosis among California sea lions (Zalophus californianus) have been reported since 1971. In this study, we collected samples from California sea lions stranded along the Pacific coast of North America during the most recent epidemic in 2004, and maintained leptospirosis surveillance of the California sea lion population along the California coast through 2007. Several isolates of Leptospira interrogans serovar Pomona were obtained from kidney and urine samples collected during this study, a finding consistent with serological evidence that California sea lions are persistently exposed to this leptospiral serovar. Combined, these data support a model whereby California sea lions are maintenance hosts for L. interrogans serovar Pomona, yet periodically undergo outbreaks of acute infection. During the 2004 outbreak, the incidence of new leptospirosis cases among California sea lions coincided with the seasonal movement of male sea lions from rookeries along the coast of central and southern California north as far as British Columbia. These data show that seasonal animal movement contributes to the distribution of leptospirosis across a large geographical region.Keywords: Leptospirosis; California sea lions; Zoonosis

Appendix B:
2009-2014 Recent/Ongoing MMHSRP Research Studies

1. Bottlenose Dolphin Georgia Health Assessments 2009
PI/CI: Teri Rowles/Lori Schwacke

Background/Reason for Study

The Turtle/Brunswick River estuary (TBRE) near Brunswick, Georgia provides habitat for a resident stock of bottlenose dolphin (*Tursiops truncatus*). There is concern for the health of dolphins in this area due to elevated levels of polychlorinated biphenyls (PCBs), mercury and other contaminants which have been reported in soil, sediments, and biota. The contaminant exposure of dolphins within the Sapelo Island National Estuarine Research Reserve (SINERR) is also of interest given the close proximity of this relatively pristine estuary to the highly contaminated TBRE and the potential range of movements for bottlenose dolphins and their prey.

NOAA, in collaboration with other partners, initiated efforts in 2004 to characterize chemical contaminant exposures of bottlenose dolphins in relation to pollutant sources along the Georgia coast and to investigate potential impacts on dolphin communities and more broadly, the coastal ecosystems of which they are a part. Efforts initially focused on bottlenose dolphins in the TBRE but were later expanded to the SINERR in coordination with ecological assessment activities being conducted under the Oceans and Human Health Initiative (OHHI).

Dart biopsy sampling was used to collect dolphin tissues for determination of chemical contaminant concentrations and photo-identification (id) surveys were initiated to develop a preliminary characterization of dolphin communities. Preliminary analysis of biopsy samples indicates extremely high concentrations of PCBs in dolphins from the TBRE site. PCB concentrations measured in dolphins in the SINERR site were low compared to TBRE dolphins, but still higher than values seen in dolphins from other mid-Atlantic coastal sites.

The photo-id study (initiated in 2008) has also contributed several important preliminary observations. First, although some dolphins do move between the TBRE and the SINERR sites, there appear to be "resident" communities at both sites, *i.e.*, a number of individuals which are exclusively sighted at each site. Furthermore, integration of preliminary sighting histories and contaminant data has shown significant variation in PCB concentrations and congener patterns in relation to residence and movements.

Objectives

To investigate the potential adverse impacts of the PCB exposures on dolphins by comprehensively evaluating dolphin health through targeted sample collection. Additionally attachment of telemetry tags was conducted to facilitate tracking of individual dolphins to understand dolphin movements, behavior, and habitat preferences to help to define potential conservation strategies and to develop ideas for restoration projects.

Sample Size

Sample size was determined based upon field conditions (water depth, distance to prime dolphin habitat, weather concerns, etc.) and the capture period. Approximately 3 dolphins per day were estimated to be able to be safely captured based upon field conditions, with a proposed sample size of 30 dolphins for the 2 week period (15 dolphins from each capture site TBRE and SINERR).

Results

Fourteen animals were captured, examined, and released from the SINERR site during week 1. During week 2, 15 animals were captured, examined, and released from the TBRE site. Animals were also tagged with VHF radio tags and tracked over a several month period in order to learn more about habitat use and range of movements.

TBRE males had the highest concentrations of PCBs reported for any marine mammal. The pattern of PCB congeners was consistent with Aroclor 1268, a highly chlorinated PCB mixture associated with a Superfund site in Brunswick. PCB levels in SINERR males were lower than in TBRE males, but comparable to the highest levels measured in other dolphin populations along the southeastern U.S. Female dolphins had higher Aroclor 1268 proportions than males, suggesting that the highly chlorinated congeners associated with Aroclor 1268 may not be offloaded through parturition and lactation as easily as less halogenated POPs. Individuals sighted farther from the Superfund point source had lower Aroclor 1268 proportions.

Dolphin densities increased with tributary size in both sites but dolphin density and total abundance were significantly higher in SINERR than in TBRE. Anthropogenic stressors within the TBRE may be an important factor contributing to the differences in abundance, density, and habitat use observed in this study.

More detailed results are outlined in the below manuscripts.

Balmer, B. C., L. H. Schwacke, R. S. Wells, J. D. Adams, R. C. George, S. M. Lane, W. A. McLellan, P. E. Rosel, K. Sparks, T. Speakman, E. S. Zolman, and D. A. Pabst. 2013. Comparison of abundance and habitat usage for common bottlenose dolphins between sites exposed to differential anthropogenic stressors within the estuaries of southern Georgia, U.S.A. Marine Mammal Science 29: E114-E135.

Balmer, B. C., R. S. Wells, L. H. Schwacke, T. K. Rowles, C. Hunter, E. S. Zolman, F. I. Townsend, B. Danielson, A. J. Westgate, W. A. McLellan, and D. A. Pabst. 2011. Evaluation of a single-pin, satellite-linked transmitter deployed on bottlenose dolphins (*Tursiops truncatus*) along the coast of Georgia, U.S.A. Aquatic Mammals 37:187-192.

Balmer, B. C., L. H. Schwacke, R. S. Wells, R. C. George, J. Hoguet, J. R. Kucklick, S. M. Lane, A. Martinez, W. A. McLellan, P. E. Rosel, T. K. Rowles, K. Sparks, T. Speakman, E. S. Zolman, and D. A. Pabst. 2011. Relationship between persistent organic pollutants (POPs) and ranging patterns in common bottlenose dolphins (*Tursiops truncatus*) from coastal Georgia, USA. Science of the Total Environment 409: 2094-2101.

2. Bottlenose Dolphin Barataria Bay, Louisiana (2011, 2013, 2014) and Mississippi Sound, Mississippi (2013) Health Assessments

PI/CI: Teri Rowles/Lori Schwacke

Background/Reason for Study

Natural Resource Damage Assessment (NRDA) pre-assessment efforts documented oil exposure of bottlenose dolphin (*Tursiops truncatus*) stocks in Barataria Bay, Chandeleur Sound and Mississippi Sound. Dolphins were observed in oiled areas and some dolphins were observed with oil patches on their skin. No overt signs of distress were observed in association with oil exposure. However, possible potential sublethal or latent effects, such as organ damage and immune dysfunction, would not be detectable by the photographic and remote biopsy studies conducted to date. In addition to the possible chronic health effects from acute exposure, the dolphins may also be subject to adverse effects if oil and associated chemicals persist in the marine environment, including the marine food web. Other indirect impacts from potential habitat degradation and loss of prey resources are also of concern and may reduce survival and reproduction over the longer term. Such effects have potential to impact the sustainability of stocks or communities.

Objectives

This project conducted capture-release health assessments of bottlenose dolphins in two impacted areas (Barataria Bay, LA -2011, 2013, 2014), and (Mississippi Sound, MS-2013), and a reference site (Sarasota Bay, FL-2011, 2013 –samples collected under NMFS permit 15543) to address potential sublethal, chronic, and indirect health impacts of the Deepwater Horizon (DWH) oil spill and provided information on the health of these populations that are also part of an Unusual Mortality Event. The health assessments enabled researchers to directly assess potential injury endpoints (anemia, organ damage, immune suppression, endocrine disruption, indication of nutritional and chronic stress). Additionally, the capture-release operation allowed for attachment of satellite and VHF tags to dolphins in Barataria Bay to better understand their movements, range and preferred habitats, which may assist in exposure assessment and restoration planning.

Sample Size

Sample size was determined based upon field conditions (water depth, distance to prime dolphin habitat, weather concerns, etc.) and the capture period. Approximately 3 dolphins per day were planned/estimated to be able to be safely captured based upon field conditions, with a proposed sample size of 30 dolphins for the 2 week period for each impacted capture location (LA, MS) and 15 dolphins for a 1 week period for the control site (FL) per year.

Results

In 2011, 32 dolphins were temporarily captured and assessed in Barataria Bay. Twenty-six dolphins were tagged with either radio and/or satellite-linked tags to learn more about habitat use and range of movements.

In 2013, 31 dolphins were temporarily captured and assessed in Barataria Bay. Eight animals were tagged with satellite-linked tags. Twenty dolphins were temporarily captured and assessed in Mississippi Sound. Nineteen were tagged with satellite-linked tags.

In 2014, 32 dolphins were temporarily captured and assessed in Barataria Bay. Eleven animals were tagged with satellite-linked tags.

Dolphins sampled from 2011 in Barataria Bay showed evidence of hypoadrenocorticism, consistent with adrenal toxicity as previously reported for laboratory mammals exposed to oil.

Barataria Bay dolphins were 5 times more likely to have moderate–severe lung disease, generally characterized by significant alveolar interstitial syndrome, lung masses, and pulmonary consolidation. Of 29 dolphins evaluated from Barataria Bay, 48% were given a guarded or worse prognosis, and 17% were considered poor or grave, indicating that they were not expected to survive. Disease conditions in Barataria Bay dolphins were significantly greater in prevalence and severity than those in Sarasota Bay dolphins, as well as those previously reported in other wild dolphin populations. Many disease conditions observed in Barataria Bay dolphins are uncommon but consistent with petroleum hydrocarbon exposure and toxicity. Results from the 2013 and 2014 captures are still undergoing analyses.

More results are detailed in the below manuscript.

Schwacke, L. H., C. R. Smith, F. I. Townsend, R. S. Wells, L. B. Hart, B. C. Balmer, T. K. Collier, S. DeGuise, M. M. Fry, L. J. Guillette, S. V. Lamb, S. M. Lane, W. E. McFee, N. J. Place, M. C. Tumlin, G. M. Ylitalo, E. S. Zolman, and T. K. Rowles. 2014. Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the Deepwater Horizon Oil Spill. Environmental Science and Technology 48: 93-103.

3. Cetacean Auditory Evoke Potentials (AEP) in the Northeast and GOM (2010, 2011,2013)
PI/CI: Teri Rowles/Katie Touhey Moore (IFAW)

Background/Reason for Study

Auditory Evoked Potential (AEP) procedures may be conducted as a method to evaluate the hearing abilities of individual animals or species (Nachtigall *et al.* 2007, Mulsow *et al.* 2012). Procedures may be conducted on stranded animals, animals in rehabilitation, or on animals captured during research studies. Currently little is known about the hearing abilities of non-bottlenose dolphin odontocete species. Live stranding response, especially live mass stranding response allowed for the testing of multiple odontocete species during the response and relocation/release process. All AEP procedures performed on stranded and rehabilitating odontocetes followed NMFS PR1 policies and protocols. Testing did not delay treatment, movement, or release of a stranded animal nor did it interfere with rehabilitation activities. It is considered best practice to conduct AEP on cetacean release candidates to assess suitability for release. Testing was stopped if an animal exhibited any adverse reaction, including abnormal respiration and locomotion, vocalization, vomiting, or other signs of distress.

Objectives

To gather baseline data on hearing abilities of stranded and live capture-release odontocetes, including bottlenose dolphins. This baseline data helped with on-scene release decisions for future stranding events and provides valuable data for cross-population comparisons of live-capture release bottlenose dolphins.

Sample Size

Sample size was opportunistic based upon the number of live stranding events per year. Additionally, sample size for live-capture release projects was determined by the PIs of those projects and AEPs were attempted on as many animals as were allowed based upon animal condition and other sampling concerns.

Result

In 2010 AEP testing was conducted on eight cetaceans including five common dolphins, two Atlantic white-sided dolphins, and one harbor porpoise. In 2011 AEP testing was conducted on eight cetaceans including two common dolphins, four Atlantic white-sided dolphins, one bottlenose dolphin, and one harbor porpoise. In 2013 AEP testing was conducted on 61 small odontocetes including twenty five animals (22 common dolphins, two Atlantic white-sided dolphins and one bottlenose dolphin) that were tested on Cape Cod, MA during stranding response efforts. Two harbor porpoises (one captive female and one juvenile male that stranded and was in rehabilitation) in Vancouver, British Columbia, Canada were tested at the request of their veterinarian, Dr. Martin Haulena. Nine bottlenose dolphins were tested during captures with the Sarasota Dolphin Research Project in Sarasota, FL as a means of not only gathering data, but also in preparation for similar captures in the Gulf of Mexico to ensure proper functioning within the larger team effort. Twenty five bottlenose dolphins were tested in Barataria Bay, LA during the NRDA Barataria Bay bottlenose dolphin health assessments.

In 2010, five of the cetaceans that were given AEP tests were healthy stranded animals that were then relocated and released according to standard IFAW protocol. Two of these animals were released with satellite TDR tags, VHF tags, and Roto Tags. The remaining three animals were euthanized due to poor health according to standard IFAW response protocols (this decision was entirely unrelated to the AEP activity). The decision to euthanize was made on the basis of clinical and hematological tests made on the animals. There was no evidence that the AEP test directly changed the behavior of any of the eight tested animals. Preliminary analysis of the satellite tag data suggests all tagged animals survived the event. Preliminary findings from the AEP project indicate that these individuals' hearing ranges are consistent with those of other small Odontocetes. This project resulted in the first recordings for common dolphins and Atlantic white-sided dolphins.

In 2011, all eight of the cetaceans that were given AEP tests were healthy stranded animals that were then relocated and released according to standard IFAW protocol. One animal was released with a satellite TDR/VHF tag; a second received a location only satellite tag with VHF capability. Five of the remaining cetaceans were released with roto tags only, and the disentangled animal from Florida had extensive damage to the dorsal fin, preventing any tag attachment. There was no evidence that the AEP test directly changed the behavior of any of the eight tested animals. Preliminary analysis of the satellite tag data suggests all tagged animals survived the event. One roto tagged animal restranded several days later, was humanely euthanized and a necropsy was conducted. Preliminary findings from the AEP project indicate that these individuals' hearing ranges are consistent with those of other small Odontocetes.

In 2013 during AEP tests on Cape Cod and at the Vancouver Aquarium, cetacean subjects were continuously provided with supportive care (thermoregulation, foam padding, quiet conditions, etc.). These measures were very effective in minimizing the stress on the tested animals. The dolphins in Florida and Louisiana were examined under strict protocols designed for the safe capture of wild bottlenose dolphins. AEP data collection was done concurrently with other sample collection and physical examination and thus did not add to the total time the animals were held. Results of data are still pending.

4. Sperm Whale Abundance, Habitat, and Spatial Distribution of the Southeastern Gulf of Mexico 2012

PI/CI: Teri Rowles/Keith Mullin

Background/Reason for Study

This project was conducted jointly by the Bureau of Ocean Energy Management (BOEM) and NMFS Southeast Fisheries Science Center. The data will be used to support environmental assessments associated with potential offshore energy exploration projects in the southeastern Gulf of Mexico and to improve understanding of potential critical habitat areas for the endangered Northern Gulf of Mexico sperm whale population. The study area included the offshore waters along the inner continental slope off the Dry Tortugas. The effort focused on known habitat for the southeastern Gulf of Mexico sperm whale aggregation. The research was conducted onboard the NOAA Ship *Gordon Gunter* from June 7 until August 6, 2012 totaling 55 sea-days.

Objectives

The primary objective of this project was to assess the abundance, habitat and spatial distribution of sperm whales of the southeastern Gulf of Mexico by means of visual and acoustic monitoring, biopsy sampling and deployment of satellite tags.

Sample Size

Sample size was determined based upon field conditions (water depth, distance to prime sperm whale habitat, weather concerns, etc.) and the capture period. Approximately 10-20 sperm whales were predicted to be encountered and tagged during the sampling period.

Results

Throughout the cruise as weather allowed, a 7-m RHIB was deployed to conduct close approaches to sperm whales to deploy satellite telemetry tags. These were implantable tags deployed from close distance using a modified compressed air line thrower (Air Rocket Transmitter System - ARTS). The system was used to deploy two types of tag units, both developed by Wildlife Computers: 1) SPOT-5 providing ARGOS satellite-based location information and 2) MK-10A units providing ARGOS locations and summaries of dive behaviors. Close approaches to sperm whales were made on 18 days of the project and 11 tags were deployed consisting of six SPOT-5 tags and five MK-10A tags. Tagging attempts were restricted to the extreme southeastern U.S. Gulf of Mexico, an area where sperm whales have not previously been satellite tagged. An attempt to collect a biopsy sample was made simultaneously with each tagging attempt. Biopsy samples were collected under MMPA Permit 779-1633 issued to the Southeast Fisheries Science Center.

5. Prevalence of Leptospirosis in Free Ranging California Sea Lions prior to, during, and after an outbreak of leptospirosis in stranded sea lions, 2010, 2011

PI/CI: Teri Rowles/Frances Gulland

Background/Reason for Study

Since 1970, periodic outbreaks of leptospirosis, caused by pathogenic spirochetes in the genus Leptospira, have caused morbidity and mortality of California sea lions along the Pacific coast of North America. Yearly seasonal epizootics of varying magnitude occur between the months of July and December, with major epizootics occurring every 3–5 years. Genetic and serological data suggest that *Leptospira interrogans serovar Pomona* is the infecting serovar and is enzootic in the California sea lion population, although the mechanism of persistence is unknown.

Objectives

The study investigated the prevalence of susceptible and carrier animals during a disease outbreak and 2-3 months after an increase in strandings due to leptospirosis. Antibody levels in these animals were measured using a microagglutination test validated for California sea lions. The *Leptospira* carrier status of animals was determined by collecting urine for testing for presence of *Leptospira* organisms using polymerase chain analysis.

Sample Size

Sample size was determined by power analysis with an estimate of 100-120 sea lions per year needed for a 50-80% power if prevalence of disease was estimated at 20%.

Results

Blood, fecal, and urine samples from 109 animals were collected at three locations in Central California in 2010. The samples were sent for analysis to laboratories at the University of California (UC), San Francisco, UC Davis, and the National Animal Disease Center (Ames, IA). All of the animals, except one, returned to the haul out site after handling and appeared to be active and mobile within 10 minutes of release from handling. Antibodies to *Leptospira* were detected in apparently free living sea lions. Novel viruses were detected in feces of sea lions from rookeries.

Active shedding of leptospires was detected in 29 of the 85 sea lions sampled via either PCR, culture or both in 2011. Results of serological analyses are pending. These data will be used to assess whether the patterns of shedding and seroprevalence of antibodies in wild-caught sea lions reflect the patterns observed in stranded sea lions.

See the below manuscript for more details of the study.

Prager KC, DJ Greig, DP Alt, RL Galloway, RL Hornsby, LJ Palmer *et al*. 2013. Asymptomatic and chronic carriage of *Leptospira interrogans* serovar Pomona in California sea lions (*Zalophus californianus*). Veterinary Microbiology, 164: 177-183.

6. Northern Fur Seal Pribilof Islands Health Surveillance Samples 2009, 2012, 2013

PI/CI: Teri Rowles/Tom Gelatt

Background/Reason for Study

The northern fur seal population on the Pribilof Islands has been experiencing a decline in population size over the last several years. To determine if disease is having any impact on

the population, screening for a variety of pathogens has been started by the National Marine Mammal Laboratory. In addition, the recent emergence of phocine distemper virus (PDV) in the Alaska region in sea otters and other marine mammals has increased the need to collect baseline data on prevalence of pathogens, including PDV in northern fur seals.

Objectives

The objectives of this study are to collect data on fur seal health and pathogens. Blood samples are used to assess general health using serum chemistries to detect changes in specific parameters that may indicate poor health and to screen for viruses and toxins. Oral, nasal, rectal, and vaginal swabs are used to assess the presence of parasites or bacterial or viral pathogens.

Sample Size

Sample size was determined by the PI (NMML) for the studies done under their research permit, NMFS Permit No. 782-1708-05 or 14327. Swabs, etc. were collected for MMHSRP on an opportunistic basis.

Results

In 2009, vaginal swabs from 156 northern fur seals were collected on St. Paul Island and 92 vaginal swabs were taken from northern fur seals on St. George Island, AK. In September and October 2012, nasal swabs from 57 northern fur seals were collected on St. Paul Island and 24 nasal swabs were taken from seals on St. George Island, AK. In 2013, nasal swabs were collected from 30 northern fur seals on St. Paul Island.

From the samples collected in 2009, samples from 30 females from each island have been tested for *Brucella sp.*, *Chlamydia sp.*, *Leptospira sp.*, herpesvirus, and toxoplasma. The only positives tests have been for herpesvirus with 97% of the St. Paul females and 80% of the St. George females testing positive by the ELISA test. Follow up PCR testing of the positive samples was ongoing to detect and identify the virus. The ELISA results may be due to cross reactivity to a fur seal or otariid herpesvirus rather than a phocine herpesvirus. Testing of nasal swabs collected in 2012 from 23 animals was negative for PDV via PCR. Swabs from 2013 have been archived and are awaiting testing.

7. Northern Fur Seal California Channel Islands Health Surveillance Samples 2012

PI/CI: Teri Rowles/Robert Delong

Background/Reason for Study

The goals of the sampling study was to sample pups and adult female fur seals to screen the San Miguel population for diseases, specifically herpesviruses, *Coxiella burnetti*, and morbilliviruses.

Objectives

The objective was to establish baseline presence of pathogens in the population at San Miguel for comparison to Alaska populations and determine if fur seal populations could be a source population for the presence of herpesvirus in California sea lions at San Miguel Island.

Sample Size

Sample size was determined by the PI (NMML) for the studies done under their research permit, NMFS Permit No. 14327. Swabs, etc. were collected for MMHSRP on an opportunistic basis.

Results

Vaginal and nasal swabs from 30 adult northern fur seals were collected under to test for the presence of herpesviruses, *Coxiella burnetti*, and morbilliviruses. All 30 adult females were negative for *Coxiella burnetti* and for morbilliviruses, suggesting that these pathogens are not currently prevalent in the population. The results for the herpesviruses are still pending.

8. Grey and Harbor Seal Northeast Health Surveillance Samples 2012, 2013

PI/CI: Teri Rowles/Gordon Waring

Background/Reason for Study

The goal of the sampling study was to screen grey and harbor seal populations for health and disease, specifically looking at morbilliviruses and influenza virus.

Objectives

The objective was to establish baseline presence of pathogens in the grey and harbor seal populations in the northeast.

Sample Size

Sample size was determined by the PI (NEFSC) for the studies done under their research permit, NMFS Permit No.17670 or 775-1875. Swabs, etc. were collected for MMHSRP on an opportunistic basis.

Results

In 2012 samples were collected from harbor seals in Chatham, Massachusetts and Rockland, Maine. Samples were collected from 16 seals in MA and 12 seals in ME. In 2013 samples were collect from 14 grey seals in Chatham, MA. CBC and Chemistry results were within normal limits for the seals tested. Samples for pathogen testing have been archived and results from influenza testing are pending.

9. California Sea Lion Channel Islands Health Surveillance Samples 2013-2014

PI/CI: Teri Rowles/Robert Delong

Background/Reason for Study

A UME was declared for California sea lions pups in March 2013. As part of the UME investigation samples were collected from both sea lion pups and adult females starting in 2013 to screen for any pathogens that could be contributing to the UME.

Objectives

To screen California sea lion pups and adult females for pathogens that could be contributing to the 2013 CA UME. Additionally, samples will continue to be collected post-UME in 2015-2017 to determine if there is any shift in pathogen profiles, specifically for sea lion pups.

Sample Size

Sample size was determined by the PI (NMML) for the studies done under their research permit, NMFS Permit No. 782-1708-05 or 14327. Swabs, etc. were collected for MMHSRP on an opportunistic basis. In general an attempt was made to sample 30 pups per island and 10-20 adult females, when females were being sampled.

Results

In 2013, 14 adult females and their pups were sampled. In 2014, 30 pups were sampled. In 2013, astroviruses were the most commonly identified virus in the surveys from fecal swabs from pups, with a 71% prevalence in 14 live wild pups and a 59% prevalence in 44 stranded pups from the UME, with at least five different astrovirus types identified. Because of the high genetic diversity of the viruses and previously documented high prevalence of astroviruses in surveys of healthy wild and captive sea lion populations, these astroviruses are currently not believed to have caused the UME.

The following pathogens and toxins were not identified in any samples tested: *Clostridium difficile* enterotoxin, *Cryptosporidium, Giardia*, and *Lawsonia intracellularis* from fecal samples; and influenza A virus, morbillivirus, paramyxovirus, and rotavirus from nasal swab samples.

NATIONAL TEMPLATE

MARINE MAMMAL STRANDING AGREEMENT BETWEEN

NATIONAL MARINE FISHERIES SERVICE OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION DEPARTMENT OF COMMERCE

AND

[Stranding Network Organization]

Prepared by Janet E. Whaley, DVM
Office of Protected Resources
1315 East-West Highway
Silver Spring, MD 20910

February 2009

Shaded denotes reserved text at the discretion of the NMFS Regional Administrator

Articles III, IV, V, and VI are reserved and issued at the discretion of the NMFS Regional Administrator.

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ARTICLE I
General Provisions

A. Authority

1. This Marine Mammal Stranding Agreement (hereinafter Agreement) is entered into between the Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS)[*insert* Regional Office], and the Stranding Network Participant [*insert* Stranding Network Organization] (Participant), under the authority of section 112(c) and section 403 of the Marine Mammal Protection Act of 1972 (MMPA), as amended. **This Agreement supersedes all pre-existing Stranding Agreements between these parties. An organizational representative with signatory authority (e.g. Executive Director, President, CEO) must sign this Agreement on behalf of the Stranding Network Organization.**

2. NMFS has been delegated authority by the Department of Commerce to administer the MMPA. To assist in the implementation and administration of the MMPA, the Stranding Network has been established to respond to stranded marine mammals within NMFS' [*insert* Region] of the United States. The [*insert* Region] consists of the following coastal states and territories: [*List* states/territories].

B. Scope

1. Under the MMPA, NMFS is responsible for mammals of the **Order Cetacea** and the **Order Pinnipedia** other than walruses (hereinafter marine mammals).

2. The geographic response area assigned to Participant consists of the following: [(*list* response area including primary and secondary geographic response areas as necessary)]. The Participant may assist in stranding response within the Region outside of their assigned response area, if requested by NMFS or by another Participant. Outside the [*insert* Region], the Participant may assist with stranding response upon request from the appropriate regional NMFS Regional Stranding Coordinator(s).

C. Limitations

1. This Agreement creates an authorization for the Participant to take marine mammals, which would be otherwise prohibited by the MMPA. This taking authorization only applies to the Participant and its authorized personnel (see Article VI) for activities that are consistent with this Agreement.

2. In particular, this Agreement does <u>not</u> authorize:

    a. The taking of any marine mammal species listed as endangered or threatened under the Endangered Species Act of 1973 (ESA), as amended. Authorization to

take ESA listed species is provided under an MMPA/ESA Permit No. 932-1489-09, as amended, issued to the NMFS National Marine Mammal Health and Stranding Response Program Coordinator and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal.

b. The sale or offer of sale of any marine mammal or marine mammal parts including cells, gametes, or cell cultures.

D. Definitions

All terms used in the Agreement shall be interpreted to have the meaning specified in the MMPA section 3 and section 409 and NMFS implementing regulations 50 CFR 216.3 unless the context or specific language requires otherwise. For ease of reference, those definitions, as well as additional terms and definitions for this Agreement, are provided in Attachment A.

ARTICLE II
Purpose and General Responsibilities

A. Purpose of Agreement. NMFS and the Participant enter into this Agreement for the following purposes:

1. To provide for rapid response and investigation of stranded marine mammals *[insert* taxa*]* within the [*insert* Region] in accordance with the purposes and policies of the MMPA.

2. To implement Title IV (Marine Mammal Health and Stranding Response Program) of the MMPA:

    a. to facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild;

    b. to correlate the health of marine mammals and marine mammal populations in the wild with available data on physical, chemical, and biological environmental parameters; and

    c. to detect and coordinate effective responses to Marine Mammal Unusual Mortality Events (UMEs).

3. To specify the activities during which the Participant may take stranded marine mammals [*insert* taxa] or marine mammal parts for the primary purpose of ensuring the appropriate response, [rehabilitation], disposition, and utilization of stranded marine mammals or marine mammal parts under MMPA sections 109(h), 112(c), and 403 and the Agreement.

4. To define the nature and extent of services that the Participant will provide NMFS under this Agreement and NMFS' responsibilities to the Participant.

5. To specify the requirements for the preparation and maintenance and reporting of records containing scientific data obtained from dead and live stranded marine mammals or parts from dead stranded marine mammals.

6. To provide for the timely exchange of information for use by both parties and other network members in furthering the objectives of the MMPA under this Agreement.

B. Joint Responsibilities

NMFS and the Participant will work cooperatively to:

1. Implement Title IV of the MMPA;

2. Effectively respond to and investigate the causes and impacts of UMEs;

3. Collect the appropriate data for determination of serious injuries and mortalities due to human interactions;

4. Collect reference data on marine mammal health and diseases;

5. Collect data on the frequency and causes of strandings; and

6. Interpret findings and identify health trends and diseases of concern to include emerging, reportable, and zoonotic diseases.

C. NMFS Responsibilities

NMFS Shall:

1. Provide the Participant with notice of any changes to laws, regulations, policies and/or guidelines applicable to or promulgated by NMFS that may apply to the Participant's activities. This includes criteria for issuance, renewal and termination of stranding agreements. Notwithstanding this provision, it is the responsibility of the Participant to comply with all laws, regulations, policies and/or guidelines that apply to the Participant's activities.

2. Conduct periodic (R*eserved* annual) compliance reviews of Stranding Agreements as stated in Article IX.

3. Provide guidance and assistance regarding investigation of marine mammal unusual mortality events including financial and physical resources (example: NOAA laboratory assistance) and financial resources when available and authorized (in accordance with section 405 of the MMPA – UME National Contingency Fund) and in coordination with the Working Group on Marine Mammal Unusual Mortality Events.

4. Alert the Participant when NMFS has been notified that there are diseases of concern that are emerging, reportable, and/or zoonotic within the [*insert* Region].

5. Pursuant to criteria established under the MMPA section 407, provide access to the National Marine Mammal Health and Stranding Response Program Database, as developed, and access to marine mammal tissues in the National Marine Mammal Tissue Bank following NMFS data and tissue access procedures and policies.

6. As needed and as resources are available, provide specialized marine mammal stranding response and investigation training on a local, regional or national basis.

7. Pursuant to MMPA section 402, collect and update periodically and make available to stranding network participants and other qualified scientists, existing information on:

   a. procedures and practices for rescuing and rehabilitating stranded marine mammals;

   b. species by species criteria used by the stranding network participants, for determining at what point a marine mammal undergoing rescue and rehabilitation is returnable to the wild based on its ability to survive in the wild and risk to the wild population of marine mammals;

   c. procedures and practices for collecting, preserving, labeling, and transporting marine mammal tissues for physical, chemical, and biological analyses;

   d. relevant scientific literature on marine mammal health, disease, and rehabilitation;

   e. compilation and analyses of strandings by region to monitor species, numbers, conditions, and causes of illness and death in stranded marine mammals; and

   f. other life history and reference level data, including marine mammal tissue analyses that would allow comparison of the causes of illness and death in stranded marine mammals with physical, chemical, and biological environmental parameters.

8. Identify a Stranding Coordinator who will serve as the Participant's primary point of contact for notification, coordination, reporting, and response [and rehabilitation] activities as specified throughout this Agreement. The NMFS Regional Administrator will serve as the Participant's primary point of contact for administration of the Agreement, as well as dispositions and other management activities as specified throughout the Agreement. The NMFS Regional Administrator's designated point of contact for this Agreement is the NMFS Stranding Coordinator; [Regional stranding coordinator or administrator, Regional Office, Protected Resources Division] (see Attachment B for contact information).

9. In certain circumstances such as large scale events (e.g. mass stranding, unusual mortality events, live right whale stranding), NMFS may establish a formal Incident Command System (ICS) for response, including the identification of an Incident Commander. Events such as oil spills, NMFS will follow direction from United States Coast Guard (USCG). Opportunities for ICS training can be accessed through the Federal Emergency Management Agency (see http://www.training.fema.gov/EMIWeb/IS/is100.asp), USCG, or NMFS. If necessary, guidance will be provided by NMFS on a case-by-case basis.

10. Relay reports of stranded marine mammals (live or dead) within the Participant's geographic range to the Participant and inquire whether the Participant has the capability to respond. If the Participant cannot respond, the Stranding Coordinator may make requests to other regional Stranding Participants to respond.

11. Coordinate regional activities to maximize geographic coverage while facilitating appropriate division of responsibilities among regional Participants according to institutional abilities and authorities.

12. Respond to the Participant's completed requests for authorizations such as requests for parts authorizations, parts transfers, and release determinations.

13. Provide information regarding availability of Prescott Grants and any other relevant NMFS funding opportunities.

14. [*Reserved* {For emergency stranding events (live or dead), provide and maintain a 24-hour stranding hotline number: ### ###-####. NMFS shall also provide and maintain a backup stranding pager number:### ###-####.}]

D. Participant Responsibilities

The Participant shall:

1. Comply with laws, regulations, policies and/or guidelines applicable to or promulgated by NMFS that apply to activities under this Agreement; or any Federal, state or municipal laws that pertain to stranding network operations (e.g., municipal water management laws).

2. Cooperate with other members of the [*insert* Region] Stranding Network and the National Marine Mammal Stranding Program as well as Federal, state, and local officials and employees in matters supporting the purposes of this Agreement.

3. Be subject to the direction of a designated employee (e.g., NMFS Marine Mammal Stranding Coordinator or NMFS Special Agent) representing the NMFS [*insert* Region] Regional Administrator or Office of Law Enforcement with respect to the taking of a stranded marine mammal.

4. Manage any and all expenses that the Participant incurs associated with the activities authorized by this Agreement. NMFS does not have funds to reimburse volunteers for expenses incurred in responding to stranding events. However under the marine mammal UME process, funding may be available for costs associated with specific analyses and additional requests in accordance with section 405 of the MMPA UME National Contingency Fund and in coordination with the Working Group on Marine Mammal Unusual Mortality Events. Additionally, competitive funding opportunities for Stranding Network Participants may be available through the Prescott Stranding

Assistance Grant Program (see http://www.nmfs.noaa.gov/pr/health/prescott/).

5. Promote human and public safety by taking precautions against injury or disease to any network personnel, volunteers, and the general public when working with live or dead marine mammals.

6. Notify [immediately or] within 24 hours the NMFS Stranding Coordinator of learning of any diseases of concern (e.g., emerging, reportable, and/or zoonotic diseases) that are detected and/or confirmed that could be a potential hazard for public health or animal health (NMFS will provide guidance on reportable diseases as it becomes available);

7. Transfer of marine mammal parts (50 CFR 216.22 and 216.37):

   a. Non-diagnostic parts, tissues, cells, gametes, or cell cultures to be used for scientific research, species enhancement, or education shall be transferred only to persons or labs that have received prior written authorization from the NMFS MMPA/ESA scientific research permit or a Regional Authorization. A unique field number assigned by NMFS (e.g., NMFS Registration Number) or the Participant must be marked on or affixed to the marine mammal part or container.

   b. Diagnostic parts, tissue samples, fluid specimens, parts, or cells may be transferred to labs within the United States for diagnostic use without any additional authorizations.

8. Work cooperatively with the NMFS and the USCG in a hazardous waste spill (i.e., oil spills) ICS if implemented.

9. Notify the NMFS Regional Administrator in writing within 30 days of any changes in its Designee organizations, key personnel (see Attachment A), capabilities, and/or geographic area of response.

10. If requested, the Participant shall coordinate with NMFS to develop and implement a media plan relating to stranding events.

11. Photo documenting (still or video) for other than diagnostic or identification purposes (such as dorsal fin identification, documentation of lesions, scars, etc.) must not interfere or influence the conduct of the stranding responders and response in any way or cause additional harassment to marine mammals.

12. If requested by the NMFS Regional Stranding Coordinator, the Participant will provide copies of any photographs, films, and/or videotapes documenting any stranding, particularly for those strandings when human interactions are reported or suspected. Reimbursement for this request is subject to negotiation between NMFS and the Participant. Any photography, film and/or videotape of the stranding response used for educational or

commercial purposes of stranding response should by the Participant should include a credit, acknowledgment, or caption indicating that the stranding response was conducted under a Stranding Agreement between NMFS and the Participant under the authority of the MMPA. NMFS will not reproduce, modify, distribute, or publicly display the photograph, film, and/or videotape without consent of the owner, unless required to release a copy under Federal law or order (such as the Freedom of Information Act).

13. By its nature, the handling of stranded marine mammals (dead or alive) is potentially a dangerous activity. The Participant shall indemnify and hold harmless the United States Government from any and all losses, damages, or liability -or claims therefore -on account of personal injury, death, or property damage of any nature whatsoever, arising out of the activities of the Participant, his/her/its employees, his/her/its qualified representatives, designees, subcontractors, volunteers, or agents. Liability for person(s) acting under this agreement is addressed in sections 406(a) and (b) of the MMPA [16 U.S.C. 1421(e)].

14. Provide accurate and honest information in all reports to NMFS.

15. Except where a longer period is specified (e.g., 15 years for rehabilitation cases, see Attachment D *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standard for Rehabilitation Facilities*), maintain records upon which required reports are based for at least 3 years on-site.

16. Upon request by the NMFS Regional Administrator, allow the Regional Stranding Coordinator, other appropriate NMFS employees, or any other appropriate person duly designated by the Regional Administrator, to inspect the facilities and inspect and/or request records that pertain to stranding network activities.

17. [*Reserved* Verbally report any right whale sightings that occur or are reported as part of their normal activities. See Attachment B for contact information.

ARTICLE III
Dead Animal Response

Reserved
OR

A. The Participant may take species of marine mammals under the MMPA for the purpose of dead animal investigation and response.

Subject to the conditions contained in this Agreement, the MMPA, and the implementing regulations, the Participant may take dead stranded marine mammals or parts therefrom for the collection of data on the health and health trends of wild populations, for the detection of marine mammal UMEs, for the detection of signs of human interaction, for research or education on marine mammal biology and life history, for the determination of cause of death, for the detection of human caused and natural mortality, or for other research as deemed appropriate by the NMFS. These activities specifically include: obtaining measurements and biological samples from dead stranded marine mammals; disposing, or assisting in the disposal, of dead stranded marine mammals at an appropriate landfill or other suitable location; and taking and transporting dead stranded or floating dead marine mammals, or parts therefrom, to facilities or individuals approved pursuant to 50 CFR. 216.22 for scientific research, maintenance in a properly curated, professionally accredited scientific collection, or for educational purposes.

B. Terms and Conditions for Dead Animal Response

1. Response

a. The Participant shall respond as practicable to reports of dead stranded marine mammals within the geographic range or response specified under Article I, Number B.2. [*Reserved* {If the Participant is the closest and/or first responder, the Participant is considered to be the on-site coordinating organization and is in charge of all on-site activities.}] In certain circumstances such as a UME, mass stranding, or endangered marine mammal stranding, NMFS may implement the ICS structure and designate an on-site coordinator to be in charge of the event (see Article II C9). In all situations, the Participant will cooperate with Federal, state and local government officials and employees and other stranding network participants when responding to these strandings. If the Participant receives a verified report of a dead stranded marine mammal and does not have the capability to respond appropriately to the report, the Participant shall notify the NMFS Regional Stranding Coordinator and/or adjacent stranding network participants within 24 hours if feasible.

b. If the Participant leaves a dead animal at the stranding site or in thecase of a UME or mass stranding response, the Participant shall, if feasible, mark each animal with a tag or mark, such as roto-tags or grease stick, to assist with data collection and to prevent multiple reports on the same animal(s).

c. If requested by NMFS Regional Stranding Coordinator and if feasible and practicable, the Participant will assist with stranding response in neighboring areas outside the Participant geographic range (specified in Article I B2).

2. Data Collection and Reporting. The Participant shall collect and provide the following information for each stranded marine mammal they respond to:

a. Complete the NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form) for each stranded marine mammal. Completed forms shall be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after responding to the stranding event. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant shall provide preliminary data (verbal or written) from the Level A - Marine Mammal Stranding Report within 24 hours.

b. As resources are available, collect additional Level B and Level C data.

c. Notify the Regional Stranding Coordinator of the following cases [immediately or] within 24 hours or according to the specific reporting guidance provided by the Stranding Coordinator:

1). possible or confirmed human interactions (including military activity),
2). suspected UMEs,
3). extralimital or out-of-habitat situations,
4). mass stranding events and/or mass mortalities,
5). large whale strandings, and
6). any stranding involving endangered or threatened species or identified species of concern [*list* species]

d. In certain circumstances (e.g., listed or rare species stranding, UME, possible human interaction case, extralimital or out-of-habitat situation), the NMFS Regional Stranding Coordinator may request necropsies be conducted by a Necropsy Team Leader, or that additional and expedited reporting (verbal or written) of Level B and C data such as analytical results and necropsy reports if available. NMFS will not reproduce, modify, distribute, or publish the data without consent of the Participant unless required to release the data under Federal law or order (such as the Freedom of Information Act);

e. Collect and make available any gear, debris, or other objects (e.g., bullets, arrows, net webbing, etc.) recovered from a stranded marine mammal that may be evidence of human interaction. The Participant must comply with chain of custody procedures or any other instructions as specified and supported by NMFS [*insert* Region] and/or NMFS Office of Law Enforcement personnel.

3. Parts Disposition. Diagnostic parts, tissue samples, fluid specimens, parts or cells may be transferred to labs within the United States for diagnostic use without any additional authorizations. For non-diagnostic parts or samples:

a. Retention: Marine mammal parts may be retained by the Participant for education and/or research purposes, provided they are properly indicated in the "Specimen Disposition" field of NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form). Parts and/or containers must be marked with the field identification number assigned by the Participant or by NMFS (i.e., NMFS registration number). Authorization to take parts from ESA listed species in the [*insert* Region] is currently provided under MMPA/ESA Permit No. 932-1489-09, as amended, issued to the NMFS Marine Mammal Health and Stranding Response Program Coordinator, and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal, prior to any action by the Participant.

b. Transfer: Report to the NMFS Regional Administrator (See Attachment B) within 30 days of the stranding event, the transfer of any parts salvaged from the stranded marine mammal collected under this Agreement as required by 50 CFR 216.22 [or 50 CFR 216.37]. The Participant must provide the institution name where specimen materials have been deposited and ensure that the retained or transferred parts are marked with the field identification number or assigned NMFS Registration number in the "Specimen Disposition" field on the NOAA Form 89864, OMB #0648-0178 (the Marine Mammal Stranding Report – Level "A" Form) and ensure that retained or transferred parts are marked with the field identification number or the NMFS Registration Number. If parts are being transferred, the Participant must ensure the receiving institution is authorized by the NMFS Regional Administrator to receive marine mammal parts.

4. Site cleanup. The Participant shall make every reasonable effort to assist in the clean up of beach areas where their activities (e.g., necropsy or specimen collection) under this Agreement that may contribute to soiling of the site.

ARTICLE IV
Live Animal Response: First Response

Reserved
OR

A. The Participant may take species of marine mammals covered under the MMPA for the purpose of live stranding first response (initial assessment and care at the site of stranding and assist in the appropriate disposition of the animal), beach triage, beach release, temporary holding for assessment and triage, translocation and/or transportation to a NMFS authorized rehabilitation center within the [*insert* Region].

1. The Participant must take live stranded marine mammals in a humane manner (as defined in 50 CFR 216.3, see Attachment A) for the protection or welfare of the marine mammal. [*Reserve for those w/ Article III authorization:* If the animal dies during the course of response and/or investigation, then the terms and responsibilities contained in Article III of this Agreement become operative.] In addition to the activities authorized in Articles I, II, (*reserved* Article III), the Participant is authorized to implement the following activities under this article:

    a. Take measurements and collecting blood or other diagnostic samples from live stranded marine mammals for health assessment.

    b. Return live stranded marine mammals, as directed by the NMFS Regional Stranding Coordinator, to their natural habitat and tagging such animals

    c. Transport live stranded marine mammals for rescue and rehabilitation to a NMFS approved rehabilitation facility or temporary holding facility.

    d. Perform humane euthanasia. Euthanasia shall only be performed by the attending veterinarian or by a person acting under the direction of the attending veterinarian and following approved guidelines such as those referenced in Attachment C (*2007 Report of the American Veterinary Medical Association Panel on Euthanasia, 2nd Edition of the CRC Handbook of Marine Mammal Medicine, 2006 Journal of the American Association for Zoo Veterinarians*). When using controlled drugs, such person(s) shall comply with all applicable state and Federal laws and regulations (i.e., registered with the Drug Enforcement Administration). Authorization for euthanasia of ESA-listed species provided under MMPA/ESA Permit No. 932-1489-09, as amended, and requires prior approval and direction from the NMFS Regional Stranding Coordinator.

2. This Agreement does not authorize any projects involving "intrusive research" (as defined in 50 CFR 216.3). Measurements or sampling for scientific research purposes (i.e., outside the scope of accepted diagnostic and treatment practices for the care of an

animal) must be authorized under a NMFS MMPA/ESA scientific research permit.

B. Terms and Conditions for Live Stranding: First Response

1. **Response**

a. The Participant shall respond to reports of live stranded marine mammals [R*eserved* for taxa and schedule]. [*Reserved* {If the Participant is the closest and/or first responder, the [Participant acronym] is considered to be the on-site coordinator and is in charge of all on-site activities.}] In certain circumstances such as a UME, mass stranding, or endangered marine mammal stranding, NMFS may implement the ICS structure and designate an on-site coordinator to be in charge of the event (see Article II C9). In all situations, the Participant will cooperate with Federal, state and local government officials and employees and other stranding network participants when responding to these strandings. If the Participant receives a verified report of a live stranded marine mammal and does not have the capability to respond appropriately to the report, the Participant shall notify the NMFS Regional Stranding Coordinator without delay. Also, if the NMFS Regional Stranding Coordinator receives a report of a live stranded marine mammal, the Regional Stranding Coordinator may contact the Participant to determine whether the Participant has the capability to respond to the stranding. If the Participant cannot respond in a timely manner, the NMFS Regional Stranding Coordinator may request another Stranding Network participant to respond.

b. The Participant shall take all steps reasonably practicable under the circumstances to prevent further injury to any live stranded marine mammal, injury to any network personnel, volunteers, government personnel and the general public.

c. The Participant shall tag or mark any animals that are immediately released to their natural habitat using a NMFS approved tag, such as one-bolt roto tag, cattle ear tags, or freeze branding. Application of other tagging methods must first be approved by the NMFS Regional Stranding Coordinator. Tagging and post-tagging activities are restricted to monitoring the success of marine mammals released to the wild. Any projects outside the scope of monitoring the success of a release must be authorized under a NMFS MMPA/ESA scientific research permit.

d. If the Participant determines that it is necessary to temporarily hold or triage a stranded marine mammal at a separate site from the NMFS approved rehabilitation facility, the animal(s) cannot be moved until the Participant obtains verbal approval from the NMFS Regional Stranding Coordinator.

Written documentation of the need for an interim location and written concurrence from the NMFS Regional Stranding Coordinator with any associated conditions must be provided at the earliest time practicable within 24 hours.

e. If the Participant considers responding to an "out-of-habitat" or free-swimming marine mammal [*Reserve:* replace marine mammal with listed species and cetaceans; or listed species and pinnipeds, or listed species] in distress (e.g., entanglement), the Participant must first contact the NMFS Regional Stranding Coordinator for approval and discuss plans for live capture and/or needs for assistance. The NMFS Regional Stranding Coordinator may require a NMFS employee to be present at the time of capture.

f. [*Reserved {*The Participant shall follow the guidance provided by the [*insert* Region] in Attachment E, Disposition of Live Stranded Marine Mammals, and shall consult with the NMFS Stranding Coordinator and the attending veterinarian to make a determination regarding immediate release, rehabilitation, or euthanasia of live stranded marine mammals or cetaceans}].

2. **Data Collection and Reporting.** The Participant shall collect and provide the following information for each stranded marine mammal they respond to:

a. Complete the NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form) for each stranded marine mammal. Completed forms shall be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after responding to the stranding event. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant shall provide preliminary data (verbal or written) from the Level A - Marine Mammal Stranding Report within 24 hours.

b. If temporarily holding a stranded animal prior to transferring to a NMFS approved rehabilitation facility acting in accordance with this Article, the Participant shall complete the NOAA Form 89878, OMB # 0648-0178 (the Marine Mammal Rehabilitation Disposition Report). This report shall be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after responding to the stranding event. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant shall provide preliminary data (verbal or written) from the Marine Mammal Rehabilitation Disposition Form within 24 hours.

c. As resources are available, collect additional Level B and Level C data.

d. Notify the NMFS Regional Stranding Coordinator of the following cases [immediately or] within 24 or according to the specific reporting guidance provided by the Stranding Coordinator:

1). possible or confirmed human interactions (including military activity),
2). suspected UMEs,
3). extralimital or out-of-habitat situations (see B.1.e. of this Article),
4). mass stranding events and/or mass mortalities,
5). large whale strandings, and
6). any stranding involving endangered or threatened species or identified species of concern [*list* species]

e. In certain circumstances (e.g., UME, possible human interaction case, extralimital or out-of-habitat situation), the NMFS Regional Stranding Coordinator may request additional and expedited reporting (verbal or written) of Level B and C data such as analytical results and necropsy reports if available. NMFS will not reproduce, modify, distribute, or publish the data without consent of the Participant unless required to release the data under Federal law or order (such as the Freedom of Information Act);

f. Collect and make available any gear, debris, or other objects (e.g., bullets, arrows, net webbing, etc.) recovered from a stranded marine mammal that may be evidence of human interaction. The Participant must comply with chain of custody procedures or any other instructions as specified and supported by NMFS [*insert* Region] and/or NMFS Office of Law Enforcement personnel.

[*Reserved for those without Article III authorization:*

3. Parts Disposition. Diagnostic parts, tissue samples, fluid specimens, parts or cells may be transferred to labs within the United States for diagnostic use without any additional authorizations. For non-diagnostic parts or samples:

a. Retention: Marine mammal parts may be retained by the Participant for education and/or research purposes, provided they are properly indicated in the "Specimen Disposition" field of NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Stranding Report - "Level A" Form). Parts and/or containers must be marked with the field identification number assigned by the Participant or by NMFS (i.e., NMFS registration number). Authorization to take parts from ESA listed species in the [*insert* Region] is currently provided under MMPA/ESA Permit No. 932-1489-09, as amended, issued to the NMFS Marine Mammal Health and Stranding Response Program Coordinator, and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal, prior to any action by the Participant.

b. Transfer: Report to the NMFS Regional Administrator (See Attachment B) within 30 day of the stranding event, the transfer of any parts salvaged from the stranded marine mammal collected under this Agreement as required by 50 CFR 216.22 [or 50 CFR 216.37.] The Participant must provide the institution name where specimen materials have been deposited and ensure that the retained or transferred parts are marked with the field identification number or assigned NMFS Registration number in the "Specimen Disposition" field on the NOAA Form 89864, OMB #0648-0178 (the Marine Mammal Stranding Report – Level "A" Form) and ensure that retained or transferred parts are marked with the field identification number or the NMFS Registration Number. If parts are being transferred, the Participant must ensure the receiving institution is authorized by the NMFS Regional Administrator to receive marine mammal parts.

4. **Site Cleanup.** The Participant shall make every reasonable effort to assist in the clean up of beach areas where their activities (e.g., euthanasia, necropsy, or specimen collection) under this Agreement.

ARTICLE V
Live Animal Response: Rehabilitation and Final Disposition
Reserved
OR

A. The Participant may take live stranded marine mammals in a humane manner with the goal of rehabilitation and release. If the animal dies during the course of rehabilitation, then the terms and responsibilities contained in Article III of this Agreement become operative. In addition to the activities authorized in Articles I, II, (*reserved* III, IV) of this Agreement and subject to the conditions contained in this Agreement, the MMPA, and the implementing regulations, the Participant is authorized to implement the following activities under this article:

1. In accordance with applicable regulations and NMFS guidelines and best practices, transfer marine mammals to another NMFS approved rehabilitation facility within the [Region] for:

   a. release back to the wild;

   b. temporary placement in a scientific research facility holding a current NMFS scientific research permit and a United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) Research License; or

   c. permanent disposition at an authorized facility (i.e. holds an APHIS exhibitors license {7 U.S.C. 2131 *et seq.*}) after consultation with, and authorization by, the NMFS Office of Protected Resources Permits, Conservation and Education Division.

2. Conduct scientific research on stranded animals in a rehabilitation facility, only if the responsible individual has a NMFS scientific research permit and the facility holds an APHIS research license in accordance with the Animal Welfare Act (see 50 CFR 216.27 (c)(6)).

3. Return rehabilitated stranded marine mammals to their natural habitat. A decision regarding whether or not a marine mammal has the potential to be released must be made as early as possible during the rehabilitation period. Any marine mammal eligible for release must be released as early as possible and no later than six months after being taken for rehabilitation unless the attending veterinarian determines that: the marine mammal might adversely affect marine mammals in the wild; release is unlikely to be successful due to the physical condition and behavior of the marine mammal; or more time is needed to make a determination. Release plans must be submitted to the NMFS Regional Administrator at least 15 days prior to the release, unless advanced notice is waived by the NMFS Regional Administrator. The NMFS Regional Administrator may require the participant to provide additional information, modify the release plan, or dispose of the marine mammal in another manner (see 50 CFR 216.27(a) and the

NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release.)

4. Tag rehabilitated stranded marine mammals, strictly for purposes of monitoring success of release to the wild using a NMFS approved tag, such as one-bolt roto-tag, cattle ear tags, or freeze branding. Application of other tagging methods must first be approved by the NMFS Regional Stranding Coordinator. Tagging and post-tagging activities are restricted to monitoring the success of marine mammals released to the wild. Any projects outside the scope of monitoring the success of a release must be authorized under a NMFS MMPA/ESA scientific research permit.

5. Perform humane euthanasia. Euthanasia shall only be performed by the attending veterinarian or by a person acting under the direction of the attending veterinarian and following approved guidelines such as those referenced in Attachment C (*2007 Report of the American Veterinary Medical Association Panel on Euthanasia, 2nd Edition of the CRC Handbook of Marine Mammal Medicine, 2006 Journal of the American Association for Zoo Veterinarians*). When using controlled drugs, such person(s) shall comply with all applicable state and Federal laws and regulations (i.e., registered with the Drug Enforcement Administration). Authorization for the euthanasia of ESA-listed species provided under MMPA/ESA Permit No. 932-1489-09, as amended, and requires prior approval and direction from the NMFS Regional Stranding Coordinator.

B. Terms and Conditions for Live Animal Response: Rehabilitation, Release, or Final Disposition Determination

1. Rehabilitation

a. The Participant shall comply with laws, regulations, policies, and/or guidelines applicable to or promulgated by NMFS that apply to activities under this Agreement. The Participant must also have all applicable Federal, state, and local permits for rehabilitation facilities, and must comply with all Federal, state, and municipal laws related to operations of the facility.

b. The Participant shall be responsible for the custody of any living marine mammal taken pursuant to this Article using standards for humane care and for practicing accepted medical evaluation and treatment as described in the *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standard for Rehabilitation Facilities* (Attachment D).

c. The Participant shall not exceed their maximum holding capacity for cetaceans and pinnipeds based on the minimum standard space requirements, the number of animals housed in each holding area, and the availability of qualified personnel as described in the *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standard for Rehabilitation Facilities* (Attachment D) unless a written waiver is first received from the NMFS Regional

Administrator. The NMFS Regional Stranding Coordinator may offer assistance for relocating animals to another rehabilitation facility and in supporting decisions to euthanize when necessary. Other considerations for determining maximum holding capacity include:

(1) On-site veterinary care, volunteer support, and experienced staff;
(2) Adequate food and medical supplies and medical test capabilities;
(3) Isolation for marine mammals;
(4) Adequate water quality;
(5) Limited public access; and
(6) Ability to maintain current, accurate and thorough records

d. The Participant shall follow contingency plans approved by NMFS for the care of marine mammals in rehabilitation during planned events (e.g., construction) or unexpected events such as mass strandings, UMEs, natural disasters (e.g., hurricanes, harmful algal blooms, El Niño), and/or hazardous waste spills.

e. The Participant shall isolate rehabilitating marine mammals from other wild or domestic animals and from any animal in permanent captivity.

f. The Participant shall prohibit the public display and training for performance of stranded rehabilitating marine mammals as required by 50 CFR 216.27(c)(5). This includes any aspect of a program involving interaction with the public.

g. The Participant shall follow any additional requirements for rehabilitation (e.g., isolation) and release prescribed by NMFS in consultation with the Working Group for Marine Mammal Unusual Mortality Events during a marine mammal UME, as recommended in the *National Contingency Plan for Response to Unusual Marine Mammal Mortality Events;* D.W. Wilkinson, NOAA Technical Memorandum NMFS-OPR-9, September 1996.

h. The Participant must temporarily refuse admittance of new cases of stranded marine mammals due to the severity of a disease outbreak when instructed by the NMFS Regional Stranding Coordinator, in consultation with the UME Working Group or other experts, if diseases of concern have been reported (e.g. diseases associated with a UME, or any emerging or zoonotic diseases).

i. The Participant shall not transfer a marine mammal being rehabilitated under this Agreement to another facility without prior approval form the NMFS Regional Stranding Coordinator.

[Reserve:

j. If a marine mammal dies while in rehabilitation, Article III applies.]

2. Release

a. Release Recommendation. The Participant shall make a final written recommendation for each animal in rehabilitation as early as possible, and no more than six months after its date of rescue, for release or non-release determination to the NMFS Regional Administrator according to any applicable NMFS release guidelines and regulations including 50 CFR 216.27 (release, non-releasable, and disposition under special exception permits for rehabilitated marine mammals). This final recommendation shall include a release recommendation signed by the Participant's attending veterinarian, attesting that the marine mammal is medically and behaviorally suitable for release in accordance with the NMFS Standards for Release, and a concurrence signature from the Participant's Authorized Representative or Signatory of the Stranding Agreement (see Attachment D, *NMFS /FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*).

b. Release Plan. If the Participant recommends release, a release plan must also be included with the final recommendation letter. This information must be submitted to and approved by the NMFS Regional Administrator at least 15 days prior to the release, unless advanced notice is waived by the NMFS Regional Administrator, as required by 50 CFR 216.27(a).

3. Data Collection and Reporting

a. Diseases of Concern Reporting. The Participant shall notify, [immediately or] within 24 hours, the NMFS Regional Stranding Coordinator of learning of any diseases of concern (e.g., emerging, reportable, and/or zoonotic diseases) that are detected and/or confirmed that could be a potential hazard for public health or animal health (NMFS will provide guidance on Reportable Diseases);

b. Disposition Reports. Upon release or other disposition of any marine mammal under this Article, the Participant shall complete the NOAA Form 89878, OMB # 0648-0178 (the Marine Mammal Rehabilitation Disposition Report Form). Completed forms shall be sent to the NMFS Regional Stranding Coordinator via the NMFS National Marine Mammal Stranding Database or in writing (see Attachment B), no later than 30 days after final disposition of the marine mammal. If requested by the NMFS Regional Stranding Coordinator and if feasible, the Participant shall provide preliminary data (verbal or written) from the Marine Mammal Rehabilitation Disposition Report within 24 hours.

c. [*Reserved* {Annual Summary Reports. The Participant shall submit an annual report (due January 31 each year) summarizing the Participant's rehabilitation activities for the past calendar year. NMFS will not reproduce, modify, distribute, or publish the data without consent of the Participant unless required to release

the data under Federal law or order (such as the Freedom of Information Act).

The reports shall include the following for each animal in rehabilitation:

i. Species and field number
ii. If the animal was released:
   (a) Date, location of release (latitude and longitude).
   (b) Type and specifics of post-release monitoring (roto-tag, satellite, etc.) and any roto-tag or freeze brand numbers used.
   (c) Photos if possible.
   (d) Duration of post-release monitoring.
   (e) Status of post-release monitoring.
   (f) Indications from monitoring relative to success of the rehabilitation effort.
   (g) Disposition of tracking data if applicable.
iii. If the animal was transferred to permanent care:
   (a) Date of physical transport (if applicable)
   (b) Location of permanent care
iv. If the animal was euthanized, provide the date of euthanasia.
v. If the animal died, provide the date of death.

[*Reserved for those without Article III authorization:*]

4. Parts Disposition. Diagnostic parts, tissue samples, fluid specimens, parts or cells may be transferred to labs within the United States for diagnostic use without any additional authorizations. For non diagnostic parts or samples:

a. Retention: Marine mammal parts may be retained by the Participant for education and/or research purposes, provided they are properly indicated in the "Specimen Disposition" field of NOAA Form 89-864, OMB #0648-0178 (the Marine Mammal Rehabilitation Disposition Report Form). Parts and/or containers must be marked with the field identification number assigned by the Participant or by NMFS (i.e., NMFS registration number). Authorization to take parts from ESA listed species in the [*insert* Region] is currently provided under MMPA/ESA Permit No. 932-1489-09, as amended, issued to the NMFS Marine Mammal Health and Stranding Response Program Coordinator, and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal, prior to any action by the Participant.

b. Transfer: Report to the NMFS Regional Administrator (See Attachment B) within 30 days of the stranding event, the transfer of any parts salvaged from the stranded marine mammal collected under this Agreement as required by 50 CFR 216.22 [or 50 CFR 216.37.] The Participant must provide the institution name where specimen materials have been deposited and ensure that the retained or transferred parts are marked with the field identification number or assigned NMFS Registration number in the "Specimen Disposition" field on the NOAA

Form 89864, OMB #0648-0178 (the Marine Mammal Rehabilitation Disposition Report Form) and ensure that retained or transferred parts are marked with the field identification number or the NMFS Registration Number. If parts are being transferred, the Participant must ensure the receiving institution is authorized by the NMFS Regional Administrator to receive marine mammal parts.

ARTICLE VI
Participant's Authorized Personnel [and Designees]

Reserved
OR

A. Personnel and Volunteers

Takings of marine mammals authorized in this Agreement may only be directed by the Participant's personnel and trained volunteers identified by the Participant in writing to the NMFS Regional Administrator. The Participant may use other (i.e., not previously identified to NMFS) volunteers to carry out activities in this Agreement only if they are under the close direction of previously identified trained personnel or volunteers. The Participant may not delegate authority to take marine mammals to another person except as provided in this article.

In the event of changes in key personnel, the prospective Participant shall notify the NMFS Regional Administrator in writing (see Attachment B) [within 30 days] and provide a description of the experience of new key personnel for review and approval by NMFS. New key personnel must be meet the qualification terms identified in the *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement* (Attachment D).

B. Untrained Citizens

If the Participant requests the assistance of untrained citizens (e.g., during a mass stranding), the Participant is responsible for the actions of those citizens during the response; must take precautions against injury or disease to those volunteer citizens; and must ensure that the citizens' actions do not cause unnecessary harassment of marine mammals.

Reserve all or C.1. and C.2.:

C. Designee Organizations.

1. Authorization for Designee Organization(s). The Participant may designate an organization, or institution, to act on behalf of the Participant as a designee in accordance with this Agreement. For the purposes of this Agreement, the term designee does not refer to individual personnel/volunteers of the Participant's organization, or to individual personnel/volunteers of the Designee organization or institution. Any designation requires prior written approval from the NMFS Regional Administrator (Appendix A). Any organization or institution so designated shall be deemed an agent of the Participant and NMFS, and is subject to ALL applicable provisions of this Agreement as well as applicable laws, regulations, and guidelines. The Participant must provide oversight of their designee organization(s). Any breach of the provisions of this Agreement by a designee of Participant shall be deemed a breach by the Participant.

2. Purpose of Designee Organization(s). The purpose of a designee organization(s) is to assist the Participant with improved sub-region coordination, response, and/or rehabilitation capability within the Participant's geographic area of responsibility. The ability to train and oversee Designees helps create new organizations and build the Stranding Network capacity. NMFS will evaluate designee organizations based on the Participant's justification for geographic need, enhancement of response capabilities, and level of experience provided by the designee organization.

3 Terms and Conditions for Adding Designee(s): To request the addition of a Designee Organization to the Participant's Stranding Agreement, the Participant must submit required written information (see below and Attachment D, *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement).* This information must be received at least 30 days prior to any prospective designation, to the NMFS Regional Administrator (see Attachment B) for review and approval. NMFS will respond in writing to the Participant's request within 30 days of receipt of the request with an approval, rejection, or request for more information.

a. Complete name of the designee person, organization, or institution.
b. Resumes or CVs of all key personnel for Designees including evidence of relevant training;
c. Justification Statement for designation;
d. Geographic coverage area for response;
e. For rehabilitation facilities, a facility operation plan including personnel, veterinary care, equipment list, and other requirement stated under any applicable NMFS laws, regulations, policies, and guidelines. The Designee must also have all applicable Federal, state, and local permits for rehabilitation facilities;
f. Oversight plan including how Participant will monitor the activities of the designee under the Agreement; and
g. A copy of written Agreement between the Participant and the Designee that must state that the designee has agreed to abide by all the terms and conditions in the Participant's Stranding Agreement.

4. A Designee organization may not be authorized for activities different than or exceeding those contained in the Stranding Agreement of the Participant.

ARTICLE VII

Rights of States and Local Governments

Nothing in this Agreement shall be construed to affect the rights or responsibilities of other Federal, state, or local government officials or employees acting in the course of their official duties with respect to taking of marine mammals in a humane manner (including euthanasia) for protection or welfare of the marine mammal, protection of public health and welfare or non-lethal removal of nuisance animals (MMPA section 109(h)).

ARTICLE VIII
Effective Dates, Renewal and Application Procedures

A. Effective Date

The terms of this Agreement shall become effective upon the signature by both [Participant acronym] and the NMFS [*insert* Region] Regional Administrator.

B. Period of Agreement

1. **Duration:** Unless terminated as provided in this Agreement, this Agreement shall expire at the end of the following applicable period [*insert* expiration date]:

   1 year for new Stranding Network Participants
   1 year for a Stranding Network Participant on probation
   3 years for a live animal responder and rehabilitator (Articles IV and V)
   6 years for a dead animal only responder (Article III only)

2. **Stranding Agreement Renewals**: No later than 90 days prior to the expiration date of this Agreement, NMFS will provide the Participant with a written notice of expiration, and prescribe information needed from the Participant for renewal (see *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement*, Attachment D). No later than 60 days prior to the expiration date, the Participant shall indicate in writing to NMFS (see Contacts, Attachment B.) that a renewal of this Agreement is requested and shall provide the prescribed information. Following NMFS review of the submitted information to determine if Participant meets applicable requirements, the Agreement may be renewed if agreed to in writing by both parties.

   <u>If no written renewal request is received from the Participant, this Agreement becomes null and void upon the above expiration date.</u>

3. **Provisional Stranding Agreements Renewals**: For new participants, the NMFS Regional Administrator will enter into this Agreement for a provisional period of one year from the effective date. The performance of the Participant will be reviewed to determine if the services provided by the Participant under this agreement have been satisfactory to NMFS. If NMFS determines that the new Participant has satisfied the terms and conditions of this stranding agreement, this Agreement may be extended for a multi-year period. New participants operating without any deficiencies (see Article IX. D), are considered to be in "good standing" under this Agreement.

4. **Denial of Stranding Agreement Renewal**: The decision to renew or deny a Stranding Agreement is solely at the discretion of the NMFS Regional Administrator and is not compelled by the Participant's adherence to the Stranding Agreement criteria. If the

NMFS Regional Administrator denies a renewal request, the denial will be issued in writing by certified mail from the NMFS Regional Administrator to the Participant within 30 days of the Participant's submission of a completed application, and will be based upon the Regional Administrator's judgment of:

a. Past performance of the Participant;
b. Existing capabilities of the Participant; and
c. Geographic and programmatic needs of NMFS' stranding program.

A Stranding Agreement for which renewal is denied by the NMFS Regional Administrator becomes null and void upon the expiration date listed above.

ARTICLE IX
Review, Modification and Termination

A.. Review

The NMFS [*insert* Region] ARA for Protected Resources shall review this Agreement [*reserve* annually or from time to time] for performance adequacy and effectiveness.

B. Modification

The Participant or the [*insert* Region] Regional Administrator may request a modification to the Stranding Agreement, including, but not limited to, procedural or administrative changes, such as a change in contact information, and a request for expansion or reduction of activities authorized by this Agreement. A request for authority for additional activities may require submission of information identified in Attachment D, *NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Evaluation Criteria for a Marine Mammal Stranding Agreement*. Modifications and reductions in authority, as well as notice of issuance or denial of a request for increased authorizations, will be given in writing within 30 days of receipt of a completed request. The Participant and the NMFS Regional Administrator may determine that a new Stranding Agreement is warranted.

C. Suspension or Termination request by Participant

The Participant may request suspension of all or part of this Stranding Agreement for a stated period of time, or may terminate this Agreement, upon 30 days written notice to the NMFS Regional Administrator. Suspension of the authorization of activities at the request of the Participant may be given without prejudice to the reinstatement of authorization or renewal of a Stranding Agreement.

D. Non-Compliance with Stranding Agreement or Violations of Law by Participant

Except in cases of willfulness, or those in which public health, interest, or safety requires immediate suspension, or termination of this Agreement, NMFS shall provide the Participant with notice and an opportunity to correct any deficiencies within a time period specified by NMFS, in writing, if the Participant fails to satisfy the terms and condition of this Agreement or violates any laws, regulations, or guidelines applicable to this Agreement, or Federal, state or municipal laws related to stranding network operations. The NMFS Region may take the following actions based on the circumstances:

1. **Probation.** The Participant may be put on probation for up to three years if deficiencies are not corrected. The NMFS Regional Stranding Coordinator and the Participant will develop a timetable with reasonable and measurable milestones that must be achieved to correct deficiencies during the probation period. Probation requires annual reviews of the Participant's activities for up to three years.

A participant on probation may not be in "good standing" with the Stranding Network.

2. **Suspension.** The NMFS Regional Administrator may suspend the Participant's authority, or any portion of their authority, as appropriate (e.g., suspend rehabilitation authority, but not live or dead animal response), with 30 days written notice, for up to 1 year or until NMFS is satisfied that all deficiencies and violations have been adequately addressed. A notice of suspension listing deficiencies and a timetable with reasonable and measurable milestones required to correct those deficiencies will be issued in writing, delivered in person or by certified mail, from the NMFS Regional Administrator if, in the judgment of the Regional Administrator, the Participant has:

   a. Submitted false information or statements in applications or reports;
   b. Not satisfied the terms and conditions of the Stranding Agreement;
   c. Failed to correct deficiencies in a timely manner; or
   d. Violated applicable Federal, state, or municipal laws, regulations, guidelines, or other requirements.

   A participant on suspension is <u>not</u> in "good standing" with the Stranding Network.

3. **Immediate suspension.** The NMFS Regional Administrator may require immediate suspension of authorization under a Stranding Agreement, or any part of the Agreement, without prior notice if, in the judgment of the Regional Administrator, suspension is needed to protect marine resources, in cases of willfulness, or as otherwise required to protect public health, welfare, interest, or safety, (which includes interest in the welfare of marine mammals). During the suspension period, the NMFS Regional Stranding Coordinator may ask other Stranding Network participants to respond in the Participant's area of geographic coverage. If the Participant's Stranding Agreement is suspended while animals are in rehabilitation, NMFS reserves the right to either confiscate the animals or to arrange for another participant to take over rehabilitation or take custody of the animals. A written notice of immediate suspension will be issued in person or by certified mail.

A participant on immediate suspension is <u>no</u>t in "good standing" with the Stranding Network.

4. **Termination**. The NMFS Regional Administrator may terminate this Agreement, or any part thereof, upon at least 30 days written notice to the Participant, delivered in person or by certified mail. The Agreement may be terminated for any reason, including the Participant's:

   a. Submission of false information or statements in applications or reports;
   b. Failure to satisfy the terms and conditions of the Stranding Agreement;
   c. Failure to correct deficiencies in a timely manner; or

d. Violation of applicable Federal, state, or municipal laws, regulations, guidelines, or other requirements.

The NMFS Regional Stranding Coordinator may ask another Stranding Network participant to respond in the Participant's area of geographic coverage. If the Participant's Stranding Agreement is terminated while animals are in rehabilitation, NMFS reserves the right to either confiscate the animals or to arrange for another participant to take over rehabilitation of or to take custody of the animals.

Termination of the Agreement for any reason shall automatically terminate any designations by the Participant to any designee organizations under this Agreement.

[*Reserve for SAs with Designees*]:

5. **Violations by Designees.** Violations by the Participant's Designee organization are considered to be violations by the Participant. NMFS will address violations by Designees directly with the Participant according to this Article. In addition, NMFS may use the remedy of terminating the designation.

Pursuant to the terms and conditions described above in this Stranding Agreement between [Region] and [Participant], the Participant is authorized *(insert applicable authorizations):*

- **Under Article III to response to strandings of dead marine mammals *{reserve for taxa}*;**
- **Under Article IV to provide first response to live stranded marine mammals;**
- **Under Article V to rehabilitate and release live stranded marine mammals**

THIS STRANDING AGREEMENT IS ENTERED INTO AND MADE EFFECTIVE THIS

Date_____ Date _____

APPROVED:

NMFS [Region] Region **[Stranding Network Organization]**

Signature of Regional Administrator **Signature of Authorized Representative**

_____ _____

THIS STRANDING AGREEMENT REMAINS IN EFFECT UNTIL:

Expiration Date: _____

Appendix A.

Designees:

Statement of Agreement for designation of authority and responsibilities to any organization or institution to act as agents under this Agreement.

AGREEMENT

I have read the conditions as stated above for participating in the Stranding Network as an agent of the_____ (Stranding Network Organization) under its Agreement with the National Marine Fisheries Service Region and agree to abide by all applicable provisions of the Agreement between the National Marine Fisheries Service Region and _____ (Stranding Network Organization).

NMFS Region	Authorized Representative of Stranding Organization	Authorized Representative of Designee Organization

Signatures

Title

Affiliation

Date **Expiration Date**

ATTACHMENT LIST

Attachment A. List of Terms and Definitions under 50 CFR 216.3, Glossary of Terms, etc.

Attachment B. Regional contact information, 24 hour numbers, etc.

Attachment C: Euthanasia guidance

Attachment D: NOAA National Marine Fisheries Service *Best Practices* for Marine Mammal Stranding Response, Rehabilitation, and Release Documents:

- **Evaluation Criteria for a Marine Mammal Stranding Agreement (New Applicants and Renewals of Existing Participants)**
- **Standards for Release**
- **Standards for Rehabilitation Facilities**
- **Level A Forms (Marine Mammal Stranding Report and Marine Mammal Rehabilitation Disposition Report)**

Attachment E: NMFS Southeast Region Disposition of Live Stranded Marine Mammal guidance.

POLICIES AND BEST PRACTICES

MARINE MAMMAL STRANDING RESPONSE, REHABILITATION, AND RELEASE

Evaluation Criteria for a Marine Mammal Stranding Agreements
(New Applicants and Renewals)

Prepared by
Janet E. Whaley, D.V.M. and Laura Engleby
NOAA National Marine Fisheries Service
Marine Mammal Health and Stranding Response Program

February 2009

Evaluation Criteria for a Marine Mammal Stranding Agreement (New Applicants and Renewals)

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Evaluation Criteria for a Marine Mammal Stranding Agreement (New Applicants and Renewals)

Shaded text denotes reserved text at the discretion of the NMFS Regional Administrator.

(1) To renew an existing Stranding Agreement, the applicant must demonstrate past compliance with the terms and responsibilities of their Stranding Agreement, including reporting requirements and deadlines.

(2) For the purpose of network development and expansion of stranding response capabilities in geographically remote or low coverage areas [e.g., Alaska, Washington, Oregon, Hawaii, and American Territories (i.e., Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Marina Islands)], referenced evaluation criteria may be waived based on the discretion of the NMFS Regional Administrator.

(3) If long-term care is not feasible, a plan for disposition of live marine mammals at alternate care facilities must be submitted.

1. Purpose and Application

These minimum evaluation criteria have been developed to assist the National Marine Fisheries Service [Region] Region (NMFS) in its evaluation of Stranding Agreement renewal requests and new Stranding Agreements proposals. Prior to issuing new Stranding Agreements, the NMFS [Region] Regional Administrator must determine there is a programmatic and/or geographic need for a Stranding Network Participant in the proposed area of response. Geographic or programmatic needs are based on, but not limited to, the following factors: the historic number of stranded marine mammals in an area, the amount of personnel and resources of stranding network participants with existing agreements in the proposed response area, the geographic extent of the proposed response area, and the proximity of the existing and prospective stranding network participants to the proposed response area.

The decision to enter into an Agreement under which an organization may take species under the Marine Mammal Protection Act for the purpose of stranding response is solely at the discretion of the NMFS [Region] Regional Administrator. NMFS [Region] Region is not compelled to enter into or to decline to enter into a Stranding Agreement based on an interested party's adherence with these criteria. NMFS weighs the geographical need, programmatic need, level of expertise, stranding related activities, cooperation, and criteria listed below when making its determination in determining whether to issue a new Stranding Agreement.

2. General Evaluation Criteria for Articles III, IV, and V Authorization [(1)]

2.1 General Information

The existing or prospective Participant should provide the following information to NMFS as part of their request to obtain or renew an existing Stranding Agreement with NMFS or upon any significant changes to the information:

1. Participant Contact Information. This should include:
   a. Mailing address, phone number, e-mail, and facsimile for all official correspondence.
   b. Physical address and location of the facility or facilities (if applicable).
   c. Name, title, and contact information for an authorized representative with signatory authority for the organization - Authorized Representative (e.g., Executive Director, Director, President, CEO, etc.).
   d. [24-hour] contact numbers if applicable, including office, home, and/or cell phone numbers of primary responders, key personnel/volunteers, and veterinarians.
2. Description of Organizational Goals, Capability, and Experience. This should include:
   a. Brief summary of the existing or proposed organization's mission, goals, and objectives and how these complement objectives for the [Region] Regional Stranding Network.
   b. Brief summary on history and type of organization (e.g., university, governmental, non-profit, aquarium, etc.).
   c. Description of any past or current collaboration with NMFS, other Stranding Network participants, researchers, or the public.
   d. Summary of relevant organizational experience with response to live/dead stranding events and /or rehabilitating marine mammals within the past three years.
   e. An overview of general capabilities to conduct stranding response.
3. Proposed Scope and Area of Geographic Response. This should include:
   a. Brief summary of the existing or proposed scope of the stranding program (e.g., all species of cetaceans, pinnipeds), and whether the request is for response to dead animals only, live and dead animals, and/or rehabilitation.
   b. Justification and description of the existing or proposed geographic area of coverage and why the area of response is appropriate for the organization (e.g., the amount of personnel/volunteers and resources available, relative to shoreline covered, historic

number of stranding events, etc.). Latitude and longitude of proposed geographic area and maps are especially helpful.

4. Description of Organizational Structure. This should include:
   a. An overview of staffing, personnel, volunteers, veterinarians, the primary representative, and primary responders, including organizational charts, titles, and position descriptions as appropriate.
   b. Brief summary of relevant training, experience, and qualifications for key stranding response personnel, including primary responders, veterinarians and volunteers as appropriate.
   c. Description of how personnel/volunteers will collect, report, and maintain Level A stranding data and conduct basic (Level B) tissue sample collection. This should also address requirements for accurate and timely reporting.
   d. Description of how volunteers are trained and monitored to ensure quality data collection.
   e. Description of how the organization will keep NMFS informed about any changes in key personnel, geographic area of coverage, or capabilities.
5. Equipment and Resources. This should include:
   a. Description of resources, supplies and equipment currently available to conduct stranding response (live and/or dead). This could include, but may not be limited to, information on types and availability of necropsy equipment, freezers, trucks, tagging equipment (e.g., roto-tags), stretchers, vessels, triage equipment, and transport equipment, and temporary and/or permanent pools.
6. Rapid Response and Investigation Procedures. This should include:
   a. Procedures for stranding response for dead/live stranded marine mammals.
   b. Human health and safety precautions used.
   c. How calls are handled, availability (e.g., 24 hour pager), and which personnel will respond.
   d. How necropsies will be coordinated and conducted.
   e. Capabilities and general rescue plan, and plans for animal care (e.g., on-site veterinary care) for live animal response including triage, transport, and euthanasia.
   f. Protocols for decision-making when responding to a live animal.
   g. Description of how the organization will coordinate with other Stranding Network members and NMFS.

7. Any other relevant documentation (permits, authorizations, agreements, etc.) for review prior to entering into any Stranding Agreement and at any subsequent time as requested by the [Region] Regional Administrator, or when additional documentation is obtained that may become relevant to performance under the Agreement.
8. Documentation of experience, ability, and knowledge (e.g., CV, resume, certificates, letters of recommendation, etc.) of key personnel (e.g., primary representative, primary responder). Experience can be obtained through paid employment, internships, volunteering, course work, and/or NMFS approved training.
9. For prospective Participants, demonstrate experience working under the direct supervision of an existing Stranding Network Participant in good standing or NMFS for at least three years or equivalent case load.[(2)] The prospective Participant may apprentice as a "designee" organization under a Stranding Agreement holder to obtain this experience.
10. Letter(s) of support from peers such as other stranding network organizations (Stranding Agreement/Designee organizations), universities/researchers, government agencies, non-governmental organizations, professional organizations, etc. Such letters of support could also be provided from the current Stranding Agreement holder under which the Participant received experience and include assurances that the prospective Participant can support programmatic and geographic needs in the area (new Stranding Agreement proposals only).

2.2 General Qualifications for Articles III, IV, and V

NMFS will evaluate existing and prospective participants based on their demonstrated track record and their capabilities in the following areas as described in their request:

1. Ability to provide description of [24-hour] on-call coverage for the proposed geographic area of response (e.g., established "hot-line" number, message phone, staffed pager, etc.).
2. Demonstrated ability to comply with standard instructions and collect Level A data from stranded marine mammals according to established protocols.
3. Ability to conduct full post-mortem exams, including obtaining histopathology samples and other biological samples (if feasible and requested by NMFS).
4. Willingness and ability to communicate in a professional manner, and demonstrated ongoing cooperation with NMFS, other network members, the general public, local and state agencies.
5. Willingness and ability to cooperate with authorized marine mammal researchers.
6. Ability to address health and safety when responding to dead or live stranded marine mammals, or marine mammals in rehabilitation (e.g., a description of the organization's

operational safety plan or protocols).

7. Demonstrated experience specific to the marine mammal species that are most likely encountered in the proposed area of geographic response.

3. Evaluation Criteria for Response to Dead Stranded Marine Mammals - First Response (Article III Authorization) [(1)]

In addition to the general criteria, Participants proposing to respond to dead stranded marine mammals should provide information that shows the Participant's plan for implementing Article III of the Stranding Agreement, and present evidence that the Participant has the skills, resources, and organizational capabilities to be successful.

3.1 Information for Article III Authorization

Key Personnel. The prospective Participant should have and maintain one Authorized Representative and at least two **Primary Responders**, at least one of whom will be on-site or supervising when dead animals are being examined or handled and is responsible for the day to day operations (i.e., paid and unpaid staff).[(2)] The **Authorized Representative** has signatory authority for the stranding organization and may be the signatory of the stranding agreement (e.g., Executive Director, President, CEO, etc.).

1. Additional personnel may be necessary, commensurate with the proposed geographic area of response and frequency of stranding events.
2. Equipment List. The prospective Participant should demonstrate they have and maintain equipment appropriate to dead animal stranding response – i.e., for dead animal response the equipment list should at least include items necessary for Level A data collection.

3.2 Qualifications for Article III Authorization

1. Key personnel should have experience or comparable training to collect Level A data and if possible to collect Level B data (i.e., complete necropsy). Requests should address key personnel qualifications as follows:
   a. Experience conducting or observing complete necropsies [on a minimum of six marine mammals with at least three of those necropsies on Code 2 animals.][(2)]
   b. Ability to identify species of marine mammals in the field (Code 2).
   c. Ability to accurately identify code condition of marine mammals in the field (Code 1-5).
   d. Ability to obtain accurate Level A stranding data and if possible, to conduct basic tissue sample (Level B) collection.
   e. Knowledge and experience complying with Level A data reporting requirements.

f. Knowledge and experience complying with sampling protocols, sample processing, and shipping procedures.
g. Knowledge of marine mammal anatomy and physiology.
h. Knowledge of human health and safety precautions including potential zoonotic marine mammal disease.
i. Knowledge of state and local disposal policies and rules.

4. Evaluation Criteria for First Response, Triage, and Transport of Live Stranded Marine Mammals (Article IV Authorization) [(1)]

In addition to criteria in sections I and II, prospective Participants proposing to conduct response to live stranded marine mammals should provide information that shows the Participant's plan for implementing Article IV of the Stranding Agreement, and present evidence that the Participant has the skills, resources, and organizational capabilities to be successful.

4.1 Information for Article IV Authorization

Key Personnel. The prospective Participant should have and maintain one Authorized Representative and at least two **Primary Responders** all with experience in marine mammal stranding response, triage, transport, and/or euthanasia, at least one of whom will be on-site or supervising when animals are being examined or handled and is responsible for the day to day operations (i.e., paid and unpaid staff)**.** The **Authorized Representative** has signatory authority for the stranding organization and may be the signatory of the stranding agreement (e.g., Executive Director, President, CEO, etc.).

1. Additional personnel may be necessary, commensurate with the proposed geographic area of response.

2. Veterinary Support. The prospective Participant should identify an attending veterinarian and identify at least one backup veterinarian or have a contingency plan for when the attending veterinarian is not available. Requests should provide documentation of the veterinarian's experience (e.g., CV, certificates, licenses, etc.).

4.2 Qualifications for Article IV Authorization

Requests should address key personnel and veterinarian qualifications as follows:

1. Key personnel should have experience or comparable training in all aspects of live animal response:
   a. Experience responding to a minimum of [five] live marine mammal stranding events (note: a mass stranding is considered to be one event).[(2)]
   b. Experience providing triage and/or transport for a minimum of [three] live stranded marine mammals during separate stranding events.[(2)]
   c. Knowledge and experience monitoring marine mammal vital signs.

d. Ability to assess the condition of stranded marine mammals and make recommendations concerning immediate release, rehabilitation, or euthanasia.
e. Ability to accurately identify species of marine mammals in field conditions.
f. Experience responding to at least one mass stranding event (preferred but not required).[(2)]
g. Ability to [draw blood and] make basic measurements (e.g., length).
h. Ability to tag a marine mammal (e.g., for situations that involve immediate release following assessment).
i. Ability to communicate professionally with other members of the Stranding Network and take direction from NMFS and other on-site coordinators.

2. Attending veterinarians should meet the following criteria:
   a. Be on-call 24-hours.
   b. Knowledge and demonstrated experience in monitoring marine mammal vital signs.
   c. Ability to assess the condition of stranded marine mammals and make recommendations concerning immediate release, rehabilitation, or euthanasia.
   d. Ability to draw blood from a marine mammal.
   e. Have the appropriate registrations and licenses (e.g., registered with the Drug Enforcement Administration for handling controlled substances) to obtain the necessary medications and euthanasia drugs.
   f. Ability to perform humane euthanasia on marine mammals.
   g. Demonstrated familiarity with marine mammal triage and transport.
   h. Access to a list of veterinarians with marine mammal expertise to consult with if needed.
   i. Compliance with any applicable state requirements for veterinary practice on stranded marine mammals.
3. The prospective Participant should demonstrate knowledge of national, state, and local/municipal laws relating to live animal response.
4. The prospective Participant should have provisions for, and willingness to conduct, humane euthanasia as necessary and appropriate.
5. Equipment List. The prospective Participant should have and maintain equipment appropriate to live stranding response, i.e., those items necessary for triage, transport, and/or euthanasia. A complete list of equipment available shall be provided by the prospective Participant.

5. Evaluation Criteria for Rehabilitation and Release of Live Stranded Marine Mammals (Article V Authorization)[1,3]

In addition to the criteria in sections II, III, and IV (if applicable), Participants requesting authorization to conduct rehabilitation of marine mammals should provide information that shows the Participant's plan for implementing Article V of the Stranding Agreement, and present evidence that the Participant has the skills, resources, and organizational capabilities to be successful. The NMFS document, "*Policies and Best Practices: Standards for Rehabilitation Facilities,*" provides additional detailed guidance for preparing Stranding Agreement requests. This document can be found at http://www.nmfs.noaa.gov/pr/health/eis.htm. Facility operations should be consistent with applicable NMFS policies, guidelines, directives, regulations, and other applicable State and Federal policies, guidelines, directives, regulations, and laws.

5.1 Information for Article V Authorization

The prospective Participant should provide information on the following:

1. Facility Capabilities and Procedures. This should include, but not be limited to:
   a. Information on facilities.
      i. Pool type (or housing/pool for pinnipeds) design, description, and dimensions.
      ii. Type of available shelter and/or shading.
      iii. Maximum holding capacity. Description of facility's maximum holding capacity based on minimum standard space requirements and number of animals housed in each holding area and the availability of qualified personnel as provided in the NMFS document, "*Policies and Best Practices: Standards for Rehabilitation Facilities*".
      iv. Water Quality. Description of water, source, quality, and how it is maintained, including how water is tested and frequency of tests.
      v. How the facility/rehabilitation area is secured from public access.
      vi. Provisions for isolating marine mammals.
      vii. How other wild and/or domestic animals will be kept isolated from marine mammals.
      viii. How animals will be quarantined if necessary.

b. Information on procedures for:

i. Food handling and sanitation.

ii. Human health and safety throughout the rehabilitation facility.

iii. How medical, husbandry, and other relevant records will be maintained for each animal. Samples of record forms are helpful.

iv. Efforts to reduce disease transmission.

v. Humane animal care, routine medical procedures, and euthanasia.

c. Key Personnel. The prospective Participant should have and maintain one **Authorized Representative** and two primary animal care specialists, all with experience in marine mammal care and rehabilitation. One of these personnel should fulfill the role of the **Animal Care Supervisor** whom is responsible for overseeing prescribed treatments, maintaining hospital equipment, and controlling drug supplies. The person should be adequately trained to deal with emergencies until the veterinarian arrives, be able to direct the restraint of the animals, be responsible for administration of post-surgical care, and be skilled in maintaining appropriate medical records. It is important that the animal care supervisor should communicate frequently and directly with the attending veterinarian to ensure that there is a timely transfer of accurate information about medical issues. Ideally, this individual should be a licensed veterinary technician or an animal health technician who reports to, or is responsible to, the attending veterinarian. Additional personnel may be necessary, commensurate with the maximum holding capacity. Information regarding key personnel should also include:

i. Overview of staffing plan and capabilities for the rehabilitation facility (e.g., veterinarian technicians, food preparation, record keeping, volunteer/shift coordination, equipment, pool maintenance, etc.).

ii. Description of on-site experienced personnel who are caring for the animals, including resumes or CVs of all key personnel and documentation of relevant training.

iii. Description of how new personnel and volunteers are trained and monitored.

iv. Veterinary Support. The prospective Participant should identify an attending veterinarian and identify at least one backup veterinarian for when the attending veterinarian is not available. Requests should provide documentation of the veterinarian's background, experience, and licensing.

2. Contingency Plans. A copy of contingency plans for protecting or relocating marine mammals in rehabilitation in case of events such as hurricanes or other natural disasters, unusual mortality events, hazardous waste spills, fire, or planned events such as construction.
3. Copies of all applicable Federal, state, and local permits for rehabilitation facilities.
4. General plans for release and post-release monitoring of marine mammals in rehabilitation, including:
    i. How animals will be assessed for release determinations and who makes the assessment.
    ii. How the prospective Participant will follow the NMFS Interim Standards for Release of Rehabilitated Marine Mammals (available on the following website: http://www.nmfs.noaa.gov/pr/health/eis.htm).
    iii. How prospective Participant will conduct tagging, release, and post-release monitoring.
5. Resources. Sufficient physical and financial resources to maintain appropriate animal care for the duration of rehabilitation, including costs associated with release (e.g., long term rehabilitation, transport to release site, post release monitoring) or transport to another facility.

5.2 Qualifications for Article V Authorization

Requests should be evaluated based on the following:

1. Key personnel should have experience or comparable training in all aspects of marine mammal rehabilitation. Requests should address key personnel qualifications for each evaluation criteria below:
    a. Experience or education leading to an understanding of the life history, behavior, biology, physiology, and animal husbandry of applicable marine mammals.
    b. Familiarity with NMFS Interim Rehabilitation Standards, NMFS Interim Standards for Release of Rehabilitated Marine Mammals, and applicable regulations.
    c. Experience in a supervisory role rehabilitating a minimum of three separate rehabilitation cases (Note: Multiple animals in rehabilitation from a mass stranding are considered to be one case).
    d. Ability to humanely restrain a marine mammal to conduct basic medical procedures such as: drawing blood from at least two sites, taking fecal, gastric, blowhole/nasal samples, morphometrics, weighing, injections, and tubing.

e. Experience maintaining and operating a facility/pool for marine mammal care, including familiarity with maintaining proper water quality.

f. Ability to supervise and coordinate on-site personnel and volunteers.

g. Ability to conduct necropsies.

h. Experience with record keeping, such as food intake records, daily behavioral records, medical records, and water quality records (e.g., water temperature, salinity, etc.).

i. Knowledge of how to design and conduct a behavior ethogram (preferred but not required).

2. Attending veterinarians should meet the following criteria:

a. Have an active veterinary license in the United States (means a person who has graduated from a veterinary school accredited by the American Veterinary Medical Association Council on Education, or has a certificate issued by the American Veterinary Graduates Association's Education Commission for Foreign Veterinary Graduates), or has received equivalent formal education as determined by NMFS Administrator (adapted from the Animal Welfare Act Regulations 9 CFR Ch. 1).

b. Assume responsibility for diagnosis, treatment, and medical clearance for release or transport of marine mammals in rehabilitation (50 CFR 216.27).

c. Ability to provide a schedule of veterinary care that includes a review of husbandry records, visual and physical examinations of all the marine mammals in rehabilitation, and a periodic visual inspection of the facilities and records.

d. Be available on a 24-hour basis to answer veterinary-related questions, and be available in case of an emergency.

e. Ability to perform routine diagnostic and medical procedures on the type of marine mammal most often admitted to the rehabilitation facility (e.g., draw blood, give injections, etc).

f. Have marine mammal experience or be in regular consultation with a veterinarian who has marine mammal experience and have access to a list of expert veterinarians to contact for assistance.

g. [*Reserved*. {Have documented one-year clinical experience working with marine mammals, or have a written consulting agreement with an experienced marine mammal veterinarian, which assures availability of consultation when needed.}]

h. Ability to conduct full necropsy on marine mammals.

i. Have access to the most recent edition of the CRC “Handbook of Marine Mammal Medicine.”

j. Be familiar with and comply with the standards of veterinary care in the NMFS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release - Standards for Rehabilitation Facilities.

k. Have the appropriate registrations and licenses (e.g., registered with the Drug Enforcement Administration for handling controlled substances) to obtain the necessary medications for the animals housed at that rehabilitation facility.

l. Be knowledgeable of species-specific pharmacology.

m. Have provisions for performance of humane euthanasia.

n. Ability to write and submit timely disposition recommendations for marine mammals in rehabilitation.

o. Be knowledgeable of marine mammal zoonotic diseases and appropriate safety precautions.

3. A trained volunteer base sufficient to initiate and maintain adequate and appropriate marine mammal care and husbandry and implementation of veterinary direction.
4. Knowledge of national, state, and local laws relating to live animal rehabilitation.
5. Familiarity with, and a copy of, the most current version of the NMFS Interim Rehabilitation Facility Standards and Interim Standards for Release of Marine Mammals.

6. Evaluation Criteria for Designee Organizations

The purpose of a Designee organization is to assist the Participant with sub-region coordination, response, and/or rehabilitation capability within the Participant's geographic area of responsibility and under the Participant's oversight. If a Participant is proposing oversight of a Designee organization(s), the Participant [must] should provide evidence that the Designee organization has the skills, resources, and organizational capability to respond to dead/live stranded marine mammals [or rehabilitate marine mammals]. In some cases, it may not be possible for each proposed Designee organization to meet all of the evaluation criteria listed below. If this is the case, NMFS needs written assurance and details specifying how the prospective Participant will take responsibility for fulfilling specific qualifications lacking for the Designee organization.

6.1 Information for Designee Organizations for Articles III, IV, and V

1. For each proposed Designee organization, the Participant should provide the same information required in sections II through V.
2. Justification for Designee. The Participant should submit a justification for the geographic need, and enhancement of response capabilities provided by the Designee organization to the Participant.
3. Copy of a written and signed Agreement between the Participant and the Designee that includes a statement that the Designee organization has read and agreed to the terms of the Participants current Stranding Agreement.

6.2 Qualifications for Designee Organizations for Articles III, IV, and V

1. Each proposed Designee organization will be evaluated according to the same required qualifications listed in sections II through V.

FINAL

POLICIES AND BEST PRACTICES

MARINE MAMMAL STRANDING RESPONSE, REHABILITATION, AND RELEASE

STANDARDS FOR REHABILITATION FACILITIES

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Standards for Rehabilitation Facilities

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Introduction

As part of the National Marine Fisheries Service (NMFS) Stranding Agreements, the Agency will require that all rehabilitation facilities meet the Minimum Standards presented in this document. The goal of this document is to set **MINIMUM** facility, husbandry, and veterinary standards for rehabilitating marine mammals in order to meet the prescribed NMFS Best Practices Marine Mammal Stranding Response, Rehabilitation, and Release - Standards for Release. Likewise some of the standards put forth in this document are based on the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) Animal Welfare Act (AWA) regulations which define minimum standards for permanent captive marine mammals. However, there are some differences between the two documents in that these standards were developed for temporary care and all age groups. **RECOMMENDED** Standards are included in some sections, and consist of facility design and operational suggestions for optimizing the rehabilitation success rate. Meeting or exceeding the recommended standards may be considered a goal to strive towards when upgrading existing, or designing new facilities or protocols.

It is the intent of NMFS to provide a reasonable process for facilities to be upgraded to meet the minimum standards set forth in this document. Substandard facilities may be improved using funds that may be available through the John H. Prescott Rescue Assistance Grant Program (Prescott Grant). Likewise Prescott Grant funds may also be used to improve facilities that meet minimum standards with the goal to achieve or exceed the recommended standards.

Health and safety practices are highly stressed in this document. NMFS expects that all personnel and volunteers to be trained to the HIGHEST LEVEL of responsibility they are assigned. Rehabilitation facilities are encouraged to comply with Occupational Safety and Health Administration regulations.

Purpose

The purpose of rehabilitation is to provide humane care for stranded marine mammals and to optimize the success of releasing the animals back to the wild. Defining a successful release encompasses many factors. As mandated by Title IV Section 402 (a) of the Marine Mammal Protection Act, NMFS has developed guidance and criteria for release based on optimizing the chances for survival and minimizing the risk to wild populations *(NMFS/FWS BEST PRACTICES for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*). These facility standards have been developed to achieve the goals set forth by the Standards for Release.

This document is organized by taxa similar to the Standards for Release. While many aspects of rehabilitating cetaceans and pinnipeds that are the same, there are likewise many significant differences. Water quality, pool space and design, and handling debilitated animals are examples of the bigger differences between facility design and equipment required for rehabilitation of these animals. Rehabilitation of cetaceans requires more expensive facilities, as there must be larger, deeper pools available, salt water systems, and more elaborate filtration in closed system situations. While some facilities have adequate equipment and personnel to rehabilitate pinnipeds, they may not meet the standards required for the rehabilitation of cetaceans. Having two sets of guidelines allows NMFS the flexibility of issuing agreements specific to the types of animals that may be rehabilitated at each facility.

1. Standards for Cetacean Rehabilitation Facilities

1.1 Facilities, Housing, and Space

Pools for stranded cetaceans must be appropriate for the basic needs of the animal including keeping the skin moist, to providing buoyancy, and aiding thermoregulation. Debilitated cetaceans often cannot swim and may require assistance when first introduced to a rehabilitation pool. Cetaceans arriving in a debilitated condition may have needs requiring smaller pools than those that are able to swim and dive upon arrival. Choice of pool size may be important and is case specific. Although chances of survival may be improved if animals capable of swimming are given larger space, deeper pools may make it more difficult and stressful to catch an animal for feeding, hydration, and treatment. Likewise with multiple strandings, grouping animals by size, ability to swim, species, and health status may improve overall survival rates. Placing the larger, more robust animals in separate pools or swimming areas away from the smaller, less dominant and/or more debilitated animals may enhance the success of the rehabilitation efforts for the weaker animals. Species of cetaceans known to be social in nature should be housed with other compatible species. Social compatibility should be considered an important part of appropriate housing. Animals should be closely monitored when introduced to a pool and carefully evaluated for social compatibility.

It is up to the attending veterinarian, as defined in Section 1.7, and experienced rehabilitation staff, to decide how to house the animal most appropriately based on their observations and physical examination.

Each animal admitted to a rehabilitation center should be placed in a quarantine holding area and have a full health evaluation performed by the attending veterinarian. Sufficient quarantine time should be allowed for results from tests and cultures to be evaluated before the animal is placed with animals that are apparently disease free. Cetaceans with evidence of infectious disease must be quarantined (See Section 1.4 Quarantine).

During multiple or unusual stranding situations such as hazardous waste spills, catastrophic weather events, toxic algal blooms, or other events leading to unusually high morbidity, rehabilitation center personnel may need to adjust the number of animals that would be normally housed in each pool, bay or ocean pen. The attending veterinarian is responsible for assuring that the number of animals housed in one pool or pen will be appropriate based on the situation. The number of animals housed should be determined not only by the amount of pool space and size of the animals, but also by the number of qualified personnel available on a per animal basis. The recommended number of

personnel to animals less than 250 kg is 3:1 for critical care cetaceans; 2: 1 - 4 once stabilized, and 1:4 when animals are eating regularly and no longer require regular handing. Larger critical care cetaceans will require more personnel per animal.

Unweaned neonate cetaceans shall not be admitted for rehabilitation without prior approval of NMFS. Unweaned cetaceans, once rehabilitated, are frequently not suitable for release or require stringent release criteria to ensure humane treatment and a successful outcome. A rehabilitation facility needs to thoughtfully consider these types of cases when developing overall facility goals and objectives. If the facility aims to rehabilitate neonatal and/or unweaned calves, then they need to discuss and seek concurrence with NMFS options for final disposition since most of these cases will be nonreleasable. These issues need to be researched, outlined and NMFS approved prior to admitting any cases. The plan should include options and criteria for release if appropriate (e.g., release with mother), considerations for permanent care, and euthanasia.

NMFS Regulation, U.S.C. 50 CFR 216.27(c)(5) states that marine mammals undergoing rehabilitation shall not be subject to public display. The definition of public display under U.S.C. 50 CFR "is an activity that provides opportunity for the public to view living marine mammals at a facility holding marine mammals captive." (See Section 1.13 Viewing).

1.1.1 Space Requirements for Pool, Bay, or Ocean Pens

MINIMUM STANDARD

- All pools or pens must be deep enough for animal(s) to float and submerge and shall be available for all rehabilitating cetaceans. The diameter and depth of the pool for critical care animals is at the discretion of the attending veterinarian.
- Pool depth for non-critical animals (animals able to swim unassisted) must equal one-half the body length or 0.9 meters (3 feet), whichever is greater.
- Pools shall have a minimum horizontal dimension (MHD) of 7.3 meters (24 feet) or two times the actual length of the largest species housed in the pool, whichever is greater.
- Animals housed longer than 6 months must be provided with pools at least 1.5 meters (5 feet) deep and must meet the USDA, APHIS AWA MHD standards unless otherwise directed by the attending veterinarian. This should be documented and justified with a signed veterinary statement in the medical records.

RECOMMENDED

- Pools shall have a depth equal to the body length or 1.8 meters (6 feet), whichever is greater.
- Pools shall have a minimum horizontal dimension of 9.0 meters (30 feet) or two times the average adult length of the largest species in the pool, whichever is greater.

1.1.2 Pool or Pen Design

Pools or pens designed to maximize the ease of handling, and to limit the amount of time the cetacean spends out of water for husbandry or veterinary procedures may help to decrease the stress of handling. Pools designed with a deep and a shallow end work well because the cetaceans may stay in the deep end while the pool level is dropped. The animal requiring treatment may be moved to the shallow end and immediately placed back in the deep end when the treatment has been completed. Pools equipped with a false bottom that can be lifted are ideal because the animal can be caught quickly without dropping the level of the pool water and the animal may be immediately returned to the pool once treatments have been completed. False bottoms in bay or ocean pens will facilitate capture, since there is no convenient way to drop the water level in those situations. Pools equipped with lift-bottoms and/or multi-level pools are recommended, however lift bottoms must be carefully designed when being retrofitted to existing pools.

Scoop-net or trampoline methods may also be used for capture, where a net is placed on the pool or pen bottom under the swimming animal and it is lifted by multiple personnel using tag lines. While this method is an inexpensive alternative to a false floor it may not be suitable for multiple or large animals.

New rehabilitation pools should be designed and constructed to minimize introduction of anthropogenic noise from life-support equipment or other sources. This can be accomplished through sloping of walls, insulation with soil or other materials around the sides of the pool and/or through isolation of noise-generating equipment. Existing pools that do not meet these specifications may be allowed, or a retrofit may be requested if the pools are substandard to the point of becoming an animal welfare issue.

MINIMUM STANDARD

- Any shape pool that meets minimum space standard
- Construction materials
    - Open water pens shall optimally be constructed of plastic or other rigid netting.

- If cotton or nylon netting material is used it must be small enough gage to prevent entanglement.

RECOMMENDED

- Pools with long axes that provide relief from constant turning while swimming
- Pools designed to promote good water circulation and to minimize anthropogenic noise.
- Single depth pool with false bottom that can be lifted

  OR
- Pool with a sloping bottom where the water level may be dropped in the shallow end to facilitate treatment

  OR
- Single or multi-depth pool with an adjoining "med pool' with a false bottom that can be lifted

  OR
- Ability to drop a pool in less than 2 hours and refill it to a "swimming level" in less than 30 minutes

1.1.3 Shelter, Shading, and Lighting

Rehabilitation facilities located where there is inclement weather need to provide shelter to rehabilitating animals that may be exposed to extreme heat or cold. Cetaceans held in rehabilitation facilities may not have normal activity levels and thin animals may be unable to thermoregulate properly. These animals may require shade structures to protect them from direct sunlight and extreme heat, or shelter to protect them from extreme cold.

Animals held in indoor facilities should be provided with appropriate light and dark photoperiods which mimic actual seasonal conditions. Light provided in indoor facilities shall be of sufficient intensity to clearly illuminate the pool.

MINIMUM STANDARD

- Shade structures or shelters must be provided to animals when local climatic conditions could compromise the health of the animal noting that some cetaceans undergoing rehabilitation may be unable to swim, dive, or thermoregulate, thus requiring either shelter from the elements or shade.
- Shade structures, where necessary, shall be large enough to provide shade to at least 50% of the MHD surface area determined for the species held in the pool. MHD is defined as 7.3 meters (24 feet) or two times the actual length of the largest species housed in the pool, whichever is greater.

- Lighting should be appropriate for the species.

RECOMMENDED

- Full spectrum lights or a natural source of lighting for animals housed indoors.
- Removable or adjustable shade structures in pens that are easily cleaned and that provide more natural sunlight to animals that are swimming and diving normally.

1.1.4 Critical Care Animals and Calves

Debilitated and ill cetaceans are often sedentary and tend to float at the surface for long periods of time. Some are unable to swim and dive. Some may require support in order to stay afloat enough to breathe regularly. Young calves may be weak and require assistance. Support may be provided by floatation devices attached to the animal or rehabilitation personnel supporting the animal utilizing a variety of methods. A shallow area that allows the animal to rest on the bottom while keeping its blowhole above the surface may also suffice. This shallow resting shelf must be of sufficient depth for larger animals (over 50 kg) to provide adequate buoyancy to prevent organ-crushing. Small cetaceans may also be supported in a stretcher that is hung within an open aluminum frame while maintaining the water depth at the midline of the animal. These animals must be protected from sun-related skin damage by providing them with shade or covering their exposed skin with an appropriate, non-desiccating sun block that allows proper thermoregulation. Exposed skin may be protected from desiccation with the use of emollients applied to the skin or a water spray.

MINIMUM STANDARD

- Ensure support is available via floatation devices, a shallow resting shelf, sloping beach, suspended stretcher system, or other support for critically ill or neonatal cetaceans that are weak and/or cannot swim normally.
- Monitor animals requiring support.
- Provide sufficient shade.
- Provide a water spray or method for keeping skin moist for cetaceans that cannot swim or dive.
- Control air temperature above the pool to facilitate recovery, protect rehabilitating animals from heat or cold extremes, and prevent discomfort. This may be achieved by heating or cooling the water appropriately for the species and condition of the animal and/or providing shelter from the elements.

1.1.5 Number of Animals Housed in Each Pool/Pen

During multiple or unusual mortality event (UME) strandings the number of cetaceans received by the facility is limited not only by the number and size of the holding pools or pens, but the number of qualified trained rehabilitation staff members available to care for the animals. Due to the intensive 24 hour assistance required for critical care cetaceans, a minimum of two qualified trained staff members are necessary for each and every dependent cetacean on the premises. The maximum number of animals maintained in each pool and onsite at the facility shall be determined by the attending veterinarian and dictated by the number of qualified staff available to care for the animals.

MINIMUM STANDARD

- Provide enough pool space for each animal to swim, dive, and maintain an individual distance of one body length from other animals housed in the same pool.
- Provide 2 qualified trained rehabilitation staff members for every critical care or dependent cetacean weighing less than 250 kg. Larger critical care cetaceans will require more personnel to handle each animal.
- Staff must be available on a 24-hour basis for critical animal care.
- Provide one trained staff member for every 3-4 cetaceans undergoing less critical periods of rehabilitation; during reconditioning or during counter-conditioning if training or desensitization was used for feeding stations, medical procedure desensitization or transport approximations.
- Provide one trained staff member for every five cetaceans that are eating regularly and do not require handling.

RECOMMENDED

- Provide enough pools or pool space to house multiple animals in accordance with the calculated space outlined in the APHIS AWA standards for captive cetaceans.
- Provide three qualified trained rehabilitation staff members for every critical care or dependent cetacean.
- Provide two trained staff members for every 1 – 4 cetaceans undergoing less critical periods of rehabilitation; during reconditioning; or prior to reintroduction.

1.1.6 Housekeeping

MINIMUM STANDARD

- Keep support buildings and grounds as well as areas surrounding rehabilitation pools clean and in good repair.
- Maintain perimeter fences in good repair, and ensure they are an adequate height and construction to keep people, animals, and pests out.
- Ensure primary enclosures housing marine mammals do not have any loose objects, sharp projections, and/or edges which may cause injury or trauma to the marine mammals contained therein.
- Objects introduced as environmental enrichment must be too large to swallow and made of non porous cleanable material that is able to be disinfected. Likewise items such as rub ropes shall be secured to prevent entanglement.
- All drains and overflows must have screened covers.
- Ensure there are no holes or gaps larger than ½ the size of the head diameter of the calf of the smallest species to be housed.

RECOMMENDED

- Coat all pool and haul-out surfaces with a non-porous, non-toxic, non-degradable cleanable material that is able to be disinfected.

1.1.7 Pest Control

MINIMUM STANDARD

- Establish and maintain a safe and effective program for the control of insects, avian and mammalian pests. This should include physical barriers to prevent feral and/or wild animals from contact with the rehabilitating animals.
- Insecticides or other such chemical agents shall not be applied in a primary enclosure housing marine mammals or a food preparation area except as authorized in writing by the attending veterinarian.
- If applied, all appropriate measures must be taken to prevent direct contact with the insecticide/pesticide, whether airborne or waterborne, by the animal.

1.1.8 Security for Facility

Stranded marine mammals often attract public attention and must be protected from excessive commotion and public contact. Ensuring a quiet stress-free environment for rehabilitating animals may improve their chance to recover and survive. Public viewing of marine mammals is discussed in Section 1.13 of this document.

MINIMUM STANDARD

- Locate rehabilitation facilities at sites that have the ability to be secured from the public.
- Prevent direct public contact with the rehabilitating animals but utilizing appropriate fencing, staff and security personnel.

RECOMMENDED

- Maintain 24- hour monitoring when animals are present or maintain a secure perimeter fence with the ability to lock the area off to the public when staff is not present.

1.2 Water Quality

Water quality is an essential part of keeping cetaceans healthy. Sick or debilitated cetaceans should be housed in pools filled with clean, appropriately treated saltwater to facilitate their recovery.

There are four basic types of water systems:

- Pools with filtration systems (closed systems)
- Pools without filtration systems (dump and fill systems)
- Pools with periodic influx of natural seawater (semi-open systems)
- Open water systems (flow-through pools, bay or sea pens)

There are a number of variables which will affect water quality. The number and size of cetaceans utilizing each pool will vary throughout the year at most rehabilitation facilities. During unusual stranding events the number of cetaceans utilizing one pool may increase dramatically, creating a heavier load of waste which must be handled by the filtration system in closed systems and by the amount of water flow-through in semi-open and open systems.

Filtration or life support systems are essential to maintaining clean water for animals held in closed or semi-closed systems. Life support systems have three basic parts; mechanical filters that remove solids, biological filters or baffles to remove or detoxify chemicals in the water, and disinfecting

methods to control or remove pathogens. In addition to maintaining clean water in the animal pools, these systems may be needed to treat waste water, depending on waste water disposal requirements. If a temporary increase in waste production overwhelms part or all of the life support system, a good water quality control program will require alternative options.

The source of water used in closed systems generally is fresh water obtained from municipal sources whereas water in open and semi-open systems comes from a bay or sea source. Municipal fresh water must have salt added to increase the salinity to appropriate levels to maintain cetaceans. Water in closed systems must be regularly filtered through sand and gravel filters to remove particulate matter, and disinfectants such as chlorine or bromine are added at appropriate levels to eliminate pathogens. More elaborate systems utilize ozone to oxidize pathogens in the water. The source should be independent of other rehabilitation and captive animal areas.

Factors that affect water quality are:

- Size of pool or pen
- Efficiency of filtration system or water flow-through rate (tides)
- Water turnover rate
- Number, size and species of animals housed in pool or pen
- Nature and amount of food consumed by animals in pool or pen
- Nature of bottom substrate
- Frequency of cleaning the pool
- Types, amounts, and the frequency with which chemicals are added to the system
- Temperature of the water
- Pathogens in the water
- Biotoxins in open water pens or in pools where the source water comes from the ocean or bay
- Contaminants (oil, pesticides, etc.) in open water pens
- Hazardous waste spills
- Inclement weather
- Sunlight contributing to algae production on pool surfaces, which in turn can support bacteria.

1.2.1 Source and Disposal of Water

The water source for cetaceans housed in closed or semi-closed systems may be municipal water, well water, or water brought into the facility from an adjacent body of water or estuary. The source should be independent of other rehabilitation and captive animal areas.

MINIMUM STANDARD

- Salt water must be readily available to fill pools housing rehabilitating cetaceans unless otherwise directed by the attending veterinarian.
- Fresh water must be available to clean and wash down surrounding areas.
- For pools without adequate filtration systems, drain water from pools daily or as often as necessary to keep the pool water quality within acceptable limits.
- Discharge wastewater in accordance with state or local regulations. Facility managers must seek appropriate authorization to dispose of waste water. Documents of authorization or necessary permits must be kept on site as part of the administrative record and may be requested by NMFS as part of the NMFS Stranding Agreement.
- Chemicals, when necessary, shall be added in appropriate amounts to disinfect the water or adjust the pH, but not added in a manner that could cause harm or discomfort to the animals.
- Have contingency protocols describing how water quality will be maintained during periods of peak animal use.

RECOMMENDED

- Enough salt water must be available to completely fill pools within two hours of draining.
- Maintain a filtration system designed to optimize water quality in each holding pool and decrease water waste.

1.3 Water Quality Testing

It is important to test the water in which the animals live on a regular basis. Coliform bacterial counts are used to monitor the efficiency of the filtration system to eliminate potentially harmful bacteria. Coliform counts should be done at least once per week and more frequently if there are very large or multiple animals utilizing the pool. While coliform numbers may be described as Most Probable Number (MPN) per 100 ml, a more accurate method of measuring coliforms is to determine the total coliform count, or the fecal coliform count.

Temperature of the water is especially important if the animal lacks the ability to thermoregulate. Water may require heating or chilling to aid debilitated animals in their ability to maintain optimal body temperature. Water temperature regulation is not feasible in open water pens, but keeping track of the water temperature in sea pens may aid the staff in making husbandry decisions.

If coliform counts or the water temperature become too high in any system, measures must be taken to correct the problem in a timely manner. A partial-to-total water change may be necessary to correct the problem in a closed or semi-closed system. If the coliform counts are considered too high in sea or bay pens, efforts should be made to circulate clean sea water through the pens using pumps, paddles or other methods of moving water.

Chemicals added to the water may damage eyes and skin, therefore levels must be monitored daily. Emergency chemicals should be on hand such as sodium thiosulfate in case of the accidental hyperchlorination of a system. Salinity may also have an impact on the health of the skin and eyes, as well as the comfort level of the animal, and should be monitored regularly.

1.3.1 Water Quality Tests

MINIMUM STANDARD

- Measure coliform growth weekly.
- Total coliform counts must not exceed 500 per 100 ml or a MPN of 1000 coliform bacteria per 100 ml water. Fecal coliform counts are not to exceed 400 per 100 ml.
- If the above tests yield results that exceed the allowable bacterial count, then two subsequent samples must be taken to repeat the test(s) where the level(s) is/are exceeded. The second sample is to be taken immediately after the initial test result, while the third sample would be taken within 48 hours of the initial test.
- If the averaged value of the three test results still exceeds the allowable bacterial counts, the condition must be corrected immediately or the animals must be moved to a contingency facility.
- Maintain pH between 6.5 and 8.5.
- Maintain salinity between 24 - 35 ppt.
- Maintain the temperature of the water so that it falls within parameters appropriate for the species.
- Measure oxidant levels in systems which require use of a chemical disinfectant and/or ozone in the system (for closed systems).

RECOMMENDED

- Maintain pH between 7.2 and 8.2.
- Total Coliforms with blanks and controls, fecal Coliform, fecal Strep, and yeast count performed at least weekly.

1.3.2 Frequency of Testing in Closed, Semi-Open, or Open Systems

MINIMUM STANDARD

- Measure water temperature, pH, salinity, chemical additives (if applicable) daily in all pools.
- Measure coliform counts weekly; and more frequently at the discretion of the attending veterinarian.

RECOMMENDED

- If ozone systems are used, measure ozone levels regularly in the animal pools. Ozone levels shall not exceed 0.02 mg/liter.
- Test source and discharge water at least once per day or more frequently for "flow through" systems.
- Maintain records for tests with time, level and results – reviewed and signed monthly by the attending veterinarian or the animal care supervisor.

1.3.3 Chemical Additives

Total chlorine = Free chlorine + Combined chlorine.

MINIMUM STANDARD

- Maintain total chlorine below 1.5 ppm, where the combined chlorine shall not exceed 50% of the total chlorine
- All additives must be recorded
- pH may be adjusted chemically – for example – pH may be raised with sodium carbonate, or soda ash; or lowered with HCl or CO2; but not added in a manner that could cause harm or discomfort to the animals.
- Maintain Material Safety Data Sheet (MSDS) information and signage as well as appropriate handling equipment for the addition of chemicals.

1.3.4 Water Circulation

The amount of water turnover through the filtration system in a closed or semi-open system is important to maintain water quality by removing organic waste and particulate matter. Likewise the amount of water movement through an open water pen is also important in the maintenance of water quality. Generally, adequate tidal action will result in the equivalent of two complete water changes per day.

MINIMUM STANDARD

- Maintain sufficient turnover of water through the filtration system in closed or semi-open systems to keep the water quality at or above acceptable limits, with a minimum of two complete water changes per day.
- Ensure methods for moving water (water paddles, pumps, spray devices) are available to aerate and move water in open water pens with insufficient flow of tides or water through the enclosures. These methods should be sufficient to provide the equivalent of two water changes per day.

RECOMMENDED

- A minimum full water turnover rate of every four hours for each pool in closed or semi-open systems.

1.3.5 Salinity

Acceptable salinity levels are dependant on the species and condition of the cetacean and the duration of the stay. Most species of cetaceans require a salinity level greater than 24 ppt in order to maintain healthy skin and eyes. Occasionally the attending veterinarian may chose to house the cetacean in fresh or nearly fresh water for a period not exceeding 3 days. Reasons for maintaining cetaceans in fresh or brackish water should be noted in the veterinary record and signed by the veterinarian. Some species of cetacean are better adapted to live in brackish water and may do well in lower salinity levels than other species.

MINIMUM STANDARD

- Maintain salinity levels over 24 ppt unless a written veterinary plan calls for lower salinity levels, or if the animals are housed in sea pens nearby their resident range.

RECOMMENDED

- Ideal salinity levels should approach natural ocean salinity levels (30 – 33 ppt) but acceptable industry standards suggest maintaining cetaceans in water with salinity levels over 24 ppt.

1.3.6 pH

MINIMUM STANDARD

- Maintain pH in a range between 6.5 to 8.5.

RECOMMENDED

- Maintain pH between 7.2 –8.2.

1.3.7 Water Temperature

Many species of cetaceans are adapted to maintain normal body temperatures when living in a broad range of water temperatures. Healthy *Tursiops* have been housed successfully in water ranging from 50° to 80° F. Atlantic white-sided dolphins fail to thrive in water over 80° F and North Atlantic harbor porpoise do best in 45 to 65° F. Some warmer water species, such as a Vaquita, will require consistent warm water environments. It is therefore important to know if the species being rehabilitated comes from a polar, temperate or tropical climate. It is of equal importance to know the temperature range of water in their primary habitat. Young, underweight, and debilitated animals may also require warmer water than found in their primary habitat.

Cetaceans such as bottlenose dolphins adjust their blubber thickness seasonally in response to water temperature. This must be considered when readying rehabilitated animals for release. Therefore animals should be acclimated to an appropriate seasonal water temperature prior to release.

MINIMUM STANDARD

- Hold water temperatures within the normal seasonal habitat temperature range for the species under rehabilitation unless otherwise authorized by the attending veterinarian in writing.
- Provide methods to heat and maintain warm water environments for species that require it, or for debilitated individuals that are incapable of maintaining appropriate body temperature.
- Monitor the temperature of water being heated or cooled.
- Design water systems to minimize the chance of rehabilitating cetaceans from becoming hyperthermic or hypothermic.

RECOMMENDED

- Monitor blubber thickness ultrasonically.

1.4 Quarantine

Cetaceans brought to a rehabilitation facility have no medical history and may carry diseases communicable to other marine mammals, other animals, or humans. Likewise, these animals are often debilitated and may suffer from a variety of illnesses which may compromise their immune systems making them susceptible to diseases from other animals and/or the rehabilitation environment. Quarantine areas must be available and proper biosecurity protocols must be in place for all incoming animals at rehabilitation facilities.

Direct contact between the general public and cetaceans undergoing rehabilitation should be avoided because of the zoonotic risk from pathogens carried by marine mammals. There have been documented cases of Brucella, Erysipelothrix, and Blastomyces being passed from cetaceans to humans.

Listed on the following website are numerous other potentially zoonotic marine mammal pathogens (see http://www.vetmed.ucdavis.edu/whc/mmz/). See also: *2004 UC Davis Wildlife Health Center Report for the Marine Mammal Commission – Assessment of the Risk of Zoonotic Disease Transmission to Marine Mammal Workers and the Public: Survey of Occupational Risks.*

MINIMUM STANDARD

Maintain sufficient quarantine facilities and space for appropriate quarantine of incoming animals or for holding animals with contagious diseases.

1.4.1 Prevention of Animal to Animal Transmission of Diseases

- Quarantine all new animals in a separate dedicated quarantine area and provide pools that can be isolated with the use of dividers, tarps, or physical space from the rest of the animal housing areas.
- Have separate filtration and water flow systems for pools in quarantine/isolation areas.
- Use dedicated protective clothing for personnel.
- Use foot baths, glove baths, and methods to disinfect clothing, wet suits, or exposure suits between handling animals within quarantine area and outside of quarantine area.
- Maintain equipment and tools strictly dedicated to the quarantine areas.

- Provide dividers between pens and pools that prevent washdown or splash from moving from one pool to another.
- Provide sufficient space; ideally greater than 20 feet or 6 meters; or solid barriers between animal enclosures to prevent direct contact – including splashed pool water and airborne disease transmission.
- Ensure sufficient air turnover in indoor facilities to prevent transmission of disease. Air turnover should be enough to prevent build-up of heat or chemical fumes and provide a method of bringing fresh air into the facility. There should be sufficient venting or openings to allow movement of air throughout the facility.
- Implement specific quarantine and sanitation procedures to prevent transmission of disease through fomites (personnel, clothing, equipment).
- Thoroughly clean and disinfect buckets, hoses, scales, transport equipment, and cleaning equipment that is moved between animal areas to prevent transmission of pathogens via fomites.
- Place open water pens so effluent is not near water intake.
- Require evaluation and written veterinary approval before placing animals together after quarantine period has been met.

RECOMMENDED

- Provide separate air handling system in indoor facilities.
- Clean and disinfect quarantine pools between uses.

1.4.2 Prevention of Domestic Animal to Marine Mammal Transmission of Disease

- Ensure appropriate fencing and placement of holding pens prevents direct contact between rehabilitating cetaceans and domestic animals.
- Prohibit personal pets from entering the facility and facility grounds. Pets must stay outside the perimeter fence at all times.
- Place foot baths at the entry and exit of animal areas.
- Require quarantine and sanitation protocols are followed to prevent transmission of disease through fomites such as wet suits and equipment.

1.4.3 Prevention of Wild Animal to Marine Mammal Transmission of Disease

- Ensure perimeter fencing will prevent wildlife from entering the rehabilitation premises.
- Provide appropriate rodent and bird control on the premises. Ensure net pens and lagoon areas have sufficient secondary fencing to keep wildlife from coming in direct contact with the animals housed in the net pens.

1.4.4 Prevention of Marine Mammal to Domestic Animal Transmission of Disease

- Provide appropriate perimeter fencing.
- Require animal personnel to change contaminated clothing and/or disinfect before leaving the rehabilitation premises.
- Require that specific quarantine and sanitation procedures are taken to prevent transmission of disease through fomites such as clothing and equipment.

1.4.5 Prevention of Stranded Marine Mammal to Captive Marine Mammal Transmission of Disease

- Train volunteers and staff to follow appropriate quarantine protocols.
- Establish quarantine protocols that take into consideration the changing status of the stranded animal.
- Establish traffic flow so that volunteers or staff working with stranded animals do not inadvertently travel into a collection animal area.
- Establish decontamination protocols before volunteers or staff members exposed to stranded animals may enter a collection animal area.
- Establish separate restrooms, showers, changing rooms, food preparation areas, etc. for staff and volunteers working with rehabilitating vs. collection animals. Food for rehabilitating animals may be prepared in the collection animal kitchen and taken to the rehabilitation animal area, however any bucket, feed implement or other item must be thoroughly disinfected before it may return to the collection animal area.

1.4.6 Methods to Reduce Spread of Disease from Animals Housed in Open Sea/Bay Pen Systems

- Consideration of substrate, water depth and public access when selecting a site for a sea or bay pen.
- Placement of pens in a secluded area where wild animals and marine mammals are unlikely to come into direct contact with the animals housed in the sea/bay pens; nets should be sufficiently rigid to prevent entanglement by mammals or fish.
- Placing a second set of perimeter nets 10 meters from the sea/bay pens to prevent direct contact with wild marine mammals.
- Do not place sea/bay pens within 1000 meters of any major outflow of storm drains or sewage treatment plants and consider the flow direction or current from these major outflows.
- Place the sea/bay pens over 500 meters and downstream from water intake pipes that bring water into facilities that house marine mammals.
- Place pens in an area where there is ample flow-through of tides/currents.
- Ensure the pens are of sufficient size to minimize biomatter build-up. Each cetacean should be housed in a pen that has a minimum depth of half of their body length, and a minimum horizontal dimension of 24 feet or two full body lengths, whichever is greater.
- Avoid overcrowded pens. Animals may fight with each other when housed too closely together. Likewise they must be able to swim and dive normally to maintain optimal muscle condition.
- Have equipment to pump or aerate the water in pens that do not have sufficient tidal action to ensure a minimum of two complete water changes per day.
- Place pens in areas where there is sufficient depth to enhance water circulation and reduce pathogen build-up. Daily coliform testing will determine if pathogen build-up exists.
- Place quarantine pens such that tidal action or underwater currents will not flow through sea pens housing healthy animals.

1.4.7 Evaluation Requirements Before Placing Marine Mammals Together

- Complete blood count (CBC)/Chemistries, appropriate cultures, physical examination before moving animals out of quarantine area.
- Review current NMFS recommendations on diseases of concern (i.e. Morbillivirus) and reportable disease (i.e. Brucella and West Nile virus).

- Consider screening for morbillivirus, herpes virus, Brucella, Leptospira, and Toxoplasma utilizing the most current diagnostic tests available.
- If animals are part of a UME, then screening for diseases must be more thorough and in direct coordination with NMFS and through UME coordinators.
- Have contingency plan for animals that are carriers of or actively infected with reportable disease such as brucellosis, herpes virus, leptospirosis, toxoplasmosis, and morbillivirus.

1.4.8 Zoonotic Considerations

- Restrict public access and direct contact with cetaceans due to zoonosis potential and public health hazard of non-trained individuals interacting with sick and injured marine mammals.
- Train staff and personnel about how to prevent contracting zoonotic diseases (*Occupational and Safety Information for Marine Mammal Workers* http://www.vetmed.ucdavis.edu/whc/mmz/).
- Train staff and personnel working directly with stranded cetaceans how to recognize symptoms of zoonotic disease.
- Provide safety equipment such as protective clothing, eye protection and face masks.
- Provide eye flushing stations as used with hazardous materials (HAZMAT) or normal saline bottles to irrigate the eyes.
- Staff with open wounds shall not enter the pool of animals carrying potentially infectious diseases.
- Persons with disabilities, respiratory conditions, infectious diseases or infectious skin conditions shall not enter pools with rehabilitating cetaceans.
- Train staff the basics of sanitation and properly handling contaminated equipment.

1.4.9 Pre-Release Guidelines

- Pre-release health screens and serologic requirements are directed by the NMFS Regional Stranding Coordinator, in coordination with Marine Mammal Health and Stranding Response Program.

1.5 Sanitation

MINIMUM STANDARD

1.5.1 Primary Enclosure Sanitation

- Remove animal and food waste in areas other than the rehabilitation pool from the rehabilitation enclosure at least daily, and more often when necessary to prevent contamination of the marine mammals contained therein and to minimize disease hazards.
- Remove particulate animal and food waste from rehabilitation/exercise pools at least once daily, but as often as necessary to maintain water quality and to prevent increased health hazards to the marine mammals that use the pools.
- Remove trash and debris from pools as soon as it is noticed, to preclude ingestion or other harm to the animals.
- Clean the walls and bottom surfaces of the rehabilitation/exercise pools as often as necessary to maintain proper water quality.
- Prevent animals from coming in direct contact with disinfectants or aerosolized disinfectants from spray or cleaning hoses.

RECOMMENDED

- Empty and allow pools to dry once each year but dry and hyperchlorine pool bottoms and walls after each use by sick cetaceans.

1.5.2 Sanitation of Food Preparation Areas and Food Receptacles

- Use separate food preparation areas and supplies for rehabilitation vs. collection animals.
- Clean food containers such as buckets, tubs, and tanks, as well as utensils, such as knives and cutting boards, or any other equipment which has been used for holding, thawing or preparing food for marine mammals after each feeding with detergent and hot water and sanitize with an appropriate disinfectant approved for use in food areas at least once a day.
- Clean kitchens and other food handling areas where animal food is prepared after every use, and sanitize at least once weekly using standard accepted sanitation practices.
- Store substances such as cleaning and sanitizing agents, pesticides and other potentially toxic agents in properly labeled containers away from food preparation areas.
- Post MSDS “right to know” documents for staff utilizing cleaning and animal treatment chemicals and drugs.

1.6 Food, Handling, and Preparation

During rehabilitation food for marine mammals shall be wholesome, palatable, free from contamination, and of sufficient quantity and nutritive value to allow the recovery of the animals to a state of good health. Live fish may be fed during rehabilitation but preferences should be given to native prey species. Live fish may contain parasites which could infect compromised animals. Feeding regimens should simulate natural patterns in terms of frequency and quantity to the extent possible while following a prescribed course of medical treatment. Most cetaceans feed repeatedly during a given day.

1.6.1 Diets and Food Preparation

MINIMUM STANDARD

- Prepare the diets with consideration for age, species, condition, and size of marine mammals being fed.
- Feed cetaceans a minimum of three times a day, except as directed by a qualified veterinarian or when following professionally accepted practices.
- Diets reviewed by a nutritionist, attending veterinarian, or the animal care supervisor.
- Train staff to recognize good and bad fish quality.
- Feeding live fish may be required for release determination. See *NMFS /FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release* for more information regarding feeding live fish.
- Food receptacles should be cleaned and sanitized after each use. Food preparation and handling should be conducted so as to minimize bacterial or chemical contamination and to ensure the wholesomeness and nutritive value of the food.

RECOMMENDED

- Feeding patterns should simulate natural patterns in terms of frequency and quantity which may require food to be offered 5 – 10 times daily.

1.6.2 Food Storage and Thawing

MINIMUM STANDARD

- Frozen fish or other frozen food shall be stored in freezers which are maintained at a maximum temperature of 0º F (-18ºC).

- The length of time food is stored and the method of storage, as well as the thawing of frozen food should be conducted in a manner which will minimize contamination and which will assure that the food retains optimal nutritive value and wholesome quality until the time of feeding.
- Freezers should only contain fish for animal consumption. Human food or specimens should not be placed in the fish freezer.
- Experienced staff should inspect fish upon arrival to ensure there are no signs of previous thawing and re-freezing, and check temperature monitoring devices in the transport container. The fish shipment should be refused or the fish discarded if temperature fluctuations occurred during transport.
- Freezers shall be of sufficient size to allow for proper stock rotation.
- All foods shall be fed to the marine mammals within 24 hours following the removal of such foods from the freezers for thawing.
- If the food has been thawed under refrigeration it must be fed to marine mammals within 12 hours of complete thawing.
- When fish is thawed in standing or running water, the coldest available running water must be used to prevent excess bacterial growth.
- To ensure optimal quality of the fish, and to prevent bacterial overgrowth, do not allow fish to reach room temperature or sit in direct sunlight.
- The thawed fish shall be kept iced or refrigerated until a reasonable time before feeding. This time will vary with ambient temperature.
- Prepared formula should be fed immediately or refrigerated and fed to the marine mammals within 24 hours of preparation. Formula, once heated to an appropriate temperature for a feed, shall be discarded if it is not consumed within one hour.

RECOMMENDED

- Calculate kilocalories of each type of fish or food items fed to each animal daily.
- Conduct food analysis for protein, fat and water content of each lot of fish used.
- Culture the slime layer from the fish lot prior to thawing for *Erysipelothrix.*

1.6.3 Supplements

MINIMUM STANDARD

- Each animal shall receive appropriate vitamin supplementation which is sufficient and approved in writing by the attending veterinarian.

1.6.4 Feeding

MINIMUM STANDARD

- Food, when given to each marine mammal individually or in groups, must be given by personnel who have the necessary training and knowledge to assure that each marine mammal receives and eats an adequate quantity of food to maximize its recovery or maintain good health. Such personnel is required to recognize deviations in each animal being rehabilitated such that intake can be adjusted and/or supplemented accordingly.

1.6.5 Public Feeding

MINIMUM STANDARD

- Public feeding of animals that are being rehabilitated is **strictly** prohibited.
- Feeding must be conducted only by qualified, trained personnel.

1.6.6 Feed Records

MINIMUM STANDARD

- Maintain feed records on each individual animal noting the actual (not an estimate) individual daily consumption for each animal by specific food type.
- If non-critical animals are housed in groups and are broadcast-fed, then daily individual food consumption estimates are acceptable
- Weigh food before and after each feeding and the record the amount consumed.
- Obtain body weight or girth measurements at least weekly from debilitated easily-handled animals. Girth measurements are taken at the level of the axilla and the anterior insertion of the dorsal fin. Girth measurements are generally less stressful to obtain than weighing the animal.
- Girth measurements or body weight should be obtained as often as practical in the later stages of rehabilitation without causing undue stress to the animal.

1.7 Veterinary Medical Care

All rehabilitation facilities shall have an attending veterinarian. The attending veterinarian is critically involved in making decisions regarding medical care as well as housing and husbandry of resident and newly admitted patients.

1.7.1 Veterinary Experience

MINIMUM STANDARD

The attending veterinarian shall:

- Assume responsibility for diagnosis, treatment, and medical clearance for release or transport of marine mammals in rehabilitation (50 CFR 216.27).
- Ability to provide a schedule of veterinary care that includes a review of husbandry records, visual and physical examinations of all the marine mammals in rehabilitation, and a periodic visual inspection of the facilities and records.
- Be available to examine animals on a regular schedule and emergency basis; daily if necessary.
- Be available to answer veterinary questions on a 24 hour basis.
- Have marine mammal experience or be in regular consultation with a veterinarian who has marine mammal experience and have access to a list of expert veterinarians to contact for assistance.
- Have an active veterinary license in the United States (means a person who has graduated from a veterinary school accredited by the American Veterinary Medical Association Council on Education, or has a certificate issued by the American Veterinary Graduates Association's Education Commission for Foreign Veterinary Graduates), or has received equivalent formal education as determined by NMFS Administrator (adapted from the Animal Welfare Act Regulations 9 CFR Ch. 1).
- Have the skills to be able to draw blood from, and give injections to the species most commonly encountered at the rehabilitation center.
- Be available to examine animals immediately upon admittance to a facility.
- Be available to assess animals during a mass stranding directly or indirectly through trained and qualified primary responders.
- Have contingency plan for veterinary backup.
- Have the appropriate registrations and licenses (e.g., registered with the Drug Enforcement Administration for handling controlled substances) to obtain the necessary medications for the animals housed at that rehabilitation facility.
- Be able to conduct a full post-mortem examination on all species of cetaceans treated at the facility.
- Be knowledgeable and able to perform cetacean euthanasia.
- Be knowledgeable about species-specific pharmacology.

- Must certify in writing that animals are fit for transport.
- Ability to write and submit timely disposition recommendations for marine mammals in rehabilitation.
- Be knowledgeable of marine mammal zoonotic diseases.

RECOMMENDED

All of the above plus:

- Membership in the International Association for Aquatic Animal Medicine.
- Have access to a current version of the CRC "Handbook of Marine Mammal Medicine"
- Complete a course that offers basic medical training with marine mammals such as Seavet, Aquavet, or MARVET.
- Have a minimum of one year of clinical veterinary experience post graduation.
- Have at least one year clinical experience working with the marine mammal type(s) most frequently admitted to the rehabilitation facility
- Be full time employees or contracted veterinarian experienced in cetacean medicine at facilities managing an average of 5 live cetacean cases per year.

1.7.2 Veterinary Program

MINIMUM STANDARD

- Veterinary care for the animals must conform with any State Veterinary Practice Act or other laws governing veterinary medicine which applies to the state in which the facility is located.
- Standard operating procedures should be reviewed and initialed by the attending veterinarian or the animal care supervisor annually and/or whenever the document is changed or updated. This document may be reviewed by NMFS as part of the NMFS Stranding Agreement or as part of inspections.
- Staff caring for animals should be sufficiently trained to assist with veterinary procedures under the direction of the veterinarian and the rehabilitation facility should maintain at least one **Animal Care Supervisor** who is responsible for overseeing prescribed treatments, maintaining hospital equipment, and controlling drug supplies. The person should be adequately trained to deal with emergencies until the veterinarian arrives, be able to direct the restraint of the animals, be responsible for administration of post-surgical care, and be skilled in maintaining appropriate medical records. It is important that the animal care supervisor should communicate frequently

and directly with the attending veterinarian to ensure that there is a timely transfer of accurate information about medical issues.

- Veterinary decisions shall be based on "best practices" (i.e., based on informed opinions and expertise of veterinarians practicing marine mammal medicine).
- A schedule of veterinary care which includes a review of husbandry records, visual and physical examinations of the animals, and a visual inspection of the facilities should be implemented.
- A health and safety plan for the staff shall be written and accessible at all times. It shall be reviewed by the attending veterinarian or the animal care supervisor annually or as prescribed by the NMFS Stranding Agreement. Also, it may be beneficial to consult with an occupational health medical professional when developing these plans. All animal care staff will be familiar with the plan. The plan shall include protocols for managing bite wounds.

The following reports may be requested annually by NMFS as required under the NMFS Stranding Agreement or as a part of inspections:

- Standard Operating Procedure (SOP) reviews
- Health and Safety Plan reviews
- Animal acquisitions and dispositions
- National Oceanic and Atmospheric Administration (NOAA) Form 89864, Office of Management and Budget (OMB) #0648-0178 (Level A data)
- NOAA Form 89878, OMB#0648-0178 (Marine Mammal Rehabilitation Disposition Report)
- Case summaries for any rehabilitation performed at a facility, including narrative descriptions of the cases as well as spreadsheets of treatments, blood values, etc.

1.8 Laboratory Tests and Frequency of Testing

Specific requirements for tests will be issued by the NMFS stranding coordinator (or UME Onsite Coordinator) in each region as outlined in the Marine Mammal Health and Stranding Response Program for release determinations, surveillance programs and UME investigations. Routine diagnostic sampling and testing protocols will be determined by the attending veterinarian. NMFS must be provided adequate time and information including a veterinary certificate of health before an animal is released as directed in 50 CFR 216.27 (see *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*).

1.8.1 Laboratory Testing

MINIMUM STANDARD

- CBC/Serum Chemistry- For most cases, all animals shall have a minimum of two blood samples drawn for CBC with differential and serum chemistry; upon admission and prior to release (see *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*). If duration of rehabilitation is shorter than a week, one blood workup may suffice and is at the attending veterinarian's discretion.
- Fecal analysis for parasites - Fecal tests for parasites shall be run upon admission of each animal at the discretion of the attending veterinarian.
- Serology as necessary for release determination based on direction of the NMFS stranding coordinator and the Marine Mammal Health and Stranding Program and for additional clinical diagnosis as deemed appropriate by the attending veterinarian.
- The administration of drugs with potential adverse side-effects may require additional testing. For example, the use of ototoxic antibiotics may require subsequent testing of hearing abilities of the animal prior to consideration for release.
- The attending veterinarian or a trained staff member shall perform a necropsy on every animal that dies within 24 hours of death if feasible. If necropsy is to be performed at a later date (ideally no longer than 72 hours postmortem), the carcass should be stored appropriately to delay tissue decomposition.
- Carcass disposal shall be handled in a manner consistent with local and state regulations.
- Perform histopathology on select tissues from each animal that dies at the discretion of the attending veterinarian. A complete set of all major tissues should be evaluated if the animal dies of an apparent infectious disease process.
- Culture and other diagnostic sampling shall be conducted as directed by the attending veterinarian to determine the cause of stranding or death.
- Contact NMFS for additional laboratory test requirements in all cases of unusual mortality outbreaks or disease outbreaks. More complete testing may be required for diseases of concern.
- For cases involving release decisions, unusual mortality investigations, or surveillance programs, serologic assays may only go to labs that have validated tests approved by NMFS, especially for release decisions or determinations. Guidance will be provided by the NMFS Stranding Coordinators or UME Onsite Coordinator.

- Notify the NMFS Stranding Coordinator of learning of any diseases of concern (e.g., emerging, reportable, and/or zoonotic diseases) that are detected and/or confirmed that could be a potential hazard for public health or animal health (NMFS will provide guidance on reportable diseases as it becomes available).
- NMFS must be provided adequate time and information (including veterinary certificate of health) before the animal is released in all cases as directed in 50 CFR 216.27 (see NMFS Standards for Release). This information is required under 50 CFR 216.27(a) and must be submitted 15 days prior to release unless advanced notice is waived by the NMFS Regional Administrator. Guidance on the waivers is provided in the *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release.*

RECOMMENDED

- Complete necropsy performed by the attending veterinarian or a pathologist within 24 hours of death.
- Full histopathology done on tissues from each animal that dies of apparent infectious disease.
- Bank 1cc of serum per blood draw in –80° F freezer.
- Bank heparinized plasma (green top) tube in –80 ^{o} F one per animal.
- Reproductive status shall be evaluated upon admission and prior to release through analysis of serum progesterone and estrogen levels in females, and testosterone in males. Elevated hormone values in females upon admission will require re-sampling within the first two weeks to assess pregnancy. Monitoring by means of monthly blood sample collection and analysis through the course of rehabilitation is strongly advised. If possible, sampling will be done in conjunction with ultrasonic examination of reproductive tracts.

1.9 Record Keeping and Data Collection

Record keeping is an essential part of the rehabilitation process. Not only do accurate and complete medical records for each stranded cetacean allow the staff to provide consistent and optimal care for each animal, but retrospective records help scientists and veterinarians to make better evaluations on how to treat individuals.

1.9.1 Record Keeping

MINIMUM STANDARD

- Record and report the “Marine Mammal Stranding Report - Level “A”.

- Complete the require NMFS Marine Mammal Rehabilitation Disposition Report NOAA 89-878, OMB #0648-0178.as in accordance with the NMFS Stranding Agreement
- Maintain and update individual medical records daily on each animal at the rehabilitation center.
- Individually identify each animal with unique field number.
- Keep an accurate description of the animal, including identification/tag number, date and location of stranding, sex, weight, and length at stranding.
- Subjective, objective, assessment and plan (SOAP) based records are preferred.
- Include food intake and medication administered to each animal in the daily records.
- Weight
    a. Recorded weekly for underweight cetacean calves or as authorized in writing by the attending veterinarian.
    b. Taken as often as possible for underweight animals without causing undue stress to the animal.
    c. Recorded on admission and prior to release for larger cetaceans.
- Measure body weight, girths (axilla and anterior insertion of the dorsal fin) and standard straight-line and length upon admission, and within one week of release/placement.
- Measure blubber thickness (ultrasonically) at standard sites upon admission, and monitor monthly throughout the course of rehabilitation, with a goal of matching blubber to seasonal water temperatures.
- Weigh the animal as practical, keeping in mind that obtaining the weight of the animal may be stressful.
- Record all treatments, blood work, test and results and daily observations in the medical records.
- Maintain individual medical records for each animal. Medical records remain on site where the animal is housed and are available for NMFS on site review upon request as stated in the NMFS Stranding Agreement.
- Maintain medical records in an accessible format on site for a minimum of 15 years.
- Maintain up to date water quality records for a minimum of two years.
- Maintain life support system maintenance records.
- Maintain records of water quality additives.

RECOMMENDED

- Full set of standard morphometrics prior to release.
- Photographic documentation, identifying marks, lesions.

- Caloric value of daily food intake calculated and recorded for each animal each day
- Daily weight of calves or emaciated animals at the discretion of the attending veterinarian.
- Maintain food acquisition and analysis records.
- Maintain "paper copy" archive of required NMFS records.

1.9.2 Data Collection

MINIMUM STANDARD

- Written documentation of the medical history, food and observation records must be kept.
- NMFS Required Forms to be completed in writing or submitted electronically in the NMFS National Marine Mammal Stranding Database as prescribed in the NMFS Stranding Agreement:
  a. Marine Mammal Stranding Report – Level A (NOAA 89-864, OMB #0648-0178)
  b. Marine Mammal Rehabilitation Disposition Report (NOAA 89-878, OMB #0648-0178)

RECOMMENDED

- Computerized documentation with hard copies.
- Ability to network with other institutions.
- Maintain real-time accessible compiled comparative data.

1.10 Euthanasia Protocols

MINIMUM STANDARD

- Each institution must have a written euthanasia protocol signed by the attending veterinarian.
- Persons administering the euthanasia must be knowledgeable and trained to perform the procedure.
- Maintain a list of individuals authorized to perform euthanasia signed by the veterinarian.
- Euthanasia shall be performed in a way to minimize distress in the animal.
- Refer to resources such as the American Veterinary Medical Association Panel Report on Euthanasia, the CRC Press Handbook of Marine Mammal Medicine and American Association for Zoo Veterinarians Guidelines for Euthanasia of Nondomestic Animals.
- Appropriate drugs for euthanasia in appropriate amounts for the largest species admitted to the facility shall be maintained in stock on site in an appropriate lockbox or under the control of a licensed veterinarian with a current Drug Enforcement Administration (DEA) license.
- Drugs for euthanasia shall be kept with an accurate inventory system in place.

- DEA laws and regulations and any applicable State Veterinary Practice Acts must be followed when using controlled drugs.
- NMFS may request this information (protocols and DEA number) as part of the NMFS Stranding Agreement.

1.11 Health and Safety Plans for Personnel

There shall be a health and safety plan on site at each rehabilitation facility that identifies all health and safety issues that may be factors when working closely with wild marine mammals. The plan should identify all potential zoonotic diseases as well as including safety plans for the direct handling of all species and sizes of cetaceans seen at that facility. Rehabilitation facilities are encouraged to comply with Occupational Safety and Health Administration regulations.

MINIMUM STANDARD

- Identify all potential zoonotic diseases in a written document available to all personnel.
- Include safety plans for the direct handling of all species and sizes of cetaceans seen at that facility.
- Include safety plan for dealing with handling any untreated discharge water.

1.12 Contingency Plans

Contingency plans shall be in place at each facility and may be required by NMFS as part of the NMFS Stranding Agreement. NMFS may require approved variances or waivers prior to planned projects such as construction, and NMFS may not allow rehabilitation efforts to occur under some circumstances. These plans should addresses in detail the operation of the facility and care of the animals under the following conditions:

- Inclement weather plan, including a hurricane/big storm plans where appropriate.
- Construction in the vicinity of the animal rehabilitation pools recognizing the potential and documented adverse impacts of construction on cetaceans, and including specific reference to how noise, dust, debris, and construction worker access will be controlled, how and how frequently animal health will be monitored, and specific criteria for when construction shall be halted or the animals will be moved to another site out of the construction area if the animals appear to be adversely impacted.
- Power outages, including plans of how to maintain frozen fish stores and life support systems.

- Water shortages.
- "Acts of God" plan which may include floods, earthquakes, hurricanes or other unpredictable problems known to occur on occasion in the region where the facility is located.

1.13 Viewing

NMFS Regulation, U.S.C. 50 CFR 216.2(c)(5) states that marine mammals undergoing rehabilitation shall not be subject to public display. The definition of public display under U.S.C. 50 CFR is "an activity that provides opportunity for the public to view living marine mammals at a facility holding marine mammals captive". Only remote public viewing or distance viewing should be allowed and only when there is no possible impact of the public viewing on the animals being rehabilitated. There is a regulatory requirement for a variance or waiver by NMFS for facilities planning to offer public viewing of any marine mammal undergoing rehabilitation.

1.14 Training and Deconditioning Behaviors

Basic behavioral conditioning of wild cetaceans for husbandry and medical procedure may be warranted during rehabilitation as long as every effort is made to limit reinforced contact with humans. Such conditioning may reduce stress for the animal during exams and acquisition of biological samples. Conditioning may assist with appetite assessment and ensuring that each animal in a group receives the appropriate amount and type of diet and medications.

In some cases, extensive contact with humans, including training, may benefit resolution of the medical case by providing mental stimulation and behavioral enrichment, and may facilitate medical procedures. The relative costs and benefits of training should be evaluated by the attending veterinarian and animal care supervisor and the likelihood of contact with humans following release should be considered. Seeking advice from a qualified cetacean behaviorist (with at least 3 years of experience) may be beneficial.

Behavioral conditioning of cetaceans must be done for the shortest time necessary to achieve rehabilitation goals and is to be eliminated prior to release such that association of food rewards with humans is diminished. If an animal has become accustomed to hand-feeding or boat-following, the animal may approach humans after release. Therefore, these behaviors should be deconditioned or counter-conditioned before the animals can be considered for release. Most behaviors will extinguish through lack of reinforcement, but some may require more concentrated efforts.

Training for research that is above and beyond the scope of normal rehabilitation practices can be approved on a case-by case basis under a NMFS scientific research permit. An exception can be made if the attending veterinarian, facility, and NMFS officials all agree that the research will not be detrimental to the animals' health and welfare and will not impede their ability to be successfully released back to the wild.

2. Standards for Pinniped Rehabilitation Facilities

2.1 Facilities, Housing, and Space

Pools for stranded pinnipeds must be appropriate for the basic needs of the animal including buoyancy and thermoregulation. Debilitated pinnipeds often cannot swim and will avoid water if offered, preferring a haul-out space to a pool. Pinnipeds arriving in a debilitated condition have different needs and may not require pools initially. If no pool is provided to the animal, means of keeping it wet and protected from direct sunlight is essential. The upper critical temperature of California sea lions is lower than most land-dwelling mammals at 24°C (75°F) and with limited thermoregulatory ability, they have special habitat needs in captivity. While dry sea lion coats absorb about 74% and wet California sea lion coats absorb almost 92% of all types of shortwave radiation respectively, a California sea lion with a wet coat exposed to direct sunlight could easily overheat on a hot day if there were no other method to cool the animal. (Langman *et al.*, 1996).

Social compatibility should be considered as a part of appropriate housing. Pinnipeds known to be social should be housed with compatible species whenever possible. Placing larger, more robust animals in separate pens, away from the smaller, weaker, or less dominant animals may enhance the success of the rehabilitation efforts for the weaker animals.

It is up to the attending veterinarian and experienced rehabilitation staff, to decide how to house the animal most appropriately based on their experience, observations, and physical examination.

Each animal admitted to a rehabilitation center should be placed in a quarantine holding area and have a full health evaluation performed by the attending veterinarian, Sufficient quarantine time should be allowed for results from tests and cultures to be evaluated before the animal is placed with animals that are apparently disease free. Pinnipeds with evidence of infectious disease must be held in separate areas from other rehabilitating animals to prevent transmission of disease. There should be sufficient isolation areas to accommodate incoming animals with evidence of disease utilizing methods to control aerosol and water-borne exposure to other on-site animals. (See Section 2.4 Quarantine).

During multiple or unusual stranding situations such as hazardous waste spills, catastrophic weather events, toxic algal blooms, or other events leading to unusually high morbidity or mortality, rehabilitation centers may need to adjust the number of animals that would be normally housed in each pen, pool, or bay or ocean pen. The attending veterinarian will be responsible for assuring that

numbers of animals housed in one pool or pen will be appropriate based on the situation. The number of qualified animal care personnel available to care for the animals could be a limiting factor on how many animals may be housed at each facility.

Care should be taken when hand rearing neonatal otariids, as some species frequently imprint on their caregivers rendering them unsuitable for release. A plan for placing animals in a permanent captive environment should be in place in advance for pinniped pups that are ultimately deemed unreleasable.

NMFS Regulation, U.S.C. 50 CFR 216.2(c)(5) states that marine mammals undergoing rehabilitation shall not be subject to public display. The definition of public display under U.S.C. 50 CFR is "an activity that provides opportunity for the public to view living marine mammals at a facility holding marine mammals captive" (See Section 2.13 Viewing).

2.1.1 Pool Requirements

MINIMUM STANDARD

- Pools shall be available for all pinnipeds under rehabilitation. Critical care animals may be temporarily held without water access at the discretion of the attending veterinarian.
- Critically ill animals or young pups are to be housed appropriately, with the pool size and depth as well as the dry resting area determined by the discretion of the attending veterinarian.
- Pools shall be deep enough for each animal to completely submerge, and shall be at least 0.76 meters or 2.5 feet deep. An exception to this would be temporary pools for young pups or debilitated animals.
- Pools shall be large enough in diameter to allow each animal housed therein to swim.

RECOMMENDED

- Pools shall have a MHD of 1 meter or 1.5 x the length of the largest animal utilizing the pool, whichever is larger.
- The minimum surface area of the pool for non-critical animals shall be at least equal to the dry resting area required by USDA, APHIS AWA standards, but using the actual length of the largest animal in the enclosure instead of the average adult length.
- The pool shall be at least 0.91 meters deep or one-half the actual length of the longest species contained therein, whichever is greater.

- If adult pinnipeds are commonly rehabilitated, facilities should be designed to accommodate the average number of adult-sized animals that strand each year, and have at least one pool and haul-out area that meet USDA APHIS AWA standards.

2.1.2 Dry Resting Area

MINIMUM STANDARD

- One non-critical animal; area of dry resting area = 1.2 x (length of the animal)^2.
- Two non-critical animals; area of dry resting area = 1.5 x (length of the longest animal)^2.
- Three or more animals in the same enclosure require the minimum space for two animals and, in addition, enough space for the animals to lay separately with at least one body length from one another, to turn around completely, and to move at least two body lengths in one direction.
- The facility must have a plan to manage adult males.
- Animals may be temporarily housed in smaller areas at the discretion of the veterinarian. The attending veterinarian should determine the minimum space which will be most appropriate for the age or medical condition of the animal.
- Critical care animals and young pups may be temporarily supplied smaller pools and less dry resting area.

RECOMMENDED

- One to two animals: 2 x (length of longest animal)^2
- Three or more animals in the same enclosure: (length of each animal)^2 x number of animals in enclosure = number of square feet of required dry resting area (DRA).

2.1.3 Pool or Pen Design

New rehabilitation pools should be designed and constructed to minimize introduction of anthropogenic noise from life-support equipment or other sources. This can be accomplished through sloping of walls, insulation with soil or other materials around the sides of the pool and/or through isolation of noise-generating equipment. A special exception may be granted by NMFS if existing pools do not meet these specifications and a retrofit is not feasible as long as animal welfare is maintained.

MINIMUM STANDARD

- Pools or pens shall be designed for ease of cleaning and handling the animals.

- Open water pens shall optimally be constructed of plastic or other rigid netting.
- If cotton or nylon netting material is used it must be small enough gage to prevent entanglement.

RECOMMENDED

- Pools designed to promote good water circulation and to minimize anthropogenic noise.
- Ability to drop a pool in less than 2 hours and refill it to a "swimming level" in less than 30 minutes or a false bottom or other method utilized for ease of capturing and treating pinnipeds.

2.1.4 Length of Stay and How it Affects Space

Facilities which handle adult animals that are kept for periods longer than six months but less than one year should meet USDA APHIS AWA standards. However the actual length of each animal may be used for each DRA calculation rather than the adult length. After one year, holding space must meet APHIS standards.

2.1.5 Shelter, Shading, and Lighting

Animals housed at rehabilitation facilities must be provided with shelter to provide refuge from extreme heat or cold. Pinnipeds held in rehabilitation facilities may not have normal activity levels and thin animals may be unable to thermoregulate properly. These animals may require shade structures to protect them from direct sunlight and extreme heat, or shelter to protect them from cold temperatures or inclement weather. Animals held in indoor facilities should be provided with appropriate light and dark photoperiods which mimic actual seasonal conditions. At the discretion of the attending veterinarian an exception to refuge from extreme cold during the pre-release conditioning phase may be made. Pinnipeds should be protected at all times from extreme heat.

MINIMUM STANDARD

- Provide shade structures or shelters to animals to aid thermoregulation when local climatic conditions could compromise the health of the animal.
- Provide shade and/or water spray to all pinnipeds that cannot swim and are housed in areas where ambient air temperatures reach > 80° F (26.6° C).
- Lighting in indoor facilities shall be appropriate for the species and shall clearly illuminate the DRA and pool during daylight hours.

RECOMMENDED

- All of the above and a source of natural or full spectrum light for animals housed indoors.
- Removable or adjustable shade structures that may be sanitized regularly in pens to provide more natural sunlight to animals that are swimming and diving normally.

2.1.6 Air Temperature

MINIMUM STANDARD

- Attention to ambient air temperature and humidity should be considered to facilitate recovery, protect rehabilitating animals from extremes of heat or cold, and to prevent discomfort.
- Method to raise or lower air temperature, as appropriate to maintain proper body temperature should be available. Access to full shade, constant water sprays and fans may be used for animals that have no access to pools during times when the ambient temperature exceeds 85°F (29.4°C). Likewise radiant heating devices or waterproof heating pads may be utilized when ambient temperatures fall below the comfort level of the animal, which will be determined by the species, age, medical condition, and body condition of the animal.
- Animals should be able to move away from point source heaters. If animals are too debilitated to move, temperature of heaters can not exceed the safe range of 60-80°F at skin surface or animals must be monitored every 2 hours.
- Large fans or "swamp coolers" available to move air across animals with no access to pools when ambient temperatures reach over 85°F (29.4°C).

RECOMMENDED

- Provide temperature-controlled shelter or holding space for critical care animals or pups.
- Monitor temperature of additional heaters such as heating pads infrared heaters and heat lamps.

2.1.7 HOUSING FOR CRITICAL CARE ANIMALS

Debilitated and ill pinnipeds are often sedentary and haul out or float at the surface of a pool for long periods of time. Young pups may be weak and require assistance moving in and out of pools. A shallow area that allows the animal to rest on the bottom with gradually sloping sides or a ramp equipped with a gripping surface to allow ease in entering and exiting the pool are considered optimal.

MINIMUM STANDARD

- Individual dry haul out space or individual enclosures shall be large enough to accommodate the most common species of pinnipeds rehabilitated routinely at the facility.
- Housing for critically ill animals that will provide shelter from the extremes of heat or cold, and will provide heat as appropriate for animals held in cold climates.
- Access to shallow water and/or water spray for all pinnipeds as advised by the attending veterinarian.
- Barriers sufficient to isolate incoming animals until the attending veterinarian determines them to be free from contagious disease (See Section 2.4 Quarantine).

RECOMMENDED

All of the above minimum standards, plus:

- Individual enclosures for each critical care animal where the dry resting area = (length of the animal)^2.
- Housing which provides optimal temperature control for critically ill animals (heating and/or air conditioning).

2.1.7 Housing of Pups

Pups of all species have special housing and management needs and require careful monitoring when introducing them to pools. Premature pups may require more time than full-term pups before introducing them to water.

MINIMUM STANDARD

Phocids less than 1 week old:

- Individual housing with fully supervised access to shallow water (< 0.5 meters deep) pools. Full supervision may stop when animals demonstrate ability to swim and haul out.

Otariids less than 3 weeks old:

- Individual housing or housing with similarly sized pups with fully supervised access to shallow water pools (<0.5 meters deep) Full supervision may stop when animals demonstrate ability to swim and haul out.

- Access to raised platforms in dry resting areas for pups of all ages at the discretion of the veterinarian. Critical or debilitated pups should not be required to lay on concrete or other hard/cold surfaces. Platforms must be low enough for easy access yet high enough to allow the floor to dry under platform. Platforms should be made of material with a sealed cleanable surface and designed to allow for waste to pass through.

RECOMMENDED

- All of the above and with pools designed with a gently sloping side/beach area with "gripping surface" to allow pups to easily haul out without assistance.

2.1.8 Housing of Older Pups

Full term phocids greater than 1 week old and otariids greater than three weeks old

MINIMUM STANDARD

- House pups with similar conspecific age group.
- House pups as individuals or groups with frequent or constant access to deeper water (> 0.5 meters deep).
- Provide a platform or shallow shelf in each pool that allows pups to easily haul out on their own.
- Provide platforms in dry resting areas allowing critical or debilitated pups an alternative to laying on concrete or other hard/cold surfaces (as above).

RECOMMENDED

- Provide a pool designed with a gently sloping side leading to a level beach area that allows pups to easily haul out.

2.1.9 Number of Animals Housed in Each Pen/Pool

During UME strandings, the number of pinnipeds received by the facility is limited not only by the number and size of the holding pools or pens, but the number of qualified trained rehabilitation staff members available to care for the animals. The maximum number of animals maintained in each pool and onsite at the facility shall be determined by the attending veterinarian and dictated by the number of qualified staff available to care for the animals.

MINIMUM STANDARD

- Provide a minimum of three qualified trained rehabilitation staff members on site for the first 25 pinnipeds housed at the facility, and two more trained rehabilitation staff members for every additional 25 pinnipeds. More staff will be required when animals are housed simultaneously in quarantine holding and recovering animal holding areas. Dependant pups are more labor intensive and require more staffing. Staff must be available on a 24-hour basis for critical animal care.

2.1.10 Housekeeping

MINIMUM STANDARD

- Keep support buildings and grounds as well as areas surrounding rehabilitation pools clean and in good repair.
- Maintain perimeter fences in good repair, and ensure they are an adequate height and construction to keep people and animals and pests out.
- Ensure primary enclosures housing marine mammals do not have any loose objects, sharp projections, and/or edges which may cause injury or trauma to the marine mammals contained therein.
- No holes or gaps larger than ½ the size of the head diameter of the pup of the smallest species to be housed.
- All drains and overflows must have screened covers.
- Objects introduced as environmental enrichment must be too large to swallow and made of non porous cleanable material.

RECOMMENDED

- Coat all pool and haul-out surfaces with a non-porous, non-toxic, non-degradable cleanable material that is able to be disinfected.

2.1.11 Pest Control

MINIMUM STANDARD

- Establish and maintain a safe and effective program for the control of insects, avian and mammalian pests. This should include physical barriers to help to prevent feral and/or wild animals from contact with the rehabilitating animals.

- Insecticides or other such chemical agents shall not be applied in a primary enclosure housing marine mammals or a food preparation area except as authorized in writing by the attending veterinarian.
- If applied, all appropriate measures must be taken to prevent direct contact with the insecticide/pesticide, whether airborne or waterborne, by the animal.

2.1.12 Security for Facility

Stranded marine mammals often attract public attention and must be protected from excessive commotion and public contact. Ensuring a quiet stress-free environment for rehabilitating animals may improve their chance to recover and survive. Public viewing of marine mammals is discussed in Section 2.13 of this document.

MINIMUM STANDARD

- Locate rehabilitation facilities at sites that are able to be secured from the public.
- Prevent direct public contact with the rehabilitating animals by utilizing appropriate fencing, staff and security personnel.

RECOMMENDED

- Maintain 24- hour monitoring when animals are present or maintain a secure perimeter fence with the ability to lock the area off to the public when staff is not present.

2.2 Water Quality

There are four basic types of water systems:

- Pools with filtration systems (closed systems)
- Pools without filtration systems (dump and fill systems)
- Pools with periodic influx of natural seawater (semi-open systems)
- Open water systems (Bay or sea pens).

There are a number of variables which will affect water quality. The number and size of pinnipeds utilizing each pool will vary throughout the year at most rehabilitation institutions. During the busy season or during unusual stranding events, the number of pinnipeds utilizing one pool may increase dramatically creating a heavier load of waste which must be handled by the filtration system in closed systems and by the amount of water flow-through in semi-open and open systems. A life support

system is used as one tool in a program of water quality maintenance to provide safe and clean water to the animals.

Filtration or life support systems are essential to maintaining clean water for animals held in closed or semi-closed systems. Life support systems have three basic parts; mechanical filters that remove solids, biological filters or baffles to remove or detoxify chemicals in the water, and disinfecting methods to control or remove pathogens. In addition to maintaining clean water in the animal pools, these systems may be needed to treat waste water, depending on waste water disposal requirements. If a temporary increase in waste production overwhelms part or all of the life support system, a good water quality control program will require alternative options.

Water used in closed systems generally is fresh water obtained from municipal sources, whereas water in open and semi-open systems comes from a bay or sea source. Water in closed systems must be regularly filtered through sand and gravel filters to remove particulate matter, and disinfectants such as chlorine or bromine may be added to eliminate pathogens. More elaborate systems utilize ozone to oxidize pathogens in the water. The source should be independent of other rehabilitation and captive animal areas.

Factors that affect water quality are:

- Size of pool or pen
- Efficiency of filtration system or water flow-through rate (tides)
- Water turnover rate
- Number, size and species of animals housed in pool or pen
- Type and amount of food consumed by animals in pool or pen
- Nature of bottom substrate
- Frequency of cleaning the pool
- Types, amounts, method and the frequency with which chemicals are added to the system
- Temperature of the water
- Pathogens in the water
- Biotoxins in open water pens or in pools where the source water comes from the ocean or bay
- Contaminants (oil, pesticides, etc.) in open water pens
- Hazardous waste spills
- Inclement weather
- Sunlight contributing to algae production on pool surfaces, which in turn can support bacteria.

2.2.1 Water Source and Disposal

The water source for pinnipeds housed in closed or semi-closed systems may be municipal water, well water, or water brought into the facility from an adjacent body of water or estuary. The source should be independent of other rehabilitation and captive animal areas.

MINIMUM STANDARD

- Fresh or salt water must be readily available to fill pools, and fresh water to clean and wash down holding pens daily.
- Drain water as often as necessary to keep the pool water quality within acceptable limits.
- Discharge waste water in accordance with state or local regulations. Facility managers must seek appropriate authorization to dispose of waste water. Documents of authorization or necessary permits must be kept on site as part of the administrative record and may be requested by NMFS as part of the NMFS Stranding Agreement.
- Chemicals, when necessary, shall be added in appropriate amounts to disinfect the water or adjust the pH, but not added in a manner that could cause harm or discomfort to the animals.
- Have contingency protocols describing how water quality will be maintained during periods of peak animal use.
- Water will be clear enough to see animals and bottom of pool and free from obvious solid waste and noxious odors.

RECOMMENDED

- Fresh or ideally salt water must be available to fill pools within two hours of draining.
- Maintain a filtration system designed to optimize water quality in each holding pool and decrease water waste.
- Ability to dechlorinate fresh water for species which require this (i.e., fur seals).
- Protocols in place for maintenance of water quality throughout the year.
- Testing of source and discharge water.

2.3 Water Quality Testing

It is important to test the water in which the animals live on a regular basis. Coliform bacterial counts are used to monitor the efficiency of the filtration system to eliminate potentially harmful bacteria. Coliform counts should be done at least once per week and more frequently if there are very large or multiple animals utilizing the pool. While coliform numbers may be described as Most Probable

Number (MPN) per 100 ml, a more accurate method of measuring coliforms is to determine the total coliform count, or the fecal coliform count.

Temperature of the water is especially important if the animal lacks the ability to thermoregulate. Water may require heating or chilling to aid debilitated animals in their ability to maintain optimal body temperature, although debilitated pinnipeds are likely to haul out, in such case the water temperature becomes less important. Water temperature regulation is not feasible in open water pens, but keeping track of the water temperature in sea pens may aid the staff in making husbandry decisions. If coliform numbers or the water temperature becomes too high in any system~~,~~ measures must be taken to correct the problem in a timely manner. A partial-to-total water change may be necessary to correct the problem in a closed or semi-closed system. If the coliform counts are considered too high in sea or bay pens, efforts should be made to circulate clean sea water through the pens using pumps, paddles or other methods of moving water.

Chemicals added to the water may damage eyes and skin and must be monitored daily. Salinity, when utilized for rehabilitating pinnipeds, may also have an impact on the health of the skin and eyes, as well as the comfort level of the animal, and should be monitored regularly. Emergency chemicals should be on hand such as sodium thiosulfate in case of the accidental hyperchlorination of a system.

2.3.1 Water Quality Tests

MINIMUM STANDARD

- Measure coliform growth weekly, unless pools are dumped and filled daily.
- Total coliform counts must not exceed 500 per 100 ml or a MPN of 1000 coliform bacteria per 100 ml water. Fecal coliform counts are not to exceed 400 per 100 ml.
- If the above tests yield results that exceed the allowable bacterial count, then two subsequent samples must be taken to repeat the test(s) where the level(s) is/are exceeded. The second sample is to be taken immediately after the initial test result, while the third sample would be taken within 48 hours of the initial test.
- If the averaged value of the three test results still exceeds the allowable bacterial counts, the condition must be corrected immediately or the animals moved to a contingency facility.
- Maintain pH between 6.5 and 8.5.
- Maintain the temperature of the water so that it falls within parameters appropriate for the species, generally between 50-80°F.

- Measure oxidant levels in systems which require use of a chemical disinfectant and/or ozone in the system (for closed systems).

RECOMMENDED

- Maintain pH between 7.2 to 8.2.
- Total Coliforms with blanks and controls, fecal Coliform, fecal Strep, and yeast count performed weekly or as needed.

2.3.2 Frequency of Testing in Closed, Semi-open, or Open Systems

MINIMUM STANDARD

- Measure water temperature, pH, salinity (if applicable), chemical additives (if applicable) daily in all pools.
- Measure coliform counts weekly; and more frequently at the discretion of the attending veterinarian.

RECOMMENDED

- If ozone systems are used, measure ozone levels regularly in the animal pools. Ozone levels shall not exceed 0.02 mg/liter.
- Test source and discharge water at least once per day (more frequently for "flow through" systems).
- Maintain records for tests with time, level and results – reviewed and signed monthly by the attending veterinarian or animal care supervisor.

2.3.3 Chemical Additives

Total chlorine = Free chlorine + combined chlorine.

MINIMUM STANDARD

- Maintain total chlorine below 1.5 ppm, where the combined chlorine shall not exceed 50% of the total chlorine.
- All additives must be recorded.
- pH may be adjusted chemically – for example – pH may be raised with sodium carbonate, or soda ash; or lowered with HCl or CO2; but not added in a manner that could cause harm or discomfort to the animals.

- Maintain MSDS information and signage as well as appropriate handling equipment for the addition of chemicals.

2.3.4 Water Circulation

The amount of water turnover through the filtration system in a closed or semi-open system is important to maintain water quality by removing organic waste and particulate matter. Likewise the amount of water movement through an open water pen is also important in the maintenance of water quality. Generally, adequate tidal action will result in the equivalent of two complete water changes per day.

MINIMUM STANDARD

- Maintain sufficient turnover of water through the filtration system in closed or semi-open systems to keep the water quality at or above acceptable limits, with a minimum of two complete water changes per day.
- Ensure methods for moving water (water paddles, pumps, spray devices) are available to aerate and move water in open water pens with insufficient flow of tides or water through the enclosures. These methods should be sufficient to provide the equivalent of two water changes per day.

RECOMMENDED

- A minimum full water turnover rate of every four hours for each pool in closed or semi-open systems.

2.3.5 Salinity

Pinnipeds under rehabilitation may be housed in fresh water. However salinity may play a part in eye health, may enhance wound healing, or may be desirable in some other instances. In some cases animals will drink fresh water which may aid in rehydration. Placing animals in water of appropriate salinity shall be left to the discretion of the animal care supervisor and staff in consultation with the attending veterinarian.

2.3.6 pH

MINIMUM STANDARD

- pH shall be held in a range between 6.5 to 8.5.

RECOMMENDED

- Maintain pH between 7.2 to 8.2.

2.3.7 Water Temperature

MINIMUM STANDARD

- Hold water temperatures within the normal habitat temperature range for the species under rehabilitation or as authorized in writing by the attending veterinarian.
- Provide methods to heat and maintain warm water environments for species that require it, or for debilitated or critically ill individuals that are incapable of maintaining appropriate body temperature.
- Monitor temperature of water being heated or cooled.

2.4 Quarantine

Pinnipeds brought to a rehabilitation facility have no medical history and may carry diseases communicable to other marine mammals, other animals, or humans. Likewise, these animals are often debilitated and may suffer from a variety of illnesses which may compromise their immune systems making them susceptible to diseases from other animals. Quarantine areas must be available and proper biosecurity protocols must be in place for all incoming animals at rehabilitation facilities.

Direct contact between the general public and pinnipeds undergoing rehabilitation should be avoided because of the zoonotic risk of some organisms carried by marine mammals. There have been documented cases of Brucella, Leptospira, Mycoplasma (Seal Finger), San Miguel Sea Lion Virus, Influenza A, and Sealpox, being passed from pinnipeds to humans.

Listed on the following website are numerous other potentially zoonotic marine mammal pathogens (see *http://www.vetmed.ucdavis.edu/whc/mmz/*). See also: *2004 UC Davis Wildlife Health Center Report for the Marine Mammal Commission – Assessment of the Risk of Zoonotic Disease Transmission to Marine Mammal Workers and the Public: Survey of Occupational Risks.*

2.4.1 Prevention of Animal to Animal Transmission of Diseases

MINIMUM STANDARD

- Quarantine all new animals in a separate dedicated quarantine area and provide pens/pools that can be isolated with the use of dividers, tarps, or physical space from the rest of the animal housing areas. Animals that are admitted in groups may be quarantined together.
- Provide dividers between pens and pools that prevent washdown or splash from moving from one pool or pen to another.
- Use dedicated protective clothing for personnel- including gloves, eye shields, safety glasses, and/or eye wash stations.
- Use foot baths, glove baths, and methods to disinfect clothing between handling animals within quarantine area and outside of quarantine area.
- Maintain equipment and tools strictly dedicated to the quarantine area or thoroughly disinfect.
- Provide sufficient space or solid-surfaced barriers between animal enclosures to prevent direct contact between animals.
- Provide sufficient air turnover in indoor facilities to prevent transmission of disease. Air turnover should be enough to prevent build-up of heat and provide a method of bringing fresh air into the facility. There should be sufficient venting or openings to allow movement of air throughout the facility.
- Implement specific quarantine and sanitation procedures to prevent transmission of disease through fomites (e.g., clothing, equipment):
    - Thoroughly clean and disinfect buckets, hoses, scales, transport equipment, and cleaning equipment that is moved between animal areas to prevent transmission of pathogens via fomites.
- Place open water pens so effluent is not near water intake.
- Require evaluation and written veterinary approval before placing animals together after quarantine period has been met.

RECOMMENDED

- Provide separate air handling system in indoor facilities.
- Separate entries to quarantine areas with no crossover with the rest of the facility.
- Clean and disinfect quarantine areas between uses.

2.4.2 Prevention of Domestic Animal to Marine Mammal Transmission of Disease

- Ensure appropriate fencing and placement of holding pens to prevent direct contact between rehabilitating pinnipeds and domestic animals.
- Prohibit personal pets within outermost perimeter of facility.
- Require that specific quarantine and sanitation procedures are taken to prevent transmission of disease through fomites such as clothing and equipment.
- Use dedicated carriers for pinnipeds – carriers should not be used for other mammals or birds unless they are thoroughly scrubbed and disinfected between uses.

2.4.3 Prevention of Wild Animal to Marine Mammal Transmission of Disease

- Ensure perimeter fencing will deter wildlife from entering the rehabilitation premises.
- Provide rodent control on the premises.
- Ensure net pens and lagoon areas have sufficient secondary fencing to keep wild mammals from coming in direct contact with the animals housed in the net pens.

2.4.4 Prevention of Marine Mammal to Domestic Animal Transmission of Disease

- Provide appropriate perimeter fencing.
- Require animal personnel to change contaminated clothing and/or disinfect before leaving the rehabilitation premises.
- Require that specific quarantine and sanitation procedures are taken to prevent transmission of disease through fomites such as clothing and equipment.
- Follow appropriate release guidelines.

2.4.5 Prevention of Stranded Marine Mammal to Captive Marine Mammal Transmission of Disease

- Train volunteers and staff to follow appropriate quarantine protocols.
- Establish quarantine protocols that take into consideration the changing status of the stranded animal.
- Establish traffic flow so that volunteers or staff working with stranded animals do not inadvertently travel into a collection animal area.

- Establish decontamination protocols before volunteers or staff members exposed to stranded animals may enter a collection animal area.
- Establish separate restrooms, showers, changing rooms, food preparation areas, etc. for staff and volunteers working with rehabilitating vs. collection animals. Food for rehabilitating animals may be prepared in the collection animal kitchen and taken to the rehabilitation animal area, however any bucket, feed implement or other item must be thoroughly disinfected before it may return to the collection animal area.

2.4.6 Methods to Reduce Spread of Disease from Animals Housed in Open Sea/Bay Pen Systems

- Place pens in a secluded area where wild animals and marine mammals are unlikely to come into direct contact with the animals housed in the sea/bay pens.
- Place a second set of perimeter nets 30 feet from the sea/bay pens to prevent direct contact with wild marine mammals. Nets should be sufficiently rigid to prevent entanglement by mammals or fish.
- Do not place sea/bay pens within 1000 meters any major outflow sewage treatment plants and consider the flow direction or current from these major outflows.
- Place the sea/bay pens 500 meters and downstream from water intake pipes that bring water into facilities that house marine mammals.
- Place pens in an area where there is ample flow-through of tides/currents.
- Ensure the pens are of sufficient size to minimize biomatter build-up. Each pinniped should be housed in a pen that has a minimum depth of half of their body length, and a minimum horizontal dimension of two full body lengths.
- Avoid overcrowded pens. Animals may fight with each other when housed too closely together.
- Have equipment to pump or aerate the water in pens that do not have sufficient tidal action to ensure a minimum of two complete water changes per day.
- Place pens in areas where there is sufficient depth to enhance water circulation and reduce pathogen build-up. Weekly coliform testing will determine if pathogen build-up exists. Water circulation may be enhanced using water paddles.
- Place quarantine pens such that tidal action or underwater currents will not flow from quarantine pens through sea pens housing healthy animals.

2.4.7 Evaluation Requirements before Placing Marine Mammals Together

- CBC/Chemistries, appropriate cultures, physical examination before moving animals out of quarantine area and at the discretion of the attending veterinarian.
- Review current NMFS recommendations on diseases of concern and reportable disease such as morbillivirus.
- Consider screening for morbillivirus, herpes virus, brucellosis, leptospirosis, and toxoplasmosis utilizing the most current diagnostic tests available and at the discretion of the attending veterinarian.
- If animals are part of a UME, then screening for diseases must be more thorough and in direct coordination with NMFS and the UME On-site Coordinators.
- Have contingency plan for animals that are actively infected with or carriers of a reportable disease such as brucellosis, leptospirosis, toxoplasmosis, herpes virus, and morbillivirus.

2.4.8 Zoonotic Considerations

- Restrict public access and direct contact with pinnipeds due to zoonosis potential and public health hazard of untrained individuals interacting with sick and injured marine mammals.
- Train staff and personnel about how to prevent contracting zoonotic diseases (*Occupational and Safety Information for Marine Mammal Workers* http://www.vetmed.ucdavis.edu/whc/mmz/).
- Train staff and personnel working directly with stranded pinnipeds how to recognize symptoms of zoonotic disease.
- Train staff the basics of sanitation and properly handling contaminated equipment.
- Provide appropriate safety equipment, as reasonable, such as protective clothing, eye protection and face masks to all staff who may be exposed to zoonotic diseases.
- Provide eye flushing stations as used with HAZMAT or normal saline bottles to irrigate the eyes.
- Staff with open wounds shall not handle animals carrying potentially infectious diseases without appropriate precautions to protect their wound(s).

2.4.9 Pre-Release Guidelines

- Pre-release health screens and serologic requirements are determined by the NMFS Regional Stranding Coordinator and the Marine Mammal Health and Stranding Response Program (see *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*).

2.5 Sanitation

2.5.1 Primary Enclosure Sanitation

MINIMUM STANDARD

- Remove animal and food waste in areas other than the rehabilitation pool from the rehabilitation enclosure at least daily, and more often when necessary to prevent contamination of the marine mammals contained therein and to minimize disease hazards.
- Remove particulate animal and food waste, trash, or debris that enter rehabilitation/exercise pens or pools at least once daily, but as often as necessary to maintain water quality and to prevent increased health hazards to the marine mammals that use the pools.
- Remove trash and debris from pools as soon as it is noticed, to preclude ingestion or other harm to the animals.
- Clean the walls and bottom surfaces of the rehabilitation/exercise pens and pools as often as necessary to maintain a clean environment and proper water quality.
- Ensure appropriate disinfectants mixed to recommended dilutions are utilized to clean pens, equipment, utensils, and feed receptacles and to place in foot baths. These disinfectants should have both bacteriocidal and virocidal qualities.
- Rotate disinfectants on a regular basis to prevent bacterial resistance.
- Prevent animals from coming in direct contact with disinfectants or aerosol from spray or cleaning hoses (i.e., water splashed from floor).

RECOMMENDED

- Empty and allow pools to dry once each year but dry and hyperchlorinate pool bottoms and walls and haul-out areas after each use by sick pinnipeds.

2.5.2 Sanitation of Food Preparation Areas and Food Receptacles

- Use separate food preparation areas and supplies for rehabilitation vs. collection animals.
- Clean food containers such as buckets, tubs, and tanks, as well as utensils, such as knives and cutting boards, or any other equipment which has been used for holding, thawing or preparing food for marine mammals after each feeding, and sanitize at least once a day. Equipment should be cleaned with detergent and hot water, sanitized and dried before reuse.
- Clean kitchens and other food handling areas where animal food is prepared after every use, and sanitize at least once weekly using standard accepted sanitation practices.

- Store substances such as cleaning and sanitizing agents, pesticides and other potentially toxic agents in properly labeled containers away from food preparation areas.
- Post MSDS "right to know" documents for staff utilizing cleaning and animal treatment chemicals and drugs.

2.6 Food, Handling, and Preparation

During rehabilitation food for marine mammals shall be wholesome, palatable, free from contamination, and of sufficient quantity and nutritive value to allow the recovery of the animals to a state of good health. Live fish may be fed during rehabilitation but preferences should be given to native prey species. Live fish may contain parasites which could infect compromised animals. Feeding regimens should be tailored to enhance weight gain for underweight animals or growing pups, and should simulate natural patterns in terms of frequency and quantity to the extent possible while following a prescribed course of medical treatment. Most pinnipeds feed several times during a given day

2.6.1 Diets and Food Preparation

MINIMUM STANDARD

- Prepare the diets with consideration for age, species, condition, and size of marine mammals being fed.
- Feed pinnipeds a minimum of twice a day, except as directed by a qualified veterinarian or when following professionally accepted practices.
- Diets reviewed by a nutritionist, attending veterinarian, or the animal care supervisor.
- Train staff to recognize good and bad fish quality.
- Feeding live fish may be required for release determination. See *NMFS /FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release* for more information regarding feeding live fish.
- Food receptacles should be cleaned and sanitized after each use. Food preparation and handling should be conducted so as to minimize bacterial or chemical contamination and to ensure the wholesomeness and nutritive value of the food.

2.6.2 Food Storage and Thawing

- Frozen fish or other frozen food shall be stored in freezers which are maintained at a maximum temperature of 0° F (-18° C).

- The length of time food is stored and the method of storage, as well as the thawing of frozen food should be conducted in a manner which will minimize contamination and which will assure that the food retains optimal nutritive value and wholesome quality until the time of feeding.
- Freezers should only contain fish for animal consumption. Human food or specimens should not be placed in the fish freezer.
- Experienced staff should inspect fish upon arrival to ensure there are no signs of previous thawing and re-freezing, and check temperature monitoring devices in the transport container. The fish shipment should be refused, or fish should be discarded if temperature fluctuations occurred during transport.
- Freezers shall be of sufficient size to allow for proper stock rotation.
- All foods shall be fed to the marine mammals within 24 hours following the removal of such foods from the freezers for thawing.
- If the food has been thawed under refrigeration it must be fed to marine mammals within 12 hours of complete thawing.
- When fish is thawed in standing or running water, the coldest available running water must be used to prevent excess bacterial growth.
- To ensure optimal quality of the fish, and to prevent bacterial overgrowth, do not allow fish to reach room temperature or sit in direct sunlight.
- The thawed fish shall be kept iced or refrigerated until a reasonable time before feeding. This time will vary with ambient temperature.
- Prepared formula should be fed immediately or refrigerated and fed to the marine mammals within 24 hours of preparation. Formula, once heated to an appropriate temperature for a feed, shall be discarded if it is not consumed within one hour.

RECOMMENDED

- Calculate kilocalories of each type of fish or food items fed to each animal daily.
- Conduct food analysis for protein, fat and water content of each lot of fish used. Analysis from fish supplier may be used, and a copy should be maintained on site.
- Calculate composition of each diet routinely used.

2.6.3 Supplements

MINIMUM STANDARD

- Each animal shall receive appropriate vitamin supplementation which is sufficient and approved in writing by the attending veterinarian.
- Salt supplements shall be given to pinnipeds housed in fresh water as necessary and as approved by the attending veterinarian.

2.6.4 Feeding

Food, when given to each marine mammal individually or in groups, must be given by an employee or trained personnel who has the necessary training and knowledge to assure that each marine mammal receives an adequate quantity of food to maximize its recovery or maintain good health. Such personnel are required to recognize deviations in each animal being rehabilitated such that food intake can be adjusted accordingly.

2.6.5 Public Feeding

MINIMUM STANDARD

- Public feeding is not allowed for animals that are being rehabilitated.
- Feeding must be conducted only by qualified, trained rehabilitation staff members.

2.6.6 Feed Records

MINIMUM STANDARD

- Maintain feed records for each individual animal noting the individual (not an estimate) daily consumption by specific food type.
- If animals are fed in groups then group feed records shall be maintained and together with daily husbandry notes and weekly weight records ensure evidence of sufficient feed intake.
- Weigh food before and after each feeding individuals and groups and the record the amount consumed.
- Weigh the animal as practical, keeping in mind that obtaining the weight of the animal may stressful.
- If weighing the animal is not an option, obtain the girth measurement at the level of the axilla if possible.

2.7 Veterinary Medical Care

All rehabilitation facilities shall have an attending veterinarian. The attending veterinarian is critically involved in making decisions regarding medical care as well as housing and husbandry of resident and newly admitted patients.

2.7.1 Veterinary Experience

MINIMUM STANDARD

The attending veterinarian shall:

- Assume responsibility for diagnosis, treatment, and medical clearance for release or transport of marine mammals in rehabilitation (50 CFR 216.27).
- Ability to provide a schedule of veterinary care that includes a review of husbandry records, visual and physical examinations of all the marine mammals in rehabilitation, and a periodic visual inspection of the facilities and records.
- Be available to examine animals on a regular schedule and emergency basis.
- Be available to answer veterinary questions on a 24 hour basis.
- Have marine mammal experience or be in regular consultation with a veterinarian who has marine mammal experience and have access to a list of expert veterinarians to contact for assistance.
- Have an active veterinary license in the United States (means a person who has graduated from a veterinary school accredited by the American Veterinary Medical Association Council on Education, or has a certificate issued by the American Veterinary Graduates Association's Education Commission for Foreign Veterinary Graduates), or has received equivalent formal education as determined by NMFS Administrator (adapted from the Animal Welfare Act Regulations 9 CFR Ch. 1).
- Have the skills to be able to draw blood and give injections to the species most commonly encountered at the rehabilitation center.
- Facility management should have contingency plan for veterinary backup.
- Have the appropriate registrations and licenses (e.g., registered with the Drug Enforcement Administration for handling controlled substances) to obtain the necessary medications for the animals housed at that rehabilitation facility.
- Be able to conduct a full post-mortem exam on all species of pinnipeds treated at the facility.
- Be knowledgeable and able to perform pinniped euthanasia.

- Be knowledgeable about species-specific pharmacology.
- Must certify in writing that animals are fit for transport.
- Ability to write and submit timely disposition recommendations for marine mammals in rehabilitation.
- Be knowledgeable of marine mammal zoonotic diseases.

RECOMMENDED

All of the above plus:

- Membership in the International Association for Aquatic Animal Medicine.
- Complete a course which offers basic medical training with marine mammals such as Seavet, Aquavet, or MARVET.
- Have at least one year of clinical experience outside of veterinary school.
- Have access to a current version of the "Handbook of Marine Mammal Medicine" Have basic hands-on veterinary experience with the species most frequently rehabilitated at the facility.
- Be full time employee or the contract veterinarian of record at facilities managing over 50 pinniped cases per year (i.e., live and dead).

2.7.2 Veterinary Program

MINIMUM STANDARD

- Veterinary care for the animals must conform with any State Veterinary Practice Act or other laws governing veterinary medicine which applies to the state in which the facility is located.
- Standard operating procedures should be reviewed and initialed by the attending veterinarian or the animal care supervisor annually and/or whenever the document is changed or updated. This document may be reviewed by NMFS as part of the NMFS Stranding Agreement or as part of inspections.
- Staff caring for animals should be sufficiently trained to assist with veterinary procedures under the direction of the veterinarian and the rehabilitation facility should maintain at least one **Animal Care Supervisor** who is responsible for overseeing prescribed treatments, maintaining hospital equipment, and controlling drug supplies. The person should be adequately trained to deal with emergencies until the veterinarian arrives, be able to direct the restraint of the animals, be responsible for administration of post-surgical care, and be skilled in maintaining appropriate medical records. It is important that the animal care supervisor should communicate frequently

and directly with the attending veterinarian to ensure that there is a timely transfer of accurate information about medical issues.

- Veterinary decisions shall be based on "best practices" (i.e., based on informed opinions and expertise of veterinarians practicing marine mammal medicine).
- A schedule of veterinary care which includes a review of husbandry records, visual and physical examinations of the animals, and a visual inspection of the facilities should be implemented
- A health and safety plan for the staff shall be written and accessible at all times. It shall be reviewed by the attending veterinarian or the animal care supervisor annually or as prescribed by the NMFS Stranding Agreement. Also, it may be beneficial to consult with an occupational health medical professional when developing these plans. All animal care staff will be familiar with the plan. The plan shall include protocols for managing bite wounds.

The following reports may be requested annually by NMFS as required under the NMFS Stranding Agreement or as a part of inspections

- SOP reviews
- Health and Safety Plan reviews
- Animal acquisitions and dispositions
- NOAA Form 89864, OMB#0648-0178 (Level A data)
- NOAA Form 89878, OMB#0648-0178 (Marine Mammal Rehabilitation Disposition Report)
- Case summaries for any rehabilitation performed at a facility, including narrative descriptions of the cases as well as spreadsheets of treatments, blood values, etc.

2.8 Laboratory Tests and Frequency of Testing

Specific requirements for tests will be issued by the NMFS stranding coordinator (or UME Onsite Coordinator) in each region as outlined in the Marine Mammal Health and Stranding Response Program for release determinations, surveillance programs and UME investigations. Routine diagnostic sampling and testing protocols will be determined by the attending veterinarian. NMFS must be provided adequate time and information including a veterinary certificate of health before an animal is released as directed in 50 CFR 216.27 (see NMFS/FWS BEST PRACTICES for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release).

MINIMUM LABORATORY TESTING

- CBC/Serum Chemistry- For most cases, all animals shall have a minimum of two blood samples drawn for CBC with differential and serum chemistry; upon admission and prior to release (see *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*). If duration of rehabilitation is shorter than a week, one blood workup may suffice and is at the attending veterinarian's discretion.
- Fecal analysis for parasites- Fecal tests for parasites shall be run upon admission of each animal at the discretion of the attending veterinarian.
- Serology as necessary for release determination based on direction of the NMFS stranding coordinator and the Marine Mammal Health and Stranding Program each year and for additional clinical diagnosis as deemed appropriate by the attending veterinarian.
- If serology is positive for pathogens of concern NMFS must give final sign off before animal is released.
- Measure body weight, and length upon admission, and within one week of release/placement. Measure girth when possible, or whenever a scale is not available to measure weight.
- The attending veterinarian or a trained staff member shall perform a necropsy on every animal that dies within 24 hours of death if feasible. If necropsy is to be performed at a later date (ideally no longer than 72 hours postmortem), the carcass should be stored appropriately to delay tissue decomposition.
- Carcass disposal shall be handled in a manner consistent with local and state regulations.
- Perform histopathology on select tissues from each animal that dies at the discretion of the attending veterinarian. A complete set of all major tissues should be evaluated if the animal dies of an apparent infectious disease process.
- Culture and other diagnostic sampling shall be conducted as directed by the attending veterinarian to determine the cause of stranding or death.
- Contact NMFS for additional laboratory test requirements in all cases of unusual mortality outbreaks or disease outbreaks. More complete testing may be required for diseases of concern.
- For cases involving release decisions, unusual mortality investigations, or surveillance programs, serologic assays may only go to labs that have validated tests approved by NMFS, especially for release decisions or determinations. Guidance will be provided by the NMFS Stranding Coordinators or UME Onsite Coordinator.
- Notify the NMFS Stranding Coordinator of learning of any diseases of concern (e.g., emerging, reportable, and/or zoonotic diseases) that are detected and/or confirmed that could be a potential

hazard for public health or animal health (NMFS will provide guidance on reportable diseases as it becomes available).

- NMFS must be provided adequate time and information (including veterinary certificate of health) before the animal is released in all cases as directed in 50 CFR 216.27 (see NMFS Standards for Release). This information is required under 50 CFR 216.27(a) and must be submitted 15 days prior to release unless advanced notice is waived by the NMFS Regional Administrator. Guidance on the waivers is provided in the *NMFS/FWS Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release – Standards for Release*.

RECOMMENDED

- CBC/Serum Chemistry with electrolytes on admission, within the week prior to release, and every other week during rehabilitation if restraint for sampling is not detrimental to the health of the animal.
- More frequent blood sampling at the discretion of the veterinarian.
- Weight measured on admission, just before release, and weekly for growing pups and underweight animals.
- Weights should be measured monthly for all animals unless the stress of capturing the animal to weigh it outweighs the benefits of the data.
- Complete necropsy performed by a veterinarian or a pathologist within 24 hours of death.
- Full histopathology done on tissues from each animal that dies of apparent infectious disease.
- Bank 1cc of serum per blood draw in –80°F freezer.

2.9 Record Keeping and Data Collection

Record keeping is an essential part of the rehabilitation process. Not only do accurate and complete medical records for each stranded pinniped allow the staff to provide consistent and optimal care for each animal, but retrospective records help scientists and veterinarians make better evaluations on how to treat individuals.

Record Keeping

MINIMUM RECORDS

- Record and report "Level A", and disposition reports as advised by Regional Coordinator and Marine Mammal Rehabilitation Disposition Report (NOAA 89-878, OMB #0648-0178) as in accordance with the NMFS Stranding Agreement.
- Maintain and update individual medical records daily on each animal at the rehabilitation center.
- Individually identify each animal with unique identifier
- Keep an accurate description of the animal, including identification/tag number, date and location of stranding, sex, weight, and length at stranding.
- Subjective, objective, assessment and plan (SOAP) based records are preferred
- Include food intake and medication administered to each animal in the records each day.
- Weight
  a. Recorded weekly for underweight pinnipeds or pups, and more often if the attending veterinarian feels it is necessary to properly care for the animal.
  b. Recorded on admission and release for larger pinnipeds.
- Record all treatments, blood work, test and results and daily observations in the medical records.
- Maintain individual medical records for each animal. Medical records remain on site where the animal is housed and are available for NMFS review upon request as stated in the NMFS Stranding Agreement.
- Hold medical records for a minimum of 15 years on site.
- Maintain up to date water quality records.
- Maintain life support system maintenance records.
- Maintain records of water quality additives.

RECOMMENDED RECORD KEEPING

All of the above plus:

- Full set of standard morphometrics prior to release.
- Photographic documentation of animals with significant lesions, identifying marks.
- Caloric value of daily food intake calculated and recorded for each animal.
- Daily weight of underweight pups. Larger species, where pups exceed 50 kg, may require obtaining weights less frequently.

- Monthly weights of larger pinnipeds (where the stress of capture to weigh does not adversely affect the rehabilitation efforts).
- Maintain food acquisition and analysis records.
- Maintain "paper copy" archive of required NMFS records.

2.9.1 Data Collection

MINIMUM STANDARD

- Written documentation of the medical history, food and observation records must be kept.
- NMFS Required Forms to be completed in writing or submitted electronically in the NMFS National Marine Mammal Stranding Database as prescribed in the NMFS Stranding Agreement:
  a. NOAA Form 89864, OMB#0648-0178 (Level A data)
  b. NOAA Form 89878, OMB#0648-0178 (Marine Mammal Rehabilitation Disposition Report).

RECOMMENDED

- Computerized documentation with hard copies.
- Ability to network with other institutions.
- Maintain real-time accessible compiled comparative data.

2.10 Euthanasia

- Each institution must have a written euthanasia protocol signed by the attending veterinarian.
- Persons administering the euthanasia must be knowledgeable and trained to perform the procedure.
- Maintain a list of individuals authorized to perform euthanasia signed by the veterinarian.
- Euthanasia shall be performed in a way to minimize distress in the animal.
- Refer to resources such as the American Veterinary Medical Association Panel Report on Euthanasia, the CRC Press Handbook of Marine Mammal Medicine and American Association for Zoo Veterinarians Guidelines for Euthanasia of Nondomestic Animals.
- Appropriate drugs for euthanasia in appropriate amounts for the largest species admitted to the facility shall be maintained in stock on site in an appropriate lockbox or under the control of a licensed veterinarian with a current DEA license.
- Drugs for euthanasia shall be kept with an accurate inventory system in place.
- DEA laws and regulations and State Veterinary Practice Acts must be followed when using controlled drugs

- NMFS may request this information (protocols and DEA number) as part of the NMFS Stranding Agreement.

2.11 Health and Safety for Personnel

There shall be a health and safety plan on site at each rehabilitation facility that identifies all health and safety issues that may be factors when working closely with wild marine mammals. The plan should identify all potential zoonotic diseases as well as including safety plans for the direct handling of all species and sizes of pinnipeds seen at that facility. Rehabilitation facilities are encouraged to comply with Occupational Safety and Health Administration regulations.

MINIMUM STANDARD

- Identify all potential zoonotic diseases in a written document available to all personnel.
- Include safety plans for the direct handling of all species and sizes of pinnipeds seen at that facility.
- Include safety plan for dealing with handling any untreated discharge water.

2.12 Contingency Plans

Contingency plans shall be in place at each facility and may be required by NMFS as part of the NMFS Stranding Agreement. NMFS may require approved variances or waivers prior to planned projects such as construction. These plans should address in detail the operation of the facility and care of the animals under the following conditions:

- Inclement weather plan, including a hurricane/big storm plans where appropriate.
- Construction in the vicinity of the animal rehabilitation pens or pools.
- Power outages, including plans of how to maintain frozen fish stores and life support systems.
- Water shortages.
- "Acts of God" plan which may include floods, earthquakes or other unpredictable problems known to occur on occasion in the region where the facility is located.

2.13 Viewing

NMFS Regulation, U.S.C. 50 CFR 216.2(c)(5) states that marine mammals undergoing rehabilitation shall not be subject to public display. The definition of public display under U.S.C. 50 CFR is "an activity that provides opportunity for the public to view living marine mammals at a facility holding

marine mammals captive". Only remote public viewing or distance viewing should be allowed and only when there is no possible impact of the public viewing on the animals being rehabilitated. There is a regulatory requirement for a variance or waiver by NMFS for facilities planning to offer public viewing of any marine mammal undergoing rehabilitation.

2.14 Training and Deconditioning Behaviors

Basic behavioral conditioning of wild pinnipeds for husbandry and medical procedure may be warranted during rehabilitation as long as every effort is made to limit reinforced contact with humans. Such conditioning may reduce stress for the animal during exams and acquisition of biological samples. Conditioning may assist with appetite assessment and ensuring that e each animal in a group receives the appropriate amount and type of diet and medications. In some cases, extensive contact with humans, including training, may benefit resolution of the medical case by providing mental stimulation and behavioral enrichment, and may facilitate medical procedures. The relative costs and benefits of training should be evaluated by the staff veterinarian, and the likelihood of contact with humans following release should be considered.

Behavioral conditioning of pinnipeds must be done for the shortest time necessary to achieve rehabilitation goals and is to be eliminated prior to release such that association of food rewards with humans is diminished. If an animal has become accustomed to hand-feeding the animal may approach humans after release. Therefore, these behaviors should be deconditioned before the animals can be considered for release. Most behaviors will extinguish through lack of reinforcement, but some may require more concentrated efforts.

Training for research that is above and beyond the scope of normal rehabilitation practices can be approved on a case-by case basis under a NMFS scientific research permit. An exception can be made if the attending veterinarian, facility, and NMFS officials all agree that the research will not be detrimental to the animals' health and welfare and will not impede their ability to be successfully released back to the wild.

2.15 References

Langman VA, Rowe M, Forthman D, Whitton B, Langman N, Roberts T, Kuston K, Boling C, and Maloney D. 1996. Thermal Assessment of Zoological Exhibits I: Sea Lion Enclosure at the Audubon Zoo. Zoo Biology 15:403-411.

3. Frequently Asked Questions

Why are there two sets of standards, "minimum" and "recommended", in the facilities guidelines?

The thought behind the two sets of guidelines was to establish a bare minimum standard which every facility should have to meet in order to rehabilitate either pinnipeds or cetaceans. The "recommended" standards are standards considered more ideal to help maximize the success of the rehabilitation effort, and to minimize the potential spread of disease. Many facilities exceed the recommended standard.

Facilities that just meet the minimum standards may wish to improve their facility over time. The Facilities Guidelines could serve as a method of justifying and helping to secure Prescott Funds or other funding to make improvements to bring a facility up to the recommended standards.

Why are there separate standards for pinnipeds and cetaceans?

While many aspects of rehabilitating cetaceans and pinnipeds that are the same, there are likewise many significant differences. Water quality, pool space and design, and handling debilitated animals are examples of the bigger differences between facility design and equipment required for rehabilitation of these animals. Rehabilitation of cetaceans requires more expensive facilities, as there must be larger, deeper pools available, salt water systems, and more elaborate filtration in closed system situations. While some facilities have adequate equipment and personnel to rehabilitate pinnipeds, they may not meet the standards required for the rehabilitation of cetaceans. Having two sets of guidelines allows NMFS the flexibility of issuing agreements specific to the types of animals that may be rehabilitated at each facility.

Many of the standards listed appear to be directly from the AWA standards. Why don't you just state that the facilities will meet all of the AWA regulations? What if the AWA regulations change?

AWA regulations have specific engineering standards to cover captive marine mammals. These standards for pool size and depth are based on captive adult-sized animals. The majority of pinnipeds admitted to most rehabilitation facilities are pups, juveniles, and sub-adults, and because they are not going to be permanent members of a collection, pool size may be smaller than the minimum sizes

stated in the AWA regulations. Cetacean facility guidelines minimum pool sizes are closer to the AWA regulations in pool size, but not identical, as these animals are not considered to be permanent residents.

AWA regulations may change, however these Facilities Guidelines were created with the consideration that animals being rehabilitated are not permanent residents of the facility. Therefore even if AWA regulations change, it is likely, the Stranding Network Facilities Guidelines will remain the same. Facilities Guidelines apply to the wild animals held by participants of the stranding network, whereas the AWA regulations refer to captive animals owned by the licensees.

Under Water Quality, no mention is made regarding protecting staff and public from discharged water.

This is covered by the statement that "All water must be discharged according to State and Local Regulations". Since state and local regulations vary, it is up to each institution to ensure their discharge policy conforms to the regulations in their area. These regulations should take into consideration the public exposure to the discharged water from the rehabilitation facility. Likewise all rehabilitation facilities should have Standard Operating Procedures in place to protect their staff from hazards which may be posed by the rehabilitation of marine mammals.

NOAA
National Marine Fisheries Service
Office of Protected Resources

U.S. Fish and Wildlife Service
Fisheries and Habitat Conservation
Marine Mammal Program

FINAL

POLICIES AND BEST PRACTICES

MARINE MAMMAL STRANDING RESPONSE, REHABILITATION, AND RELEASE

STANDARDS FOR RELEASE

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Standards for Release

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Executive Summary

Rescue, rehabilitation, and release of wild marine mammals is allowed for authorized individuals under listed conditions by the Marine Mammal Protection Act (MMPA) [16 U.S.C. 1379 § 109(h)]. Section 402(a) of Title IV of the MMPA specifically mandates that "The Secretary shall… provide guidance for determining at what point a rehabilitated marine mammal is releasable to the wild" [16 U.S.C. 1421 §402(a)]. This document fulfills the statutory mandate and is not intended to replace marine mammal laws or regulations.

In accordance with the MMPA, these guidelines were developed by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) in consultation with marine mammal experts through review and public comment on the 1997 draft NOAA Technical Memorandum "Release of Stranded Marine Mammals to the Wild: Background, Preparation, and Release Criteria." Comments from the public review process and other outstanding issues were compiled by NMFS and FWS. The agencies consulted with experts in three areas: cetaceans, pinnipeds and sea otters, and manatees. The experts reviewed and discussed the public comments and provided individual recommendations. This current document encompasses revisions and updates to the 1997 draft and is titled differently.

These guidelines provide an evaluative process to help determine if a stranded wild marine mammal, following a course of treatment and rehabilitation, is suitable for release to the wild. These guidelines describe "Release Categories" for rehabilitated marine mammals of each taxonomic group (i.e., cetaceans, pinnipeds, manatees, sea otters and polar bears). After completing a thorough assessment as prescribed, the release candidates are to be assigned to a Release Category as follows: **Releasable**, **Conditionally Releasable, Conditionally Non-releasable (Manatees only)**, and **Non-releasable**. This document establishes essential release criteria that trained experts should use to determine whether or not individual animals are healthy enough to release into the wild. The essential release criteria are assessed in the following categories:

1) Historical Assessment
2) Developmental and Life History Assessment
3) Behavior Assessment and Clearance
4) Medical Assessment and Clearance
5) Release Logistics
6) Post Release Monitoring

By using clearly defined Release Categories for rehabilitated marine mammals, NMFS and FWS can evaluate and support the professional discretion of the attending veterinarian and their assessment team (i.e., biologists, veterinarians, animal care supervisors, and other team members of the marine mammal stranding network). Based on these Release Categories, NMFS and FWS can consult experts on challenging cases in which the survival of the rehabilitated marine mammal or its potential to pose a health risk to wild marine mammals is in question.

Refinement of requirements and guidelines for release of rehabilitated marine mammals to the wild is a dynamic process. Use of these standardized guidelines will also aid in the evaluation of rehabilitation procedures, successes, and failures, and will allow for on-going improvement of such protocols. These guidelines are based on the best available science and thus will be revised periodically.

1. Introduction

1.1 Background

Prior to the early 1990s, release decisions for marine mammal species under the jurisdiction of the National Marine Fisheries Service (NMFS) were made by individual rehabilitation facilities without much direction or input from NMFS. Decisions were inconsistent and invoked controversy, especially for cetacean cases. The Marine Mammal Commission and NMFS sponsored several workshops focusing on procedures and needs regarding marine mammal strandings, rehabilitation, and release (see Appendix A). Discussions at these workshops provided starting points for establishing objective release criteria. A stronger impetus to formalize these release guidelines came in 1992 when, as part of the Marine Mammal Health and Stranding Response Act, Congress mandated establishing objective guidelines for determining releasability of rehabilitated marine mammals. The Marine Mammal Protection Act (MMPA) was amended to include Title IV, Section 402(a) which states that: ***"The Secretary [of Commerce] shall, in consultation with the Secretary of Interior, the Marine Mammal Commission, and individuals with knowledge and experience in marine science, marine mammal science, marine stranding network participants, develop objective criteria, after an opportunity for public review and comment, to provide guidance for determining at what point a rehabilitated marine mammal is releasable to the wild***."

In accordance with the MMPA, these guidelines were developed by NMFS and the U.S. Fish and Wildlife Service (FWS) in consultation with marine mammal experts through review and public comment of the 1997 draft National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum "Release of Stranded Marine Mammals to the Wild: Background, Preparation, and Release Criteria." Comments from the public review process and other outstanding issues were compiled by NMFS and FWS. The agencies consulted with experts in three areas: cetaceans, pinnipeds and sea otters (*Enhydra lutris*), and manatees (*Trichechus manatus*). The experts reviewed and discussed the public comments and provided individual recommendations. This current document encompasses revisions and updates to the 1997 draft and is titled differently.

The purposes of this document are as follows:

1. To provide guidance for determining release of rehabilitated marine mammals to the wild including marine mammal species under the jurisdiction of the NMFS (Department of Commerce) and those under the jurisdiction of the FWS (Department of the Interior);

2. To state the NMFS and FWS legal requirements and provide recommendations for medical, behavioral, and developmental assessment of rehabilitated marine mammals prior to release;
3. To identify the persons and agencies responsible for completing an assessment of a rehabilitated marine mammal for a release determination and to describe the communication requirements and process with NMFS or FWS;
4. To state the NMFS and FWS requirements and recommendations for identification of releasable rehabilitated marine mammal, selection of a release site, and post-release monitoring; and
5. This document does not include guidance for the following situations:
    a. Immediate release following health assessment and/or emergency triage typically associated with mass stranding events, out of habitat rescues, and disentanglement efforts.
    b. Release following relocation of healthy marine mammals.

1.2 Review of Key Legislation Pertinent to Marine Mammal Rehabilitation and Release to the Wild

Congress delegates the responsibility for implementing the MMPA to the Secretary of Commerce and the Secretary of the Interior. Cetaceans and pinnipeds, exclusive of walruses (*Odobenus rosmarus*), are the responsibility of NMFS (i.e., NMFS species). Walruses, polar bears (*Ursus maritimus*), manatees, and sea otters are the responsibility of FWS (i.e., FWS species). NMFS and FWS responsibilities for these species are regulated under 50 CFR (See Appendix B).

Rehabilitation and release of wild marine mammals is authorized by key statements within the MMPA (16 U.S.C. 1379 §109(h)) entitled "Taking of Marine Mammals as Part of Official Duties." This section allows for the humane taking of a marine mammal, by a Federal, State, or local government official or employee or a person designated under section 112(c) of the MMPA, for its protection or welfare and states that an animal so taken is to be returned to its natural habitat whenever feasible. Regulations that implement the MMPA for NMFS species (50 CFR 216.27(a)(1)) require that a marine mammal held for rehabilitation be released within six months unless "…the attending veterinarian determines that: (i) The marine mammal might adversely affect marine mammals in the wild; (ii) Release of the marine mammal to the wild will not likely be successful given the physical condition and behavior of the marine mammal; or (iii) More time is needed to determine whether the release of the marine mammal in the wild will likely be successful…" and (b)(1) "The attending veterinarian shall provide the Regional Director or Office Director with a

written report setting forth the basis of any determination." Also, (a)(iii) "releasability must be re-evaluated at intervals of no less that six months until 24 months from capture or import, at which time there will be a rebuttable presumption that release into the wild is not feasible."

For NMFS species, the MMPA section 112 (c) Stranding Agreements (formerly Letters of Agreement or LOAs) are formally established between the *NMFS Regions* and *Stranding Network Participants*. Understanding and following the MMPA and implementing regulations, policies, and guidelines, **is the responsibility of all persons involved** in marine mammal rescue, rehabilitation, and release. These guidelines are founded on and support the MMPA and related regulations. The laws and regulations outlined below are therefore fundamental to proper enactment of marine mammal rehabilitation and release. Appendix B contains the full titles and citations of these laws and regulations.

1.3 Structure of the Document

This document is organized as follows: General Procedures (Section 2); Guidelines for Release of Rehabilitated Cetaceans (Section 3); Guidelines for Release of Rehabilitated Pinnipeds (Section 4); Guidelines for Release of Rehabilitated Manatees (Section 5); Guidelines for Release of Rehabilitated Sea Otter (Section 6); Policies Regarding Release of Rehabilitated Polar Bears (Section 7); References (Section 8); Glossary of Terms (Section 9); and Appendices (Section 10).

The approach developed in this document primarily involves a complete assessment of an animal's health and behavior and release logistics. The assessment is completed by the attending veterinarian and their Assessment Team following this standardized guidance for determining the disposition of a marine mammal after treatment and rehabilitation. Section 2, "General Procedures," summarizes the pertinent laws and regulations and outlines the release requirements and recommendations for all species of rehabilitated marine mammals. This section provides an overview of documentation required throughout rehabilitation and release. Parties responsible for release determinations are identified. General principles for developmental, behavioral, and medical assessments of rehabilitated marine mammals are described, as well as methods for post-release identification (i.e., marking and tagging), monitoring, and selection of appropriate release sites.

There are several critical variables among each taxonomic group, such as natural history, social organization, and species specific rehabilitation and release considerations. These variables are addressed in separate chapters (Sections 3-7) for cetaceans, pinnipeds, manatees, sea otters, and polar

bears. These chapters provide greater detail and rationale for the release guidelines for each marine mammal group.

The reference section lists current literature on marine mammal biology, medicine, rehabilitation, and release. A glossary of terms is provided to define key terms initially noted in the text with italics. The appendices provide ready access to marine mammal laws and regulations and examples of required documentation for rehabilitated marine mammals. Additional appendices include examples correspondence letters between the Stranding Participant and NMFS, lists of Diseases of Concern, and related references for cetaceans, pinnipeds, manatees, and sea otters.

1.4 Funding

Funding of marine mammal rehabilitation is the responsibility of the rehabilitation facility. Specific resources, such as freezers for serum banking, histopathology services, equipment, and personnel for post-release monitoring may be provided through NMFS and FWS to support the biomonitoring program. Some costs associated with response and rehabilitation during a Marine Mammal Unusual Mortality Event (UME) may be reimbursed through the UME National Contingency Fund (in accordance with section 405 of the MMPA). For additional information regarding expense reimbursement, contact the appropriate NMFS or FWS coordinator. For NMFS species, the John H. Prescott Marine Mammal Rescue Assistance Grant Program is also available as a funding source for marine mammal stranding response and rehabilitation. More information on this program can be found on the following website: http://www.nmfs.noaa.gov/pr/health/prescott/.

2. General Procedures

2.1 Stranding Agreements, MMPA 109(h) Authority, and Permits for Stranding Response for ESA species

2.1.1 NMFS Policies

NMFS may enter into a Stranding Agreement (formerly known as a Letter of Agreement or LOA) with a person or organization for stranding response and rehabilitation. The NMFS Stranding Agreement states that the Stranding Network Participant will obey laws, regulations, and guidelines governing marine mammal stranding response and rehabilitation. This includes requirements for communications with NMFS, *humane care* and husbandry and veterinary care of rehabilitated marine mammals, and documentation of each stranding response and rehabilitation activity. The Stranding Agreement does not authorize the taking of any marine mammal species listed as endangered or threatened under the Endangered Species Act of 1973 (ESA), as amended. However, authorization to take ESA-listed species by the Stranding Network is currently provided under *MMPA/ESA Permit No. 932-1489-09*, as amended, and requires authorization and direction from the NMFS Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered marine mammal.

2.1.2 FWS Policies

Rescue, rehabilitation, and release of non ESA-listed marine mammal species under FWS responsibility is authorized with a *Letter of Authorization (LOA)* issued by the *Division of Management Authority (DMA)* in the FWS Headquarters Office in Arlington, VA. For ESA-listed species, an LOA holder is authorized under a permit issued by the DMA. The *FWS Field Offices* in the lower 48 states or the *Marine Mammals Management Office in Alaska* coordinate with LOA and permit holders for all rescue, rehabilitation, and release activities for species under their jurisdiction.

2.2 Parties Responsible for Release Determinations and Overview of Agency Approval

The *attending veterinarian* and their *Assessment Team* (i.e., veterinarians, lead animal care supervisor, and/or consulting biologist with knowledge of species behavior and life history) representing the Stranding Network Participant, Designee, or 109(h) Stranding Participant will assess the animal and make a written recommendation for release or non-release**. For NMFS species, the recommendations are sent to the NMFS Regional Administrator. For FWS species, the**

recommendations are sent to the FWS Field Office and any recommendations for non-release are coordinated with the FWS Division of Management Authority.

In general, for NMFS species that are deemed "Releasable," a 15-day advance written notification is necessary. However, 50 CFR 216.27 (a)(2)(i)(A) allows for waiving this advance notification in writing by the Regional Administrator. Generally, these cases are anticipated (e.g., the typical annual cluster of cases where the etiology is known and diagnosis and treatment is routine) and can be appropriately planned. For such waivers, the Stranding Network Participant should submit a protocol for such cases, including location of release. These waivers will require pre-approval by the NMFS Regional Administrator on a schedule as prescribed in the Stranding Agreement. The *release determination recommendation* includes a signed statement from the attending veterinarian, in consultation with their Assessment Team, stating that the **marine mammal is medically and behaviorally suitable for release in accordance with the release criteria** (i.e., similar to a health certificate) and include a written *release plan and timeline*. NMFS may also require a concurrence signature from the "*Authorized Representative" or Signatory* of the Stranding Agreement. The Regional Administrator (i.e., NMFS staff) will review the recommendation and release plan and provide a signed written notification to the Stranding Network Participant indicating concurrence and authorization to release or direct an alternate disposition (*letter of concurrence from the Regional Administrator*) (50 CFR 216.27). For more challenging cases and potential "Conditionally Releasable" cases, plans for release should be submitted well in advance of the 15-day period to provide adequate time for evaluation. Also, it is highly recommended that dissenting opinions among members of the Assessment Team regarding an animal's suitability for release and/or the release plan be communicated to NMFS well in advance of the required 15-day advance notice so that additional consultation can be arranged in adequate time for resolution and planning.

By regulation (50 CFR 216.27 (a)(3), Appendix B), the NMFS Regional Administrator (or Office Director of Protected Resources) has the authority to modify requests for release of rehabilitated marine mammals. In accordance with 50 CFR 216.27 (a)(1), any marine mammal held for rehabilitation must be evaluated for releasability within six months of collection unless the "attending veterinarian determines that the marine mammal might adversely affect other marine mammals in the wild, release of the marine mammal to the wild will not likely be successful given the physical condition and behavior of the marine mammal, or more time is needed to determine whether the release of the marine mammal will likely be successful." If more time is needed, then NMFS will require periodic reporting in writing from the attending veterinarian, including a description of the

condition(s) of the animal that precludes release and a prognosis of release. NMFS may require that the marine mammal remain at the original rehabilitation facility or be transferred to another rehabilitation facility for an additional period of time, be placed in permanent captivity, or be euthanized. NMFS may also require a change of conditions of the release plan including the release site and post-release monitoring. An expanded release plan may be required including a justification and detailed description of the logistics, tagging, location, timing, crowd control, media coordination (if applicable) and post release monitoring. NMFS may require contingency plans should the release be unsuccessful including recapture of the animal following a specified time after release.

Generally for animals deemed "Non-releasable" and with the concurrence from the NMFS Regional Administrator, the animal can be permanently placed in a public display or research facility or euthanized. If the animals is to be placed in permanent captivity, the receiving facility must be registered or hold a license from the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) [7 U.S.C. 2131 *et seq*.] and comply with MMPA (16 U.S.C. 1374 §104(c)(7)). These facilities (i.e., the rehabilitation facility or another authorized facility) are required to send a *Letter of Intent* to the Office of Protected Resources, Permits, Conservation and Education Division (NMFS PR1) to permanently retain or acquire the animal (information available at http://www.nmfs.noaa.gov/pr/permits/mmpa_permits.htm). This letter should include a signature of the "*Responsible Party of Record*". As part of the decision making process, NMFS will consult with APHIS and may review the qualifications and experience of staff, transport protocols, and placement plans (i.e., integration based on appropriate composition of species, sex, and age and the intended proposed plan for public display or scientific research). Once approved, NMFS PR1 will respond with a *Transfer Authorization Letter* and include Marine Mammal Datasheets (MMDS), OMB Form 0648-0084, to be returned to NMFS PR1 within 30 days of transfer. Upon receipt of the MMDS, NMFS PR1 will acknowledge the transfer in writing and return updated MMDS to the receiving facility.

For FWS species, LOA and permit holders provide recommendations to the FWS Field Offices for decisions regarding releasability of rehabilitated marine mammals (see Appendix H for contact information). The FWS retains the authority to make the final determination on the disposition of these animals. If FWS determines that a marine mammal is non-releasable, the holding facility may request a permit for permanent placement in captivity as prescribed in section 104(c)(7) of the MMPA for non-depleted species, or section 104(c)(3) or section 104(c)(4) and section 10(a)(1)(A) of the ESA for depleted species.

Manatee releases require a minimum 30-day advance notice (although exceptions may be made in the event of extenuating circumstances) and must also include a signed statement from the attending veterinarian that the **animal is medically and behaviorally suitable for release in accordance with the release criteria** (i.e., similar to a health certificate) and include a written release plan and timeline. Upon receipt, FWS will evaluate and determine the suitability of the release site and release conditions (see taxa specific sections for further guidance).

For cases involving declared *UMEs*, the *Working Group on Marine Mammal Unusual Mortality Events* will be consulted to determine if event specific release standards should be implemented as stated in the **1996 NOAA Technical Memorandum – National Contingency Plan for Response to Unusual Marine Mammal Mortality Events**. Priority will be given to protecting the health of wild populations over the disposition of an individual animal. Provisions may require monitoring a representative subset of released animals to determine survivability impact on the affected population or holding rehabilitated animals beyond the projected release time to determine long term health effects.

2.3 Documentation for Rehabilitation and Release of Marine Mammals

2.3.1 NMFS

Pursuant to the Stranding Agreement between the Stranding Network Participant and appropriate NMFS Regional Office that allows a stranding organization to respond to and/or rehabilitate marine mammals, the Stranding Network Participant must provide documentation to NMFS regarding their activities that involve the taking and disposition of marine mammals as described below. The same holds true for actions under MMPA section 109(h). Figure 2.1 presents the documentation and procedures following submission of the written "release determination recommendation."

- **Marine Mammal Stranding Report Level A Data**, NOAA Form 89-864, OMB No. 0648-0178 (Appendix C).

  This report is mandatory for all stranding events and includes basic information regarding the site and nature of the stranding event, a statement that the animal was found alive or a description of the condition of its carcass, morphologic information, photo or video documentation, initial disposition of any live animal, tag data, and information on disposal, disposition, and necropsy of dead animals. This report must be sent to the appropriate NMFS Regional Office within the time stated in the Stranding Agreement.

- **Marine Mammal Rehabilitation Disposition Report,** NOAA Form 89-878, OMB No. 0648-0178 (Appendix C)

  This report is mandatory for all rehabilitation cases (i.e., long-term and short-term temporary holding) and includes a brief history of the stranding and related findings of an individual marine mammal. It also includes the disposition of samples taken from the animal and disposition of the animal including release site and tagging information. This report includes verification and date that a pre-release health screen was done on the animal. This document must be sent to the appropriate NMFS Regional Office no later than 30 days following the final disposition (e.g. released or non-released) of the marine mammal or as prescribed in the Stranding Agreement. NMFS compiles these data annually to monitor success of rehabilitation and identify where changes and enhancements should be made.

- **Release Determination Recommendation 50 CFR 216.27 (a)(2)** (Appendix B)

  This regulation states that the custodian of a rehabilitated marine mammal must provide the appropriate NMFS Regional Office with written notification at least 15 days prior to the release of any marine mammal to the wild, including a release plan. The pre-notification requirement may be waived in writing for certain circumstances (e.g., the typical annual cluster of cases where the etiology is known and diagnosis and treatment is routine) by the NMFS Regional Administrator in accordance with specific requirements as stated in the Stranding Agreement. The required notification (release determination recommendation) should provide information sufficient for determining the appropriateness of the release plan, including a description of the marine mammal (i.e., physical condition and estimated age), the date and location of release, and the method and duration of transport prior to release (50 CFR 216.27(a)(2)(ii)). The release recommendation should include a signed report or statement from the attending veterinarian that the marine mammal is medically and behaviorally suitable for release in accordance with NMFS release criteria (i.e., similar to a health certificate under the Animal Welfare Act). NMFS may also require a concurrence signature from the "Authorized Representative" or Signatory of the Stranding Agreement. In the case of more challenging releases such as animals considered Conditionally Releasable," requests for release should be submitted well in advance of the 15-day period to provide adequate time for review and planning. NMFS reserves the right to request additional information and impose additional requirements in any release plan to improve the likelihood of success or to protect wild populations (50 CFR 216.27 (a)(3)). NMFS also can order other disposition as authorized upon receipt of the report (release determination recommendation)

(50 CFR 216.27 (b)(2). For guidance, see Appendix J for a Recommended Standard Checklist for Release Determination.

- **Notification of Nonrelease/Transfer of Custody**

  For animals deemed "Non-releasable," and with the concurrence from the NMFS Regional Administrator, the animal can be permanently placed in a public display or research facility or be euthanized. If the animal is to be placed in permanent captivity, the receiving facility must be registered or hold a license from APHIS [7 U.S.C. 2131 *et seq*.] and comply with MMPA (16 U.S.C. 1374 §104(c)(7)). Facilities wishing to obtain non-releasable animals should send a *Letter of Intent* to NMFS PR1 to permanently retain (i.e., if affiliated with the rehabilitation facility) or acquire the animal. This letter should include a signature of the *"Responsible Party of Record"*. As part of the decision making process NMFS will consult with APHIS and may review the, qualifications and experience of staff, transport, and placement plans (i.e., integration based on appropriate composition of species, sex, and age and the intended proposed plan for public display or scientific research). Once approved, NMFS PR1 will respond with a *Transfer Authorization Letter* and include MMDS, OMB Form 0648-0084, to be returned to NMFS PR1 within 30 days of transfer. Upon receipt of the MMDS, NMFS PR1 will acknowledge the transfer in writing and return updated MMDS to the receiving facility.

2.3.2 FWS

Requirements for the rehabilitation and release of marine mammals under FWS jurisdiction are specified under individual permits or LOAs. These requirements are specific to the species, the organization, and the activity being conducted. The required documentation for manatee rescue, rehabilitation, and release activities is provided in Appendix C.

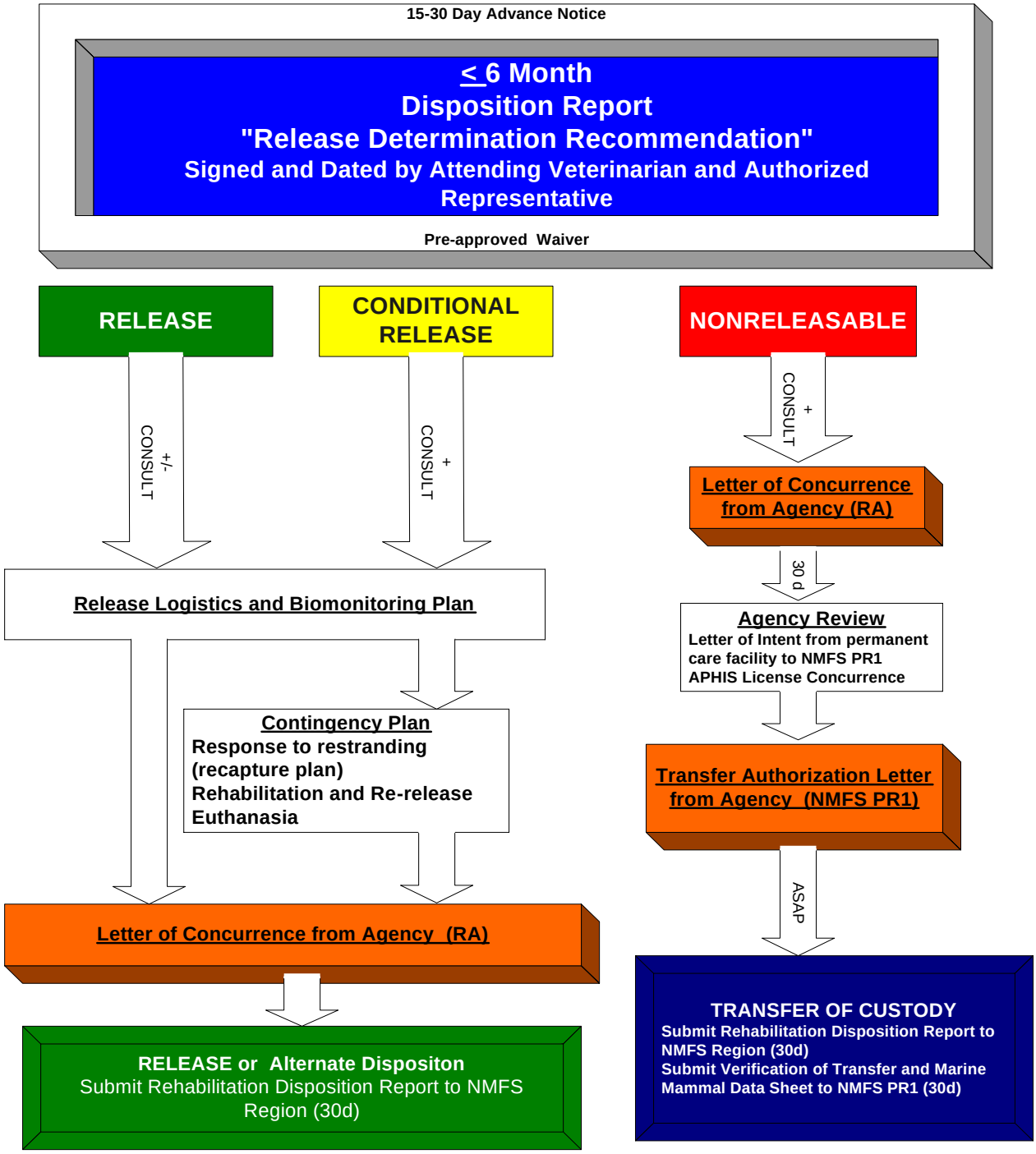

Figure 2.1 Documentation and Procedures Following Submission of the Written "Release Determination Recommendation."

2.4 Assessment Process for a Release Determination

These guidelines provide an evaluative process to determine if a stranded wild marine mammal, following a course of treatment and rehabilitation, is suitable for release to the wild. The basic format for these guidelines provides assignments for each taxonomic group (e.g., cetaceans, pinnipeds, manatees, sea otters, walrus, and polar bears) of rehabilitated marine mammals into "Release Categories." Release potential is characterized and categorized based on a thorough assessment of the health, behavior, and *ecological status* of the animal, as well as the release plan. It is critical that detailed historical, medical, and husbandry records are maintained and reviewed. Following a complete evaluation, the attending veterinarian and Assessment Team should categorize the animal into one of the following Release Categories: **Releasable**, **Conditionally Releasable**, **Conditionally Non-releasable (for manatees only)**, and **Non-releasable.** "Conditionally Non-releasable" is only a category for manatees because the FWS has had success releasing manatees that have been in captivity in excess of 20 years. NMFS species are deemed "Non-releasable" if they have been in captivity for over two years (see 50 CFR 216.27(a)(1)(iii)) and therefore a "Conditionally Non-releasable" category is not necessary. Based on the findings from the Assessment Team, the attending veterinarian provides a recommendation on releasability to NMFS or FWS. The Agencies will review and consider this information as a part of the release determination review process.

In most release cases, NMFS requires the release of marine mammals within six months of admission to rehabilitation (50 CFR 216.27(a)). This assessment can be done at more frequent intervals or earlier in the process of rehabilitation such as for obvious nonrelease cases (e.g., neonatal cetaceans, blind or deaf animals, etc). Rather than staying in a rehabilitation situation for up to six months, it may be in the best interest of the animal to immediately assess, determine releasability, and transfer to a more suitable permanent care facility. This is particularly important for all marine mammals that need socialization or expert care.

The Assessment should include the following steps and general parameters (see Figure 2.2 on page 2-16):

1. **Historical Assessment**. The Assessment Team should complete a historical evaluation that includes information gathered from the time of stranding through the duration of rehabilitation. Such information can impact the management of the case and determination of release. Circumstances such as an ongoing epidemic among other wild marine mammals, presence of environmental events such as a harmful algal bloom or hazardous waste spill,

acoustic insult; and special weather conditions (e.g., El Niño, hurricane, extreme cold, extreme heat, changes in oceanographic parameters, etc.) should be documented. It should be noted if the animal: had previously stranded and been released; was part of an official UME; had been exposed to other wild or domestic animals just prior to and/or during rehabilitation; or had attacked and/or bitten (including mouthing of unprotected skin) a human while being handled. This assessment should also include if the animal is evidence and part of a *human interaction* or criminal investigation. Such information can help guide the diagnostic and treatment strategy during rehabilitation and may impact the plan for post-release monitoring. It should be noted that strict measures are to be in place to prevent any disease transmission from other wild and domestic animals and humans during the rehabilitation process. Other considerations that should be taken into account include whether the animal was transferred from another facility (i.e., short-term triage/holding facility or rehabilitation facility) and the quality of care and treatment of each rehabilitation facility.

2. **Developmental and Life History Assessment.** In order to be deemed "Releasable," all rehabilitated marine mammals should have achieved a developmental stage wherein they are nutritionally independent. **Nursing nutritionally dependent animals should not be released in the absence of their mothers**. The ability of a young marine mammal to hunt and feed itself independently of its mother is critical to successful integration into the wild. Also of great importance is achievement of a robust body condition such that the animal has adequate reserves for survival. Other developmental issues, such as reproductive status and advanced age, seldom stand alone as determinants of release candidacy but are evaluated in conjunction with the overall health assessment. The Assessment Team should seriously consider information concerning the natural life history for the species. Therefore, it is important that the makeup of the team include someone with expertise or working understanding of the species behavior and life history. Important questions to be addressed include: 1.) does the species depend on a social unit for survival or does it exist solitarily in the wild?; 2.) has the animal developed the skills necessary to find and capture food in the wild?; 3.) has the animal developed the social skills required to successfully integrate into wild societies?; 4.) is there knowledge of their home range or migratory routes?; and 5.) does the animal have skills in predator recognition and avoidance? In other words, how important is it to the survival of the animal to be released with or near other cohorts? The Assessment Team can work with NMFS to consult with outside experts to evaluate the animal and

address these questions. Greater details regarding developmental assessment are included in the appropriate section for each taxonomic group.

3. **Behavioral and Ecological Assessment and Clearance.** In order to be deemed "Releasable," a marine mammal should meet basic behavioral criteria and some of which are specific for taxa. Across taxonomic groups, behavioral requirements for release include demonstration of normal breathing, swimming, and diving with absence of aberrant (i.e., abnormal) behavior, auditory, and/or visual dysfunction that may significantly compromise survival in the wild and/or suggest diseases of concern. The rehabilitated animal should also demonstrate the ability to recognize, capture, and consume live prey prior to its release when access to live natural prey is feasible, or, in the case of manatees, the ability to identify and feed on appropriate forage types. Because abnormal behavior may reflect illness or injury, this should be done in concert with the attending veterinarian and the medical assessment. The **behavioral clearance** should be part of the overall recommendation for release that is passed on to NMFS or FWS. Outstanding concerns regarding the behavioral suitability of the marine mammal for release are to be discussed with NMFS or FWS. Additional information is included in the behavioral assessment section for each taxonomic group.

   Also included in this thought process, is the concept of **ecological status**. This concept attempts to integrate the medical and behavioral evaluations into an extrapolation of how the animal would likely do in the wild when exposed to typical ecological pressures (personal comm. Wells 2005). It goes beyond the assessment of the current condition of the animal in an artificial environment at the rehabilitation facility relative to a limited set of immediately observable or measurable parameters. It places the animal in its current rehabilitated condition in the context of life in the wild. This process recognizes the importance of a team approach, involving complementary expertise, to evaluate the probability that a rehabilitated animal will survive and thrive back in the wild. It would be useful to include in the deliberations a behavioral ecologist with knowledge of the species specific (or closely related species) solutions to ecological challenges in the wild. The behavioral ecologist would be familiar with the species habitat, including oceanographic parameters, ranging patterns, life history, feeding ecology, potential predators, social structure, and anthropogenic threats likely to be faced by the animal once it is released.

4. **Medical Assessment and Clearance.** Although this document focuses on the evaluation and preparation of rehabilitated marine mammals for release, the medical assessment spans the entire time the animal is in rehabilitation and is critical to understanding the animal's health prior to release. The medical assessment includes information related to any health trend and diagnostic testing, treatment, and response to treatment. The attending veterinarian should perform a hands-on physical examination upon admission and prior to the release determination. The attending veterinarian should review the animal's complete history including all stranding information, diagnostic test results (i.e., required by NMFS or FWS), and medical and husbandry records. The goal of required testing requested by NMFS or FWS is to safeguard the health of wild marine mammal populations and this is achieved by testing for diseases (*reportable diseases*) that pose a significant morbidity or mortality risk to wild populations.

   Other reportable diseases include those that are of *zoonotic* or *public health and safety concern* and the agencies will require immediate notification to assure proper protocols are put into place. The agencies may request testing for other *emerging diseases* as part of a *surveillance program* to identify potential *epidemics* of concern or to determine health trends. Additional testing will be required if the animal was part of an official UME. Specific testing requirements (i.e., pre-release health screen) will come from the NMFS Marine Mammal Health and Stranding Response Program (MMHSRP) through the National Stranding Coordinator and follows the term and responsibilities stated in the NMFS Stranding Agreement. For FWS species, contact the appropriate Field Office for guidance (see Appendix H for contact information).

   Throughout the rehabilitation period, the frequency of physical exams and decisions for performance of additional diagnostic testing are determined by the attending veterinarian. The animal should be closely monitored for disease throughout rehabilitation. Regardless of the precise cause of the animal's stranding, the stranding event itself and the animal's abrupt transition to a captive environment can cause significant stress, which may increase its susceptibility to disease (St. Aubin and Dierauf 2001). The rehabilitation facility may also harbor pathogens not encountered in the wild or new antibiotic resistant strains (Measures 2004, Moore *et al*. 2007, Stoddard *et al*. in press). Should the animal become infected with such a pathogen during rehabilitation, it could become ill or become a carrier of that pathogen and may pose a threat to a naïve wild population or even public health if it is released.

Introduction of pathogens from rehabilitated animals to free-ranging wild animals is a significant concern for diseases with serious *epizootic or zoonotic* potential (Gilmartin *et al.* 1993, Griffith *et al.* 1993, Spalding and Forrester 1993). Pathogens, particularly viruses, bacteria, and some protozoans, can quickly replicate in their hosts and are susceptible to selective forces that can drive microbial adaptation and evolution leading to changes in transmission rates, virulence, and pathogenicity via genetic modification (Ewald 1980, 1983, 1994; Su *et al.* 2003). Thus, infectious agents may become more pathogenic as they pass through new individuals and naïve species.

The attending veterinarian is urged to utilize the full spectrum of diagnostic modalities available for health assessment of the animal. In addition to basic blood work, serology, microbial culture, cytology, urinalysis, and fecal exam, advanced techniques for pathogen detection such as Polymerase Chain Reaction (PCR), microarrays, and toxicology assessments are also available. A number of imaging techniques including radiology, bronchoscopy, and laparoscopy may also be utilized. The marine mammal literature has expanded to include numerous references on the performance and interpretation of diagnostic tests (see references and Appendices D, E, F, and G for partial list).

Except as otherwise noted, acquisition of blood for a complete blood count (CBC) and chemistry profile plus serum banking may be required by NMFS and FWS upon admission of a marine mammal to a rehabilitation facility. Such blood work should to be repeated by the original laboratory, to avoid problems with inter-laboratory variability, prior to release of the marine mammal. Microbial culture and isolation (i.e., aerobic and anaerobic bacterial, viral, fungal) should be a part of the medical evaluation and done upon admission and before exit from rehabilitation centers. Such paired tests help determine the types of pathogens that a marine mammal may have acquired in the wild and those that may have been acquired during its rehabilitation. Because the number of pinnipeds entering a rehabilitation facility annually may be quite high and presenting with similar diagnosis, particularly in El Niño years, NMFS may waive additional clinical evaluation as mentioned above for each pinniped but instead require that a percentage of these animals entering a facility have a thorough clinical work-up. This will be dependent on several factors, such as the stranding location, time of year, the clinical diagnosis upon admission, and disease status of the wild population (e.g., ongoing outbreaks, UMEs, etc). For walrus and polar bears, testing requirements will be on a case-by-

case basis. The NMFS or FWS stranding coordinator can provide guidance on this and other recommendations mentioned above.

The attending veterinarian interprets the results of blood work and additional diagnostic tests in light of physical exam findings, the animal's age, reproductive status, molt status, behavior, and other relevant or historical factors. Circumstances surrounding the stranding, recent environmental events, known health issues of resident wild marine mammals, and exposure to other animals are examples of historical factors that may provide information regarding the health status of the stranded marine mammal. The attending veterinarian should also consider if the animal was held in close proximity to other animals (e.g., penmates) undergoing rehabilitation and the disease history of those animals (e.g., within facility transmission). A number of references provide data useful for the interpretation of marine mammal diagnostic tests. Appendices E, F, G and H provide information on diseases of concern for cetaceans, pinnipeds, manatees and sea otters.

5. **Release Considerations**.

   a. **Required Identification Prior to Release.** Marine mammals must be marked prior to release for individual identification in the wild (see 50 CFR Sec. 216.27(a)(5) for species under NMFS jurisdiction). Examples of identification systems include flipper roto tags, flipper All-Flex tags, flipper Temple tags, passive integrated transponder tags (PIT tags), radio tags, satellite tags, and freeze branding (Geraci and Lounsbury 2005). Invasive tag application procedures should be done under the direct supervision of the attending veterinarian and will need prior approval from NMFS and FWS and may require a monitoring period following the procedure. Proper photo identification for some species should also be considered part of the protocol. Standard identification protocols exist for various groups of marine mammals that detail the methods and procedures for marking for future identification in the wild, and are included in the appropriate section for each taxonomic group. Contact the Agency stranding coordinator for additional information.

      As described, roto tags or flipper tags (basic tags) for cetaceans and pinnipeds (except walrus) are to be obtained from or coordinated through the NMFS Regional Stranding Coordinator. For FWS species, tags for walrus are to be obtained from the *USGS* and tags for polar bears are obtained from FWS. Tags for manatees are to be

obtained from FWS or the appropriate State Agency. Tags for sea otters are obtained by each individual LOA or permit holder.

Depending on the species, if the animal restrands or the tag is found, this information should be reported to the appropriate NMFS or FWS and/or USGS Stranding Coordinator. The NMFS National Marine Mammal Stranding Database centrally archives tag data for NMFS species. The FWS and/or USGS track these data for walruses, sea otters, and polar bears. For manatees, the State agencies maintain the tag data.

b. Release Site Requirements and Recommendations. Rehabilitated marine mammals are to be released to the wild under circumstances that reflect the natural history of their species and maximize the likelihood for their survival. This will vary with age and sex of the individual. Timing should be set to minimize additional energetic and social demands, and maximize foraging success and ease of social acceptance with conspecifics. For NMFS species, information regarding the date, location, and logistics of the release and any other information requested are included in the required 15-day advance notification of the Agency prior to release as cited in 50 CFR 216.27 (a)(2). Key factors in determining a release site include specific habitat, geographic and environmental factors such as weather and oceanographic states, past successful releases, public use, potential for predators, and availability of prey as well as transport time. Maintenance of stock fidelity, proximity of conspecifics, timing in relation to breeding seasons and migration activities are also crucial considerations. As the natural history of each species provides the framework for planning a release, greater details for each taxonomic group are provided in the appropriate section of this document.

6. Post-Release Monitoring. Post-release monitoring is a key method by which the efficacy of rehabilitation efforts can be assessed and revised. Such monitoring may also provide an opportunity to recover individuals that are unable to readjust to the wild. Simple post-release monitoring plans include such methods as visually tracking tagged or marked animals by land, air, or sea. More costly radio-telemetry and satellite tracking are highly desirable methods of post-release monitoring as they provide detailed information of the movement and behavior of released marine mammals. Post-release monitoring is recommended for all

rehabilitated marine mammals and is required for some taxonomic groups, such as cetaceans and manatees, depending on release category. The intensity of post-release monitoring efforts is determined by such factors as the age and species of the marine mammal, its status as threatened or endangered, and concerns regarding its health or developmental issues that may impact its ability to readjust to the wild. Advanced post-release monitoring techniques may be required for "Conditionally Releasable" animals when significant concerns regarding their chances of survival exist. All post-release monitoring plans for rehabilitated marine mammals are to be approved in writing by, and coordinated with, NMFS or FWS. NMFS may require the submission of follow-up monitoring summaries at specified intervals post-release (e.g., 90 day intervals), until such time as contact with the animal has ended. The final update should include tracking data and an evaluation of the success of the rehabilitation and release along with recommendations for future cases. NMFS may use these data in order to make future revisions to marine mammal rehabilitation and release guidelines. In order to compare individual cases, standardization of data collection protocols for monitoring released animals is highly recommended and may be required by NMFS. Formal study of monitoring data and its dissemination to the stranding network will aid in the assessment of marine mammal rehabilitation and release programs.

2.5 Emergency or Special Situations

NMFS and FWS are responsible for monitoring and protecting the health of wild marine mammal populations. To fulfill this responsibility, and as stated in the NMFS Stranding Agreements, these agencies may require or recommend increased documentation, testing, and/or post-release monitoring of rehabilitated marine mammals when a stranding event appears to be related to wide spread environmental events such as algal blooms, hazardous waste spills, outbreaks of disease, UMEs, etc. An increased incidence of illness or injury to marine mammals may prompt NMFS or FWS to require specific diagnostic testing as part of a surveillance program and additional communication regarding case outcomes. NMFS and FWS personnel are to provide Stranding Network Participants and rehabilitation facilities with this information and may be able to provide additional funding and other support regarding such circumstances. For example, NMFS holds contracts with specific diagnostic labs that can provide services for rehabilitation facilities free of charge.

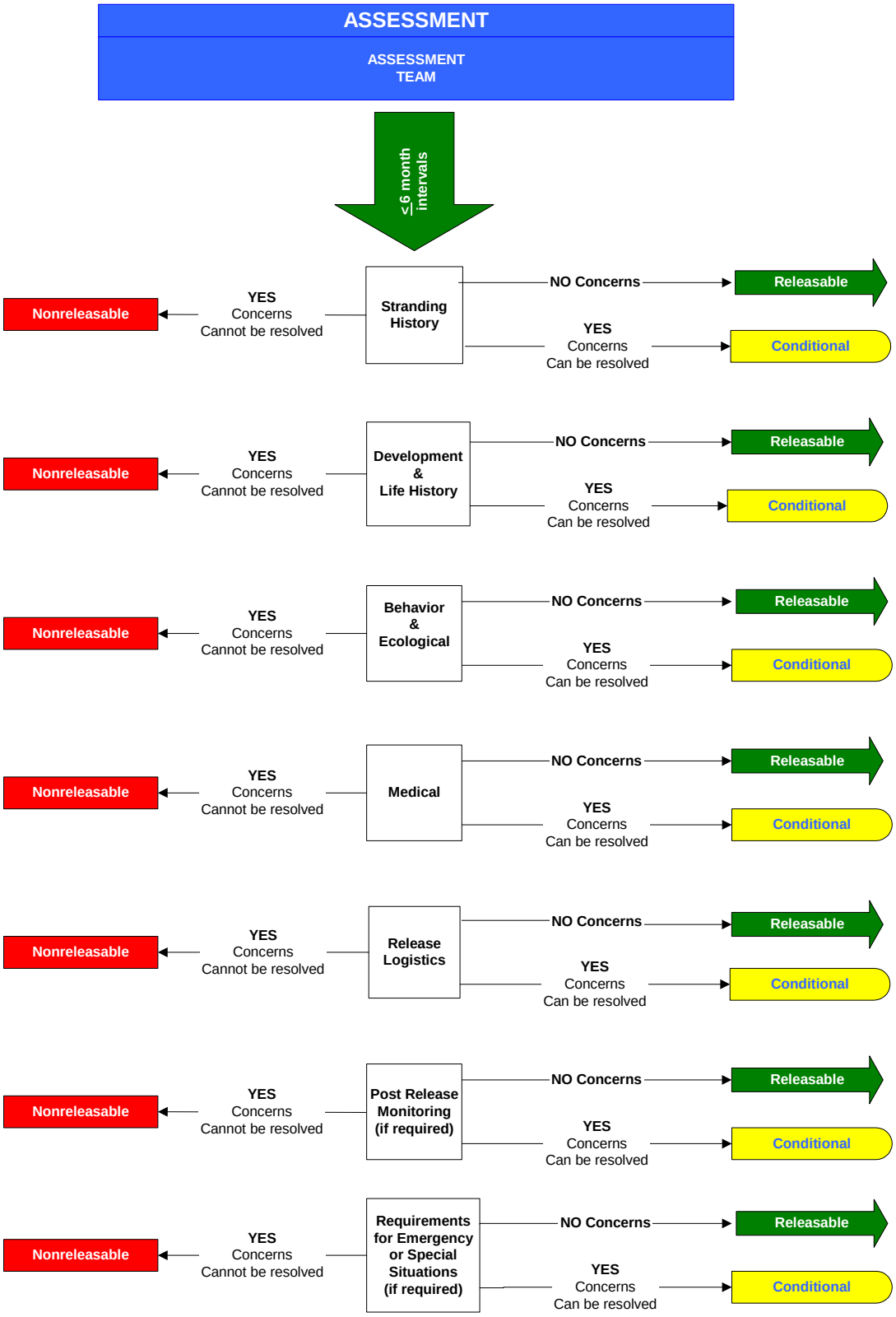

Figure 2.2 Steps and General Parameters for Animal Release Assessment

3. Guidelines for Release of Rehabilitated Cetaceans

3.1 Introduction

Few species of cetaceans (i.e., primarily bottlenose dolphins, rough-toothed dolphins, grampus dolphins, and harbor porpoise) are rehabilitated in the United States each year. Although the natural history of cetaceans differs among the various species, the general release criteria set forth in this document are applicable to all cetaceans in the United States. Prior to the release of any cetacean, NMFS requires that a thorough evaluation of the historical, developmental, behavioral, and medical records and status be completed by the Assessment Team (i.e., Stranding Network Participant, attending veterinarian, animal care supervisor, and biologist with knowledge of species behavior, ecology, and life history). For all cetacean cases, a release determination recommendation must be sent to the NMFS Regional Administrator at least 15 days (typically 30 days) in advance of a proposed release date. Waivers for advanced notice are not generally considered in cetacean cases. The release determination recommendation must include a signed statement from the attending veterinarian in consultation with their Assessment Team that the animal is **medically and behaviorally suitable for release in accordance with the release criteria** and include a written release plan and timeline. The request should also include a statement(s) from an expert biologist(s) with knowledge of the species or similar species that is being considered for release and should state that the animal meets behavior and ecological criteria for release in accordance with the release criteria. NMFS may recommend or require additional testing beyond these guidelines for reportable diseases in light of new findings regarding various disease and health issues. A release plan will require a justification statement and detailed description of the logistics for transporting, tagging, location, timing, crowd control, media coordination (if applicable), post-release monitoring, and recovery should the animal fail to thrive. NMFS may require a recapture contingency plan if the animal appears to be in distress or poses a risk following a specified time after release. NMFS may consult with individual experts for further guidance. NMFS reserves the right to impose additional requirements in the release plan as stated in 50 CFR 216.27 (a)(3).

3.2 Overview of “Release Categories” for Cetaceans

Cetaceans evaluated at rehabilitation facilities can be grouped into one of three “Release Categories” based on historical, developmental, behavioral, ecological, and medical criteria set forth in a **standardized checklist**. It is recommended that the standardized checklist (see Appendix J) be used to assess and document the release candidacy of rehabilitated cetaceans. The checklist includes a

health statement (i.e., health certificate) to be signed by the attending veterinarian and authorized representative, which verifies that a cetacean meets appropriate standards for release. This checklist could be used to determine and document releasability (i.e., as part of the required documentation sent to NMFS – refer to Figure 2.1) and as a final check just prior to release.

The case should fit into one of three **"RELEASE CATEGORIES:"**

1. **"RELEASABLE":** This category indicates that there are no significant concerns related to the likelihood of survival in the wild and/or risk of introducing disease into the wild population. Also, the animal meets basic historical, developmental, behavioral, ecological, and medical release criteria. The release plan has been approved in writing by NMFS Regional Administrator via a letter of concurrence to the applicant.
2. **"CONDITIONALLY RELEASABLE":** This category indicates that there are concerns about the historical, developmental, behavioral, ecological, and/or medical status of the animal, raising a question of survival or health risk to wild marine mammals. A cetacean may be deemed conditionally releasable if requirements for release cannot be currently met but may be met in the future without compromising the health and welfare of the individual animal. In such cases, more time may be needed to determine the feasibility of release (see 50 CFR 216.27(a)(1)(iii)).

   All "Conditionally Releasable" cetaceans must be discussed with NMFS. For some cases, NMFS may consult with individual experts to seek additional advice. The experts may include scientists and veterinarians with expertise in cetacean biology and medicine (i.e., particularly experts with species-specific knowledge). These discussions may reveal that additional medical testing, rehabilitative therapy, and strategies for post-release monitoring may be required to release a "Conditionally Releasable" cetacean.
3. **"NON-RELEASABLE":** This category indicates that there are significant historical, developmental, behavioral, ecological, and/or medical concerns regarding its release to the wild. It has a documented condition demonstrating little chance for survival in the wild and/or a diagnosed health risk to wild marine mammals. This category also includes animals that have been in rehabilitation greater than two years (see 50 CFR 216.27(a)(1)(iii)). Additionally, a cetacean may be deemed "Non-Releasable" if an appropriate release site or post-release monitoring plan cannot be arranged.

For animals deemed "Non-releasable," and with the concurrence from the NMFS Regional Administrator, the animal can be permanently placed in a public display or research facility or

euthanized. If the animal is to be placed in permanent captivity, the receiving facility must be registered or hold a license from APHIS [7 U.S.C. 2131 *et seq*.] and comply with MMPA (16 U.S.C. 1374 §104(c)(7)). Facilities wishing to obtain non-releasable animals should send a *Letter of Intent* to NMFS PR1 to permanently retain (i.e., if affiliated with the rehabilitation facility) or acquire the animal. This letter should include a signature of the *Responsible Party of Record*. As part of the decision making process NMFS will consult with APHIS and may review the qualifications and experience of staff, transport, and placement plans (i.e., integration based on appropriate composition of species, sex, and age and the intended proposed plan for public display or scientific research). Once approved, NMFS PR1 will respond with a *Transfer Authorization Letter* and include MMDS and OMB Form 0648-0084, to be returned to NMFS PR1 within 30 days of transfer. Upon receipt of the MMDS, NMFS PR1 will acknowledge the transfer in writing and return updated MMDS to the receiving facility.

3.3 Historical Assessment of Cetaceans

Historical stranding information may guide the management of rehabilitation and the plan for post-release monitoring. Important historical information should include:

1. **A record of previous stranding –** Stranded cetaceans that have previously stranded and been released, and subsequently strand again, are deemed "Conditionally Releasable" for further release attempts pending consultation with NMFS. Such animals should be reassessed and as they may have underlying health issues requiring additional evaluation, diagnostic testing, and advanced post-release monitoring. Alternatively, such cetaceans may be assessed as "Non-Releasable" and be transferred to permanent captivity or euthanized.
2. **A mother-calf pair –** A stranding of a mother/calf pair may be the result of illness or injury to either the mother, calf, or both. If the calf dies or is euthanized, the mother could be considered for release following a thorough and appropriate assessment. If the mother dies or is euthanized, a dependent calf is likely non-releasable because it cannot forage on its own and should be placed in permanent captivity or euthanized.
3. **An association with an ongoing epidemic among other wild marine animals or a UME** – If the stranding of a cetacean occurs close to (i.e., temporally and geographically) an ongoing epidemic of wild marine animals or to a UME, fish kill, harmful algal bloom, hazardous waste spill, or other such environmental event, the cetacean is deemed "Conditionally Releasable" and consultation with NMFS is required. NMFS may request additional testing, documentation, and/or post-release monitoring of such cetaceans.

4. **Stranding location and active/home range –** Stranded cetaceans may be deemed "Conditionally Releasable" if they stranded in areas where there is an increase in human activity (e.g., active fishery, increased recreational use, military activity, shipping activity, etc.) or hazardous environmental conditions (e.g., harmful algal bloom or hazardous waste spill, and/or special weather conditions like El Niño, hurricane, extreme cold, extreme heat, etc). The geographical distance between the stranding location and the rehabilitation facility is important to acknowledge, as there could be important differences in the microflora in the facility's water system. Information on areas of human activity and environmental hazards is also vital for determining an appropriate release site.
5. **The animal has been exposed to (or injured by) other wild or domestic animals –** Stranded cetaceans with a history of exposure to terrestrial wild (e.g., raccoons, coyotes, etc.) or domestic animals (e.g., cats, dogs, etc.) are deemed "Conditionally Releasable" and must be discussed with NMFS. There is a potential for zoonotic pathogens to be transmitted between wild or domestic animals to marine mammals but signs of clinical disease are undetectable. Additional testing may be required to better assess the health status and decrease the potential for transmitting diseases of concern to wild marine mammal populations following release. Consultation with NMFS is required for cetaceans that have a history of exposure to terrestrial animals.
6. **The animal was transferred from another holding, triage or rehabilitation facility** – The opportunity for exposure to pathogens can occur at different stages of response and rehabilitation. Therefore, it is important to obtain medical records and document the quality of care and treatment at each stage of this process.
7. **The animal was evidence or part of a human interaction or criminal investigation – This includes an investigation by** NOAA Office of Law Enforcement, the U.S. Department of Justice, or other Federal, state or local authorities.
8. **The animal was part of a mass stranding (stranding involving more than one cetacean if not a cow-calf pair)** – Mass strandings are typically influenced by behavior, with the majority of stranded animals being healthy but in need of assistance to return to the ocean. If a stranding response can be mounted quickly and safely and the animals are assessed and deemed healthy, individuals of a mass stranding may be released or relocated for immediate release. However, some individuals may be admitted into rehabilitation and may be "Conditionally Releasable" based on the pathologic findings of the pod mates that perished during the event.

9. **The animal was transferred from a research facility or undergoing permitted research during rehabilitation** – Research activity may extend the frequency and intensity of handling time and could increase the risk of altering behavior or increasing the chance of exposure to facility pathogens or chemicals (e.g., anesthetic agents, metabolic agents, etc). These animals will be considered "Conditionally Releasable" or "Nonreleasable."

3.4 Developmental Assessment of Cetaceans

A fundamental criterion for developmental clearance of a rehabilitated cetacean is that it has attained a sufficient age to be nutritionally independent, including the ability to forage and hunt. The cetacean calf grows from a state of total nutritional dependence through nursing to partial maternal dependence as it learns to forage for fish and/or squid. Eventually the young cetacean achieves total nutritional independence and forages completely on its own. Factors including individual and species variations, rehabilitation practices, health status, plus environmental factors affect the rate at which such development occurs (see Appendix I for Developmental Stages by Cetacean Species). For bottlenose dolphins (*Tursiops truncatus*), the age at which a calf may be completely weaned is approximately 1-4 yrs. Calves that are nutritionally dependent at the time of admission to rehabilitation are automatically placed in the "Conditionally Releasable" category and must be discussed with NMFS. In situations where a nursing, dependent calf strands with its mother and both animals achieve medical, behavioral and ecological clearance, the calf must be released with its mother. Very young nursing calves that strand alone or whose mothers die may lack socialization and basic acquired survival skills as they grow older. Neonatal and very young nursing calves will be deemed "Non-Releasable." Cases involving older calves and juveniles having some foraging skills may be considered "Conditionally Releasable" but require a thorough assessment and optimum planning for release and subsequent monitoring.

Reproductive status in and of itself does not impact release candidacy unless a female strands with its calf or gives birth during rehabilitation. For instance, a single pregnant female should be returned to the wild as soon as both medical and behavioral clearance has been achieved and NMFS approves of the release plan. However, all mother-calf cetacean pairs are deemed "Conditionally Releasable" and must be fully discussed with NMFS and its advisors. The well-being of both the mother and the calf is to be carefully considered in such cases. Efforts should be made to reduce their time in captivity and to keep the mother-calf pair together, yet allow for continued treatment and rehabilitation of both individuals if warranted.

Cases involving cetaceans showing signs of advanced age are considered "Conditionally Releasable" and should also be thoroughly evaluated and discussed with NMFS. Although it is not always feasible to precisely determine the age of a living adult cetacean, the physical condition of the animal may suggest to the Assessment Team that it is geriatric. Geriatric animals may have underlying clinical conditions that contributed to their stranding or may be behaviorally or ecologically unsuited for continued life in the wild.

3.5 Behavioral Assessment of Cetaceans

Complete assessment of the behavior and ecological potential may be limited by the confines of a temporary captive environment and behavior of the animal will differ from that displayed in the wild. A full understanding of what constitutes “normal” for a given cetacean species also may be lacking. Behavioral and ecological clearance is thus founded on evaluation of basic criteria necessary for the survival of the animal in the wild. Behavioral evaluation often overlaps with medical evaluation as abnormal behavior may indicate an underlying disease process. Experts with species specific knowledge of cetacean behavior and ecology, in addition to the attending veterinarian, should assess the behavior of the rehabilitated cetacean. These assessments should involve closely evaluating and documenting behavior throughout rehabilitation (i.e., *ethogram*), relating the behavioral, sensory, and physical capabilities of the animal to its prospects of surviving and thriving in the wild.

To achieve basic behavioral clearance, a cetacean should breathe normally, including rate, pattern, quality, and absence of respiratory noise. A cetacean should swim and dive effectively without evidence of aberrant behavior or auditory or visual dysfunction that may compromise its survival in the wild or suggest underlying disease that may threaten wild marine mammals. Behavioral clearance also should include confirmation that the cetacean is able to recognize, capture, and consume live prey when such tests are practical (for example, it may not be possible to obtain live prey for offshore or deep water species). Documented dependency on or attraction to humans and human activities in the wild would warrant special consideration as a possible conditional release or non-release decision.

Basic behavioral conditioning of wild cetaceans for husbandry and medical procedures may be necessary during rehabilitation as long as every effort is made to limit reinforced contact with humans. Station training may be necessary to assure animals are appropriately fed and to control social dominance when multiple animals are being treated in the same pool or pen. Also, such conditioning may reduce stress for the animal during examinations and acquisition of biological samples. Behavioral conditioning of cetaceans is to be done for the shortest time necessary to achieve

rehabilitation goals and is to be eliminated prior to release such that association of food rewards with humans is diminished. Additional information on behavioral conditioning of marine mammals is provided in the references.

3.5.1 Breathing, Swimming, and Diving

The Assessment Team should evaluate respiration at the pre-release exam to determine that the animal does not exhibit abnormal breathing patterns or labored breathing. Respiratory measurements should be standardized to record the number of breaths per five-minute intervals. Evaluation of swimming and diving should confirm that the cetacean moves effectively and does not display abnormalities such as listing, difficulty submerging, asymmetrical motor patterns, or other potentially disabling conditions. In small pools (i.e., less that 50 ft diameter), cetaceans may not be able to demonstrate a full range of locomotor and maneuvering abilities; therefore, evaluation in larger pools is highly recommended. Cetaceans exhibiting persistent abnormalities of breathing, swimming, or diving, are to be considered “Conditionally Releasable” or “Non-releasable” and must be discussed with NMFS.

3.5.2 Aberrant Behavior

The behavioral clearance of the cetacean should include confirmation that the animal does not exhibit aberrant behavior. Examples of aberrant behavior include, but are not limited to, regurgitation, head pressing, postural abnormalities such as repetitive arching or tucking, decreased range of motion, abnormal swimming or breathing as described above or excessive interest in interaction with humans. Cetaceans displaying abnormal behavior may have an underlying disease process or may have permanent injury or tendencies that will decrease their chance of survival in the wild. Cetaceans displaying aberrant behavior are considered “Conditionally Releasable” or “Non-releasable” and thus are to be fully discussed with NMFS.

3.5.3 Auditory and Visual Acuity

The behavioral and ecological clearance of the cetacean should include evaluation of auditory and visual acuity. Auditory dysfunction, involving production or reception of typical sounds or signals occurring in the wild, may be a reflection of active disease, permanent injury, or degenerative changes associated with aging. Evaluators may suspect that a cetacean has compromised auditory function if it appears to have difficulty locating prey items or various objects via echolocation or if it minimally responds to novel noises. Reduced auditory abilities can compromise the ecological

functionality and social abilities of some species, thus reducing the probability of survival in the wild. In each case, it is highly recommended that hydrophone-recording systems with an appropriate frequency response be used to record sound production in the water to document production of normal classes and qualities of sounds made by the cetacean. It is important to evaluate hearing if there are signs of compromised auditory function and diagnostic testing such as auditory evoked potential (AEP) may be necessary to further evaluate the anima. Such testing requires approval and coordination with NMFS. Cetaceans having discoloration, swelling, abnormal shape, position or appearance of the eye or eyelids may have visual dysfunction and also require discussion with NMFS.

3.5.4 Prey Capture

The rehabilitated cetacean should demonstrate foraging behavior (i.e., the ability to hunt and capture live prey) prior to its release when practical. Normal consumption of solid food should also be part of the medical assessment. This demonstrates the ability to swallow and that there is no pharangeal and/or gastrointestinal abnormalities. This evaluation is especially important for young and geriatric animals. Prey items normally found in the animal's environment and of good quality should be used whenever possible. Natural prey items may not be available for rehabilitating pelagic cetacean species; evaluators may try to utilize other prey species. However, many cetaceans often will not consume non-prey species. For social species, it may be just as important to look for cooperative or coordinated feeding behavior. NMFS should be notified if a rehabilitated cetacean appears compromised in its ability to recognize and/or capture live prey or if logistical issues preclude assessment of this behavior.

Cetaceans that are believed to have had limited foraging experience prior to stranding (i.e., young juveniles) require particularly careful assessment of prey capture ability. This behavior is learned and cetaceans that strand at a young age may not have gained adequate foraging skills to sustain themselves in the wild. Also, knowledge of the natural history of the species may be useful. If the species forages and hunts as a social unit, this may affect its ability to survive in the wild if released as a solitary animal. Similarly, amputated appendages may preclude the use of some specialized feeding techniques or attainment of sufficient speed or maneuverability for prey capture, or diminished auditory function may prevent individuals that prey on soniferous (i.e., noise-producing) fishes from locating sufficient prey to survive (e.g., coastal bottlenose dolphins).

3.5.5 Predatory Avoidance

Testing a cetacean's ability to avoid predators is not practical in most cases, but indirect evidence of abilities can be evaluated. If the individual is determined to have stranded primarily as a direct result of a shark attack (as opposed to secondarily, as an attack on an otherwise compromised animal), then this suggests that the animal may lack the skills or physical abilities to continue to survive in the wild. This would be especially important in the case of young animals, recently separated from their mothers. For social species, observations of group behavior may indicate the cohesiveness of the group which is an important behavioral mechanism for predatory avoidance.

3.5.6 Social Factors

The survival of an individual cetacean may be critically dependent on social organization and conspecifics (see Appendix I for Cetacean Species Specific Group Occurrence). A tremendous range of variability of sociality exists across the cetaceans. Members of species involved in mass strandings (i.e., presumably a social species) should not be rehabilitated singly or in unnatural social groups. The composition of these groups should be carefully considered when animals are recovered from a stranding and considered for release. It would be naïve to assume that any two cetacean species can be put together to form a functional social unit or that even two unfamiliar members of the same species will bond into a functional social unit. Therefore, for social species it is important to assess the group dynamics and behavior (*reasonable social group*) in the same manner as for individuals. Cetaceans that do not live in social groups do not necessarily require conspecifics for release, as long as they are released into an appropriate habitat where conspecifics are likely to occur. Indications of social problems that may be a contributing factor of the stranding (e.g., evidence of extensive fresh tooth raking marks in the absence of other medical factors) and should be considered. Other factors that are important for proper socialization and should be evaluated include hearing, sound production, missing appendages, and missing teeth.

3.6 Medical and Rehabilitation Assessment of Cetaceans

The medical assessment includes information related to any diagnostic testing, treatment, and response to treatment. The attending veterinarian should perform a hands-on-physical examination upon admission and prior to the release determination. The attending veterinarian should review the animal's complete history including all stranding information and diagnostic testing, and medical and husbandry records. The primary goal of the testing required by NMFS is to determine the risk to the health of wild marine mammal populations. This is achieved by testing for diseases that pose a

significant morbidity or mortality risk to wild populations (i.e., reportable diseases). Those that are zoonotic or a public health and safety concern require immediate NMFS notification to assure proper protocols are put into place. Additional testing will be required if the animal was part of an official UME or suspected anthropogenic exposure (e.g., acoustic insult, hazardous waste spill, etc.). NMFS may request testing for other emerging diseases to support surveillance for potential epidemics of concern and to monitor changes in disease status due to rehabilitation practices. The directive for the pre-release health screen will come from the NMFS Regional Stranding Coordinator through the MMHSRP. Appendix D lists diseases of concern for cetaceans.

A complete health screen should be completed upon admission and just prior to release including basic blood collection for a CBC, chemistry profile (including BUN and creatinine, enzymes and electrolytes), serology, microbial and fungal culture (i.e., blow hole, rectal, ocular, and lesions), cytology, urinalysis, and fecal exam. If the animal is female and at reproductive age, it is advisable that pregnancy be determined as soon as possible to avoid potentially fetal toxic medication. Serum (3ml/each) should be banked at the time of admission and just prior to release for retrospective studies. Cessation of antibiotics should occur two weeks prior to release examination to assure that the animals is no longer dependant on the medication and that the drug has cleared based on the pharmacokinetics and requirements made by the veterinary community and the Food and Drug Administration. Some antibiotics clear the body quickly and require shorter withdrawal time. When this recommendation cannot be met, seek advice from NMFS. **The attending veterinarian should provide written notification to the NMFS Regional Stranding Coordinator that a health screen and assessment of the cetacean has been performed. The notification must also include the final release plan and a plan for hands-on physical examination by the attending veterinarian (including last blood draw and evaluation) within 72 hours of its release. The required documentation and signed release determination will be part of the administrative record along with the signed (by the NMFS Regional Administrator) letter of concurrence approval for release.**

It is of extreme importance that the cetacean be monitored closely for disease throughout its rehabilitation. Regardless of the stranding etiology, handling and care can stress the animal increasing its susceptibility to disease. If not properly managed, rehabilitation facilities provide an environment where mutated or novel pathogens not typically encountered in the wild can easily be transmitted from animal to animal. This scenario can become problematic if an animal is exposed during rehabilitation and may carry a pathogen to a naïve wild population upon release. Introduction

of pathogens from rehabilitation centers to the wild is a concern as diseases with serious epizootic potential have previously been detected (Measures 2004, Moore *et al*. 2007, and Stoddard *et al.* in press). During rehabilitation, infectious agents may become altered (i.e., change in virulence and infectivity) as they pass through new hosts or mix with other microbes and potentially result in a multi-antibiotic resistance strain.

The attending veterinarian is urged to utilize the full spectrum of diagnostic modalities available for health assessment of the cetacean. In addition to the complete health screen analyses, advanced techniques for pathogen detection such as PCR and toxicology analyses are available. A number of diagnostic imaging techniques including radiology, CAT scans, and MRI may be used as well as bronchoscopy and laparoscopy. The cetacean literature has expanded to include numerous references on the performance and interpretation of diagnostic tests.

3.7 Release Site Selection for Cetaceans

Ideally, the rehabilitated cetacean is released into its home range, genetic stock, and social unit. For species such as coastal resident bottlenose dolphins, returning the animal to its exact home range may be extremely important. For widely ranging species such as the pilot whale, specificity of the release site may be less critical as the genetics of these cetaceans may be more *panmictic*. Returning the animal to its home range or species range may increase the likelihood that the animal will have a knowledge of available resources, potential predators, environmental features, and social relationships that would support its successful return to the wild. Consideration should also be given to the time of year, since the range of the animal may change based on season and where conspecifics are along their migration route at a given point in time.

In many cases, the precise home range of the individual will not be known. There may not be any information regarding the animal's social unit or its individual ranging patterns prior to its stranding. In some cases, photographic identification records may help identify the home range or social group for some species. When the home range of the cetacean is unknown, the animal should be released at a location near to its stranding site that is occupied regularly by its conspecifics, ideally those of the same genetic stock. Genetic analyses of a tissue sample via a qualified laboratory and appropriate tissue archive may aid with determining the appropriate stock of origin. Pelagic cetaceans are to be released offshore into a habitat occupied by conspecifics at that time of year. For animals that mass strand, depending on the life history, social units should be maintained whenever possible thus cetaceans that stranded together should be released together as a group. Because much of cetacean

behavior is learned, juveniles should be released with adults or in the presence of conspecifics and mothers with their dependent young.

Other factors to be considered in release site selection are availability of resources and condition of the habitat. NMFS and the Stranding Network Participant are to ensure that severely depleted resources or degraded habitat at the release site do not pose an obvious threat to the released animal. Release plans should include alternative release sites or schedules if there is a substantial decline in resources or habitat quality such as massive fish kills, significant declines in commercial and/or recreational fish landings, harmful algal blooms, or high concentrations of environmental contaminants. Animals should not be released into areas of dense public use and/or high commercial and recreational fishing activity.

3.8 Marking for Individual Identification of Cetaceans Prior to Release

Three forms of identification have routinely been used for cetaceans including photo-identification (documenting individual identifying physical characteristics such as scars, color pattern, dorsal fin shape, etc.), freeze branding, and dorsal fin tags. NMFS recommends the use of all three forms of identification for all releases. For delphinids, photo-identification should include body, face, dorsal fin, flukes, and pectoral flippers. Numerical freeze brands should be at least 2” high and may be placed on both sides of the dorsal fin and/or on the animal’s side just below the dorsal fin, except for species that lack a dorsal fin or have small dorsal fins such as the harbor porpoise. Roto-tags should be attached on the trailing edge of the dorsal fin. Tag application and freeze branding should only be done by experienced personnel as improper tagging may cause excessive tissue damage, infection, or premature loss of the tag or mark. Marking of non-delphinid cetaceans can be more challenging due to unique anatomical features and should be determined in consultation with NMFS. NMFS must receive advance notification of and approve any additional forms of identification that a rehabilitation facility voluntarily wants to place on a cetacean besides those mentioned above. NMFS authorization is required prior to placement of VHF radio or satellite-linked radio tag.

The identification system to be used on cetaceans deemed “Conditionally Releasable” must be approved by NMFS. As these animals are required to have an advanced post-release monitoring plan, conditionally releasable cetaceans will often require VHF or satellite tagging in addition to photo-identification, freeze-branding, and placement of a visual fin tag.

3.9 Post-Release Monitoring of Cetaceans

Few data is currently available regarding the long-term fates of released cetaceans. Post-release monitoring provides essential information to develop and refine marine mammal rehabilitation and release practices. "Conditionally Releasable" cetaceans should be monitored daily for at least two months after release. The specific post-release monitoring plan for each cetacean is to be coordinated through NMFS. Post-release monitoring methods may include visual observations from land, sea, or air, and/or radio or satellite-linked monitoring. It is understood that post-release monitoring of cetaceans, particularly pelagic species, is an extensive undertaking for which significant support is required, often from multiple sources. In a few instances, NMFS has provided resources such as financial support, personnel, and equipment for post-release monitoring but it is not standard practice. Therefore, the rehabilitation facility is encouraged to seek funding to enhance their post-release monitoring program.

The first month after release is a particularly critical period during which it will become evident whether the animal is thriving, including avoiding predators, capturing sufficient prey, and being accepted by conspecifics. For coastal species it is recommended that monitoring continue on a regular basis for at least one year. Funding resources, such as the Prescott Grant Program, can assist with the financial burden of such endeavors. NMFS requires periodic and final reports on released animals. These reports will facilitate future revisions to the marine mammal rehabilitation and release guidelines. In order to compare individual cases, standardization of data collection protocols for monitoring released cetaceans will be required. NMFS will provide the stranding network with the desired format for receipt of tracking data in reports. Presentation, discussion, and formal study of monitoring data and its dissemination to the stranding network will aid in the assessment of cetacean rehabilitation and release programs.

Release plans should include the contingency plans that are available for recovering the animal, should monitoring indicate its failure to thrive. The release plans should also address treatment and euthanasia if the animal is retrieved or restrands. In addition, NMFS may require such contingency plans for "Conditionally Releasable" cetaceans, depending on the circumstances.

3.10 Decision Tree – Cetacean Release Categories

3.10.1 Releasable

The cetacean is cleared for release by the attending veterinarian (including the Assessment Team) and the NMFS Regional Administrator concurs in writing. This means that the requirements for the health and behavior assessment, marking/tagging, and release plan have been met and both veterinary and biological opinions regarding release have been received (see text for details). For an animal to be considered "releasable" the response to all of the essential release criteria below should be met.

History

Cetacean has no historical information requiring consultation with NMFS such as stranding in close temporal or geographic relation to a UME, stranding associated with an environmental event of concern,, an acoustic insult, a human interaction or criminal investigation, or a mass stranding.

Developmental Stage/Life History

a) Cetacean has attained sufficient size and age to be nutritionally independent.
b) Cetacean is not a female with calf.
c) Cetacean is not a geriatric animal and not compromised due to age related conditions.
d) Cetacean was not exposed to captive or domestic animals during rehabilitation.

Behavioral Clearance

a) Cetacean breathes normally, swims and dives effectively.
b) Cetacean does not exhibit aberrant behavior, auditory, or visual deficits.
c) Cetacean demonstrates appropriate foraging ability.
d) Cetacean did not strand as direct result of a failure to avoid predators.
e) Cetacean did not strand as a result of taking food from humans in the wild.
f) Cetacean did not strand as a direct result of a demonstrated inability to obtain sufficient food in the wild.
g) Cetacean did not strand as a direct result of conspecific injury.

Medical Clearance

a) Health status of the cetacean is deemed appropriate for release by the attending veterinarian.
b) Hands-on physical exam by the veterinarian at time of admission to rehabilitation and within 72 hours of release.
c) Laboratory tests performed at time of admission and within seven days of release are complete and submitted for review:
    - CBC;
    - Chemistry Profile to include: Glucose, Sodium, Potassium, Chloride, Calcium, Phosphorus, Iron, Bicarbonate, Alkaline Phosphatase, ALT, AST, GGT, BUN, Creatinine, Uric Acid, CPK;
    - Serum Banking (3 ml upon admission and 3 ml at time of release, more if available; and
    - Aerobic Bacterial Cultures (Blowhole, Rectal, Lesions).
d) Cetacean is free of drugs (excluding sedatives used for transport) a minimum of 2 weeks prior to release.

Release Logistics

a) Tagging/Marking - Delphinids: 3 forms of identification approved by NMFS (dorsal fin tag, freeze brand, photo, other).
b) Release Site - Return to appropriate stock and geographical site under favorable environmental conditions, and for social species, introduced in areas with conspecifics.
c) Tracking - minimum of 2 months post-release monitoring coordinated with NMFS (provide NMFS with regular tracking updates).
d) Provide NMFS a report at the end of the tracking period.

3.10.2 Conditionally Releasable

The cetacean did not meet one or more of the essential release criteria but may be releasable in the future pending resolution of the problems identified by the attending veterinarian and Assessment Team.. This may involve discussion with outside experts in consultation with NMFS. Contingency plans for recapture, treatment, permanent care, and euthanasia should be required if release is unsuccessful and the animal restrands. The following may be true for one or more assessment points.

History

a) Cetacean stranded in close temporal or geographic relation to a UME.
b) Cetacean stranded in association with an environmental event of concern or an anthropogenic acoustic insult.
c) Cetacean was involved in a mass stranding.
d) Cetacean stranded previously on one or more occasions.
e) Single stranding of a social species.
f) Cetacean was part of a NMFS permitted research project, potentially being handled more frequently.

Developmental Stage/Life History

a) Cetacean is nutritionally dependent, but older calf with some foraging skills.
b) Cetacean is recently weaned.
c) Cetacean is a female with calf.
d) Cetacean is a geriatric animal and is compromised due to age related conditions.

Behavioral Assessment

a) Cetacean exhibits aberrant behavior, which may include but is not limited to, abnormal breathing, swimming, and/or diving, auditory or visual dysfunction.
b) Ability of the cetacean to forage for prey is questionable or logistical circumstances prevent testing of forage or prey capture ability.
c) Cetacean requires significant conditioning due to developmental stage and/or medical condition.
d) Predator wounds were likely secondary to another cause of the stranding.
e) Attraction to humans in the wild has been extinguished.
f) Cetacean is a social species and has stranded due to injury from conspecifics.

Medical Assessment - The attending veterinarian determines that the health status of the cetacean is uncertain regarding suitability for release. The veterinarian arrives at a determination of "Conditionally Releasable" through performance and interpretation of physical examinations and interpretations of tests such as CBC, chemistry profile, cultures, and other tests required by NMFS, plus any other diagnostic tests deemed necessary to fully evaluate the animal. Response of the cetacean to therapy and the clinical judgment of the veterinarian may also contribute to a

determination of "Conditionally Releasable." Further tests may be required including ultrasound or radiographs to clarify medical issues.

Cetaceans exhibiting any of the following medical or physical conditions are to be discussed with NMFS, with the expectation that without resolution, such conditions will make the animal an unsuitable candidate for release:

a) Compromised function of sensory systems (auditory, visual).
b) Decreased range of motion.
c) Deformed or amputated appendage.
d) Laboratory tests interpreted as abnormal or suspicious of disease (CBC, chemistry, cultures, or other tests).

Release Logistics

a) Tagging, marking, post-release monitoring - Extensive post-release monitoring of cetaceans deemed "Conditionally Releasable" is required and is to be approved and coordinated through NMFS. Post-release monitoring of such animals should be at least two months duration, likely longer. Monitoring is likely to include advanced tracking techniques, such as satellite tracking via radio-tracking or photographic identification searches if the animal is likely to move outside of the range of monitoring. The cetacean will continue to be deemed "Conditionally Releasable" until the post-release monitoring plan required by NMFS can be implemented.
b) Stock of origin is unknown, uncertain, or temporarily unreachable due to environmental or natural history factors - When such circumstances exist, the case is to be discussed with NMFS. The cetacean will be deemed "Conditionally Releasable" until specifics of release are approved by NMFS.
c) Plan for recapture - NMFS may request a contingency plan if feasible for a "Conditionally Releasable" cetacean prior to its release should the animal appear to be unable to readjust to the wild. This should include plans for follow up treatment, permanent care and/or euthanasia. The cetacean will continue to be deemed "Conditionally Releasable" until NMFS approves a contingency plan.

3.10.3 Non-Releasable

The cetacean is determined to be unsuitable for release by the attending veterinarian and Assessment Team and the NMFS Regional Administrator concurs. The animal did not meet the essential release criteria, and thus does not have a reasonable chance of survival in the wild or poses health risks to wild marine mammals.

History

a) Cetacean has been in captivity for more than two years or is otherwise too habituated and counter-conditioning techniques have been unsuccessful.
b) Cetacean stranded previously on one or more occasions.
c) Cetacean was part of a NMFS permitted research project, potentially being handled more frequently, and circumstances preclude its suitability for release.

Developmental Stage/Life History

a) Cetacean is nutritionally and socially dependent (neonate and young nursing calf without foraging skills).
b) Cetacean is geriatric and exhibiting other medical and/or behavioral abnormalities.

Behavioral Clearance

a) Exhibits abnormal breathing, swimming, diving, or other aberrant behavior that may compromise survival in the wild or may be caused by a disease of concern to wild marine mammals.
b) Exhibits auditory or visual dysfunction that would compromise survival in the wild or may be caused by an ongoing disease process of concern to wild marine mammals.
c) Unable to capture and consume live prey.
d) Demonstrated inability to avoid predators.

Medical Clearance - The attending veterinarian determines that the health of the cetacean precludes release. In such cases, the medical condition of the animal prevents normal function to a degree that would compromise its survival in the wild or pose a health risk to wild marine mammals. The veterinarian supports the determination of "Non-Releasable" status with required physical examinations and tests such as CBC, chemistry profile, cultures, and those required by NMFS plus any other tests deemed necessary to fully evaluate the animal. Further tests may be required,

including ultrasound or radiographs, to clarify medical issues. The veterinarian presents their findings to the NMFS Regional Stranding Coordinator and recommends that the cetacean be maintained in captivity or be euthanized.

Conditions that warrant consideration that a cetacean is deemed "Non-Releasable" include, and are not limited to, the following:

a) Compromised function of sensory systems (auditory, visual).
b) Decreased range of motion.
c) Deformed or amputated appendage.
d) Laboratory tests interpreted as abnormal or suspicious of disease of concern.
e) Geriatric, or believed to have chronic disease, which may compromise survival in the wild.

Release Logistics

a) Tagging/Biomonitoring - The cetacean requires extensive post-release monitoring for which there are insufficient resources.

4. Guidelines for Release of Rehabilitated Pinnipeds

4.1 Introduction

Each year in the United States, several different species of pinnipeds from three taxonomic families, Phocidae (true seals), Otariidae (eared seals), and Odobenidae (walrus), are rescued and rehabilitated. As walrus are under the jurisdiction of FWS, these guidelines should be generally applied but there are a few exceptions. Close consultation with FWS is required with each walrus case.

Except as otherwise noted, each pinniped is required to have a complete historical, developmental, behavioral, and medical status assessment by the attending veterinarian and animal care supervisor and be properly marked for identification prior to release. The release determination recommendation must include a signed statement from the attending veterinarian in consultation with the Assessment Team that the animal is **medically and behaviorally suitable for release in accordance with the release criteria** and include a written release plan and timeline. NMFS or FWS may require additional testing for reportable diseases in light of new findings regarding various disease and health issues and this information should be included in the release request. A release plan will require a justification statement and detailed description of the logistics for transporting, tagging, location, timing, crowd control, media coordination (if applicable), post release monitoring, and recovery should the animal fail to thrive (e.g., restrands). NMFS or FWS may require recapture if the animal appears to be in distress following a specified time after release. Recapture will require special authorization from NMFS or FWS prior to this activity. NMFS or FWS may consult with individual experts for further guidance. NMFS reserves the right to impose additional requirements in the release plan as stated in 50 CFR 216.27 (a)(3).

The NMFS Regional Administrator may allow for pre-approved waivers for routine pinniped cases as stated in 50 CFR 216.27(a)(2)(i)(A). Typically these cases are anticipated (e.g., the typical annual cluster of cases where the etiology is known and diagnosis and treatment is routine) and can be appropriately planned. For such waivers, the Stranding Network Participant should submit a protocol for such cases including location of release. These waivers will require pre-approval by the NMFS Regional Administrator on a schedule as prescribed in the Stranding Agreement. NMFS may require that a certain percentage of these cases that present with similar clinical signs and diagnosis be thoroughly tested and assessed each year. Similarly, NMFS may give blanket authorization for pre-approved release sites and for post-release monitoring plans.

4.2 Overview of Release Categories for Pinnipeds

Pinnipeds evaluated at rehabilitation facilities can be grouped into one of three "Release Categories" based on historical, developmental, behavioral, ecological, and medical criteria set forth in a **standardized checklist**. It is recommended that the standardized checklist (see Appendix J) should be used to assess and document the release candidacy of rehabilitated pinnipeds. The checklist includes a health statement (i.e., health certificate) to be signed by the attending veterinarian and authorized representative, which verifies that a pinniped meets appropriate standards for release. This checklist could be used to determine and document releasability (i.e., as part of the required documentation sent to NMFS) and as a final check just prior to release.

The majority of walrus typically strand as calves and are not good release candidates due to the extended period of maternal dependency. FWS generally considers walrus calves to be "non-releasable" and considers all stranded walrus on a case-by-case basis for permanent placement. If the animal is placed in permanent captivity, the receiving facility must hold an Exhibitor's License from APHIS [7 U.S.C. 2131 *et seq*.] and comply with MMPA (16 U.S.C. 1374 §104(c)(7)). Questions regarding disposition of stranded walrus should be directed to the FWS contact as identified in Appendix H.

1. **"RELEASABLE":** There are no significant concerns and the animal meets basic historical, developmental, behavioral, ecological, and medical criteria, supporting the likelihood of survival and a lack of risk to the health of wild marine mammals. The release plan (post-release identification, release site, contingency plans, and post-release monitoring) has been approved in writing by NMFS via the letter of concurrence. For the pinniped to be deemed "Releasable," **all** items on the checklist should be answered as **"Yes."** The attending veterinarian signs the checklist confirming the information and the assessment.

2. **"CONDITIONALLY RELEASABLE":** One or more items on the standardized checklist have been marked **"No"** for pinnipeds in this category. This may pertain to historical, developmental, behavioral, ecological, and/or medical status concerns regarding the animal's potential to survive in the wild and/or its potential to pose a health risk to other marine mammals. A pinniped may also be deemed conditionally releasable if requirements for release cannot be met at present but may be met in the future and without compromising the health and welfare of the individual animal. In such cases, more time may be needed to

determine the feasibility of release (see 50 CFR 216.27(a)(1)(iii) for species under NMFS jurisdiction).

All "Conditionally Releasable" pinnipeds must be discussed with NMFS or FWS. NMFS or FWS may consult with individual experts to discuss specific cases. Experts include scientists and veterinarians with expertise in pinniped biology and medicine (particularly experts with species specific knowledge). Such discussions will clarify the most appropriate disposition. For example, additional medical testing, rehabilitative therapy, and additional strategies for post-release monitoring may be required to release a "Conditionally Releasable" pinniped.

3. **"NON-RELEASABLE":** One or more items on the standardized checklist have been marked **"No"** for pinnipeds in this category. This may pertain to historical, developmental, behavioral, ecological, and/or medical status concerns that preclude release to the wild. It has a documented condition demonstrating little chance for survival in the wild and/or a diagnosed health risk to wild marine mammals. For NMFS species, this category also includes animals that have been in rehabilitation greater than two years (see 50 CFR 216.27(a)(1)(iii)). Additionally, a pinniped may be deemed "Non-Releasable" if an appropriate release site or post-release monitoring plan cannot be arranged. Rehabilitation facilities that believe that they may have a walrus that is non-releasable must contact the FWS Marine Mammals Management Office (as identified in Appendix H) for concurrence on this finding and eventual disposition of the animal. If FWS determines that a walrus is non-releasable, the holding facility may request a permit for permanent placement of the animal as long as the facility meets the requirements under section 104(c)(7) of the MMPA.

   For animals deemed "Non-releasable" and with the concurrence from the NMFS Regional Administrator, the animal can be permanently placed in a public display or research facility or euthanized. If the animal is to be placed in permanent captivity, the receiving facility must be registered or hold a license from APHIS [7 USC 2131 et seq.] and comply with MMPA (16 USC 1374 Section 104(c)(7)). Facilities wishing to obtain non-releasable animals should send a *Letter of Intent* to NMFS PR1 to permanently retain (i.e., if affiliated with the rehabilitation facility) or acquire the animal. This letter should include a signature of the *"Responsible Party of Record"*. As part of the decision making process will consult with APHIS and may review the qualifications and experience of staff, transport, and placement plans (i.e., integration based on appropriate composition of species, sex, and age and the intended proposed plan for public display or scientific research). Once approved, NMFS PR1

will respond with a *Transfer Authorization Letter* and include MMDS, OMB Form 0648-0084, to be returned to NMFS PR1 within 30 days of transfer. Upon receipt of the MMDS, NMFS PR1 will acknowledge the transfer in writing and return updated MMDS to the receiving facility.

4.3 Historical Assessment of Pinnipeds

Historical stranding information may guide the management of rehabilitation and the plan for post-release monitoring. Important historical information should include:

1. **A record of previous stranding -** Pinnipeds that have previously stranded and been released, and subsequently strand again, are deemed "Conditionally Releasable" pending consultation with NMFS or FWS. Such animals should be reassessed as they may have underlying health issues requiring additional evaluation, diagnostic testing, and advanced post-release monitoring. Alternatively, such pinnipeds may be assessed as "Non-Releasable" and be transferred to permanent captivity or euthanized.

2. **An association with an ongoing epidemic among other animals or with a UME -** If the stranding of a pinniped occurs in close temporal or geographic proximity to a UME, fish kill, harmful algal bloom, hazardous waste spill, or other such environmental event, the pinniped is deemed "Conditionally Releasable" and consultation with NMFS or FWS is required. The agencies may request additional testing, documentation, and/or post-release monitoring of such pinnipeds.

3. **Stranding location and active or home range -** Areas that are worth assessing are increased human activity (e.g. active fishery, increased recreational use, military activity, shipping activity, etc.) or hazardous environmental conditions (e.g., harmful algal bloom or hazardous waste spill, and/or special weather conditions like El Niño, hurricane, extreme cold, extreme heat, etc). During an El Niño event, the rehabilitation center should consult with NMFS regarding management and release of the animal because unfavorable environmental conditions may persist once an animal is ready for release and thus the animal should be deemed "Conditionally Releasable." Also, the geographical distance between the stranding location and the rehabilitation facility is important to acknowledge as there could be important differences in the microflora at the facility. Information on areas of human activity and environmental hazards is also vital for determining an appropriate release site.

4. **The animal was exposed to (or injured by) other wild or domestic animals -** Pinnipeds having a history of exposure (i.e., confirmed or suspected) to terrestrial wild or domestic animals are deemed "Conditionally Releasable" and must be discussed with NMFS or FWS. Pinnipeds may contract disease from terrestrial wild or domestic animals such as foxes or dogs. For instance, canine distemper represents a serious health threat to pinnipeds. Should a rehabilitating pinniped contract such an pathogen, it could transmit the illness to its wild cohorts. Such transmission of pathogens can occur even when a rehabilitated pinniped is not showing clinical signs of disease. Consultation with NMFS or FWS is thus required for pinnipeds that have a history of exposure (i.e., confirmed or suspected) to terrestrial animals.

5. **The animal has a record of attacking or biting a human -** Pinnipeds that have inflicted a bite (including mouthing of unprotected skin) of a human are deemed "Conditionally Releasable" and must be discussed with NMFS or FWS. A variety of infectious diseases may be transmitted from animals to humans via bite wounds. Although documentation of rabies among pinnipeds is rare (there is one published case of rabies in a ringed seal from the Svalbard Islands, Norway [Odegaard and Krogsrud 1981]) the fatal outcome of this disease in humans warrants careful consideration of factors surrounding pinniped bites to people. NMFS or FWS may require consultation with state public health officials regarding pinnipeds that inflict bites on humans and may request that the facility follow state policies and guidelines for unvaccinated non- domestic animal bites. NMFS may also impose quarantine or additional diagnostic testing requirements prior to authorizing release.

6. **The animal was evidence or part of a human interaction or criminal investigation – This includes an investigation by** NOAA Office of Law Enforcement, the U.S. Department of Justice, or other Federal, state or local authorities.

7. **The animal was transferred from another holding, triage or rehabilitation facility** – The opportunity for exposure to pathogens can occur at different stages of response and rehabilitation. Therefore, it is important to obtain medical records and document the quality of care and treatment at each stage of this process.

8. **The animal was transferred from research facility or undergoing permitted research during rehabilitation** – Research activity may extend the frequency and intensity of handling time and therefore could increase the risk of altering behavior or increasing the

chance of exposure to facility pathogens or chemicals (e.g., anesthetic agents, metabolic agents, etc). These animals will be considered “Conditionally Releasable” or “Non-releasable.”

4.4 Developmental Assessment of Pinnipeds

In order to be deemed "Releasable," a young pinniped should be able to feed itself and have adequate body condition to survive readjustment to the wild. Generally, pups are to be held in rehabilitation centers for roughly the normal duration of lactation. Because maternal dependence may vary greatly in some species, it is recommended that the straight length and weight of each pinniped pup be taken at admission and again when evaluating the animal for release to aid in the assessment of the animal’s body condition. Such measurements may be compared to known weaning lengths and weights of appropriate wild pinniped species or to data from successfully rehabilitated and released stranded pups (see Appendix I for species specific developmental stages and pupping information). The risk of altered behavior can be related to both the length of treatment and the age of the animal at the time of stranding. Pups stranded as maternally dependent neonates and animals spending an extended time in rehabilitation being at highest risk. Special care should be taken with these species especially if rehabilitating very young pups and should be considered “Conditionally Releasable”.

Reproductive status in and of itself does not impact release candidacy of a pinniped unless a female strands with her pup or gives birth during rehabilitation. Such females and their offspring are “Conditionally Releasable” and are to be discussed with NMFS or FWS. The natural history of the pinniped species involved and factors related to maternal relationship may impact the timing and conditions of release for mother or pup. For instance, a pup that has not reached weaning weight may be releasable with its mother, but not alone. A healthy mother may be kept in rehabilitation to assist its sick or injured pup; however, this should be weighed against the risk of habituation that could minimize the chance of a successful release. Female pinnipeds in estrus or late pregnancy are releasable unless the attending veterinarian believes that the health history of the animal warrants extra precautions to minimize stress during its return to the wild. Such animals are “Conditionally Releasable” due to health concerns and are to be discussed with NMFS or FWS.

Pinnipeds that are in molt are “Conditionally Releasable” and these cases should be discussed with NMFS. Because behavior and physiology change during a molt, factors related to the pinnipeds health history, age, reproductive status, and other relevant parameters should be considered in order to determine if release is preferable to holding the animal until molting is completed.

4.5 Behavioral Assessment of Pinnipeds

The limitations imposed by the captive environment of rehabilitation may preclude a detailed behavioral assessment where behavior of the captive animal may differ from that displayed in the wild. Also, there lacks a set of behavioral and functional tests that relate to behavior in the wild and there are limitations on the complete knowledge of "normal" behavioral parameters of each species. Behavioral clearance is thus founded on basic criteria necessary for survival of the animal in the wild. The behavioral evaluation often overlaps with the medical evaluation as abnormal behavior may indicate an underlying illness. Biologists and animal care supervisors with expertise in pinniped behavior and the attending veterinarian should jointly assess the behavior of the animal.

To achieve behavioral clearance, a pinniped should breathe normally and demonstrate effective swimming, diving, and locomotion on land (if appropriate for its species). The animal should not display aberrant behavior or auditory or visual dysfunction that may compromise its survival in the wild or suggest an underlying disease of concern to wild marine mammals (i.e., reportable disease). Behavioral clearance also includes confirmation that the animal can respond to, and is able to capture and consume, live prey.

4.5.1 Breathing, Swimming, Diving, and Locomotion on Land

Evaluation of respiration is done to determine that the pinniped does not exhibit abnormal breathing patterns or labored breathing during exertion. Evaluation of swimming, diving, and locomotion on land is done to confirm that the pinniped moves effectively and does not exhibit abnormalities such as listing to one side, decreased capacity to submerge, asymmetrical motor patterns, etc. Pinnipeds that display abnormalities of breathing, swimming, diving, or locomotion on land are deemed "Conditionally Releasable" or "Non-Releasable," depending on the nature and degree of their dysfunction.

4.5.2 Aberrant Behavior

Behavioral clearance of the pinniped includes confirmation that the animal does not exhibit aberrant behavior that may compromise survival in the wild or suggest an underlying disease of concern to wild marine mammals. Examples of aberrant behavior include, but are not limited to, regurgitation, head pressing, postural abnormalities such as repetitive arching or tucking, head swaying, stereotypic or idiosyncratic pacing, decreased or unusual range of motion, and abnormalities of breathing, swimming, diving, and locomotion on land as previously discussed. Other examples include

attraction to or desensitization to the presence of humans such as in the case of pups imprinting on humans. Pinnipeds displaying aberrant behavior are deemed "Conditionally Releasable" or "Non-Releasable" depending on the nature and degree of the behavior.

4.5.3 Auditory and Visual Function

Behavioral clearance of the pinniped includes evaluation of auditory and visual function. Auditory dysfunction may be a reflection of active disease, permanent injury, or degenerative changes associated with aging. Evaluators may suspect that a pinniped has compromised auditory function if it responds minimally to loud noises created above or below water. Pinnipeds that have visual dysfunction may show difficulty locating prey items, tendency to collide with boundaries of their enclosure, or difficulty maneuvering about objects placed in their path. Discoloration, swelling, abnormal shape, position, or appearance of the eye or eyelids may suggest visual dysfunction. Pinnipeds with auditory or visual dysfunction should be deemed "Conditionally Releasable" or "Non-Releasable" depending on the degree and nature of their condition.

4.5.4 Prey Capture

Rehabilitated pinnipeds should demonstrate the ability to chase, capture, and consume live prey prior to their release. Prey items found in the animal's natural environment should be used whenever possible. If natural prey items are not available, evaluators may utilize other prey species. Evaluation of the pinniped includes assessment of each component of feeding behavior including the ability to chase prey, to actually capture prey, and to consume prey without assistance from humans. Pinnipeds that display ineffective prey capture and consumption are deemed "Conditionally Releasable" or "Non-releasable." If logistical issues preclude evaluation of prey capture and consumption or there is a question about the quality of live prey, NMFS or FWS should be consulted.

Rehabilitated pinnipeds that have been in captivity longer than one year and young pinnipeds having little or no previous foraging experience in the wild require particularly careful assessment of feeding behavior. Repeated feeding trials using live prey with concurrent assessment of the animal's ability to maintain good body condition are helpful in thoroughly evaluating such animals.

4.6 Medical Assessment of Pinnipeds

The medical assessment includes information related to any diagnostic testing, treatment, and response to treatment. The attending veterinarian should perform a hands-on-physical examination upon admission and prior to the release determination. The attending veterinarian should review the

animal's complete history including all stranding information and diagnostic testing (i.e., required by NMFS and any additional data), and medical and husbandry records (including food consumption and weight and length progression). The primary goal of testing required by NMFS or FWS is to safeguard the health of wild marine mammal populations. This is achieved by testing for diseases that pose a significant morbidity or mortality risk to wild populations (i.e., reportable diseases). Those that are zoonotic or public health and safety concern require immediate NMFS notification to assure proper protocols are put into place. Additional testing will be required if the animal was part of an official UME. NMFS may request testing for other emerging diseases as part of a surveillance program to identify potential epidemics of concern and to monitor changes in disease status that may have occurred due to rehabilitation practices. The directive for the pre-release health screen will come from the NMFS Regional Stranding Coordinator through the MMHSRP. Appendix E lists diseases of concern for pinnipeds.

A complete health screen should be completed upon admission and just prior to release including basic blood collection for a CBC, chemistry profile (including BUN and creatinine, enzymes and electrolytes), serology, microbial and fungal culture (i.e., nasal, rectal, ocular, and lesions), cytology, urinalysis, and fecal exam. If the animal is female and at reproductive age, it is advisable that pregnancy is ruled out prior to prescribing potentially fetal toxic medication. Serum (3ml/each) should be banked at the time of admission and just prior to release for retrospective studies. Cessation of antibiotics should occur two weeks prior to release examination to assure that the animals is no longer dependent on the medication and that the drug has cleared based on the pharmacokinetics and requirements made by the veterinary community and the Food and Drug Administration. Some antibiotics clear the body quickly and require shorter withdrawal time; therefore, when this recommendation cannot be met seek advice from NMFS. **The attending veterinarian should provide written notification to the NMFS Regional Stranding Coordinator that a pre-release health screen of the pinniped has been performed two weeks prior to release and will be conducted within 72 hours of release as a final check. The two week notification must also include the final release plan. The final assessment at the 72 hour mark can be emailed just prior to the release or immediately following the release as prescribed by the NMFS Regional Stranding Coordinator. The required documentation and signed release determination recommendation will be part of the administrative record along with the signed (by the NMFS Regional Administrator) letter of concurrence approval for release.**

It is of extreme importance that the pinniped be monitored closely for disease throughout its rehabilitation. Regardless of the stranding etiology, handling and care can cause significant stress increasing susceptibility to disease. If not properly managed, rehabilitation facilities provide an environment where genetically altered or novel pathogens not typically encountered in the wild can easily be transmitted from animal to animal. This scenario can be problematic when an animal is exposed and becomes a carrier of that pathogen to a naïve wild population if released. Introduction of pathogens from rehabilitation centers to the wild is a significant concern as diseases with serious epizootic potential have been detected (Measures 2004, Moore et. al., 2007). Infectious agents may become more pathogenic as they pass through new individuals and naïve species or genetically altered from indiscriminant use of antibiotics.

The attending veterinarian is urged to utilize the full spectrum of diagnostic modalities available for health assessment of the pinniped. In addition to basic blood work, serology, microbial culture, cytology, urinalysis, and fecal exam, advanced techniques for pathogen detection such as PCR and toxicology analyses are available. A number of diagnostic imaging techniques including radiology, CAT scans, and MRI may be used as well as bronchoscopy and laparoscopy. The pinniped literature has expanded to include numerous references on the performance and interpretation of diagnostic tests.

Both agencies may request testing for other emerging diseases as part of a surveillance program to identify potential epidemics of concern and identify health trends. Additional testing will be required if the animal was part of an official UME. Specific testing requirements (i.e., pre-release health screen) will come from the NMFS Regional Stranding Coordinator through the MMHSRP and follows the term and responsibilities stated in the NMFS Stranding Agreement.

4.7 Release Site Selection for Pinnipeds

The release of a rehabilitated pinniped should be planned to maximize its chances for survival. The release should be timed and staged to increase its likelihood of foraging success and acceptance by conspecifics. Factors including its species, age, reproductive status, previous home range, social unit, and migratory patterns should be considered. Weather conditions at the release site and other environmental factors impacting the habitat and food availability should also be evaluated.

The rehabilitated pinniped is to be released into its home range, genetic stock, and social unit whenever possible. Return of the animal to its home range is preferable as the reacclimating pinniped would presumably have familiarity with available resources, potential predators, environmental

features, and social relationships. In many cases, this can be accomplished by releasing the pinniped at its stranding site through a simple hard-release process (i.e., the animal is released directly after transport to the release site without acclimation through holding in a temporary enclosure at the site).

For wide ranging species, such as hooded and ringed seals, the release site selection is considered on a case-by-case basis. Consultation with NMFS is required for these cases. If the range of conspecifics is distant form the original stranding site, rehabilitators may consider various options depending on the natural history of the species and the temporal relationship of release to seasonal distribution. The pinniped may be released to migrate on its own or with conspecifics still in the vicinity. Alternatively, the pinniped may be held in captivity until conspecifics return or it may be transported to the location of its migrated cohorts. The risks of extended time for the pinniped in captivity, logistics of transport to a migration site, and costs associated with the extended stay are examples of factors to be considered. As explained later in this section, movement of pinnipeds recovering from infectious disease to other sites should be carefully considered regarding disease risk to wild pinnipeds.

When information on the animal's ranging patterns or social unit prior to stranding is not known, or when a pinniped strands outside of the previously known range of its species, NMFS is to be consulted regarding an appropriate release strategy. For pinniped species that have vast territorial ranges, such as those that naturally traverse the length of the North American continent, knowledge of the animal's specific ranging patterns previous to stranding may not be necessary. Such pinnipeds may be released in the general vicinity of their stranding site or anywhere within the vast range inhabited by that species with the following important exception (see below).

When a pinniped has recovered from an infectious disease, it may be preferable to release the animal near its original stranding site in order to minimize disease risks to wild pinnipeds. For example, even if the entire population of a far-ranging pinniped species has been exposed to a particular infectious agent, changes in the virulence of the pathogen may initially occur at distinct geographical sites. A seal exposed to a particularly virulent strain of pathogen in the far Northeast may pose a health risk to pinnipeds in the Mid-Atlantic that have not yet encountered that particular strain of virus. Additionally, the clinical signs of many infectious diseases mimic each other. As rehabilitation centers cannot always perform definitive diagnostic tests for all viral agents, moving rehabilitated pinnipeds from the general region of their stranding to distant locations for release may pose some risk to wild marine mammals. NMFS is to be consulted regarding the preferred release site when pinnipeds recovering from an infectious disease cannot be released near their original

stranding site. Another important consideration is the location of the rehabilitation facility to the normal habitat range for the species, e.g., the rehabilitation of an ice seal in the Caribbean. The decision to release in the normal habitat range would need to be thoroughly discussed with NMFS.

It is important to ensure that conditions at the release site do not pose any obvious immediate threat to the released animal, such as areas where resources and habitat is severely depleted or degraded. If evidence exists of a substantial decline in resources or habitat quality such as massive fish kills, significant declines in commercial and/or recreational fish landings, red tides, etc., it may not be appropriate to release the pinniped until conditions at the release site improve or a different release site is found. Also, release in areas of dense public use and/or high commercial and recreational fishing activity should be avoided.

4.8 Identification of Rehabilitated Pinnipeds Prior to Release

NMFS and FWS have determined that all pinnipeds must be flipper tagged for identification prior to release to the wild. Tags and placement instructions are to be obtained from NMFS or FWS and/or USGS (for walrus) as appropriate for the pinniped species (see Appendix H for contact information. Although resightings of flipper-tagged individuals may provide some information regarding the relative success of a rehabilitation effort, flipper tags are not reliable for long-term monitoring. They may be difficult to read from a distance and may become damaged or lost. Other methods for identification such as freeze-branding, glue tags, etc. may be used in addition to flipper tags (Geraci and Lounsbury 2005).

4.9 Post-Release Monitoring of Pinnipeds

Post-release monitoring of pinnipeds provides essential information for the development and refinement of marine mammal rehabilitation and release practices. Post-release monitoring methods may include visual observations of tagged or freeze-branded pinnipeds from land, sea, or air, as well as radio or satellite-linked monitoring. Radio and satellite-linked monitoring programs are highly desirable as they provide a wealth of information regarding the activities and fates of released animals. NMFS or FWS may require and coordinate post-release monitoring plans for “Conditionally Releasable” pinnipeds. Additionally, rehabilitation centers may voluntarily provide post-release monitoring plans for routinely released pinnipeds. When such monitoring will be performed voluntarily, the rehabilitation center is required to inform NMFS or FWS of the intent to implement post-release monitoring when seeking authorization for release of the pinniped.

The first month after release of the pinniped is a particularly critical period during which it will become evident whether the animal is thriving, including capturing sufficient prey and being accepted by conspecifics. It is recommended that monitoring continue on a regular basis via field observations, radio, or satellite-linked monitoring for up to one full year and such funding resources as the Prescott Grant Program can assist with the financial burden of such endeavors. NMFS may request these data in order to make future revisions to pinniped rehabilitation and release guidelines. In order to compare individual cases, standardization of data collection protocols for monitoring released pinnipeds may be helpful, and this should include the length of the tracking time, the type of tracking equipment, and assessment of outcome. Formal study of monitoring data and its dissemination to the stranding network can aid in the assessment of pinniped rehabilitation and release programs.

Release plans should include contingency plans for recovering the released pinniped, should monitoring indicate its failure to thrive, including options for treatment, permanent care, or euthanasia. In addition, NMFS will request such contingency plans for "Conditionally Releasable" pinnipeds, depending on the circumstances.

5. Guidelines for Release of Rehabilitated Manatees

5.1 Introduction

West Indian manatees (*Trichechus manatus*) are found throughout the Caribbean basin. In the United States, the Florida subspecies (*Trichechus manatus latirostris*) is commonly found in southeastern coastal waters, with Florida at the core of its range. The Antillean subspecies (*Trichechus manatus manatus*) is found outside of Florida throughout the Caribbean basin (including Puerto Rico and possibly Texas). While most reports of distressed manatees occur in Florida, manatees have been rescued throughout the region. The focus of manatee rescue and release activities is to promote the conservation of wild manatee populations.

Reports of distressed manatees include animals compromised by human activities and natural causes. Human causes of distress include collisions with watercraft, entrapment in structures, entanglement in and ingestion of fishing gear and debris, and other sources. Natural causes of distress include exposure to cold and brevetoxins, mother/calf separation, seasonal disorientation, etc. All rescue-related communications and the day to day decision making process in the field are generally handled by the local field Stations of the Florida Fish and Wildlife Conservation Commission (FWC) in conjunction with report from the public utilizing the FWC hotline (1-888-404-FWCC). All activities related to the verification of a report of a manatee in trouble, subsequent rescue, and transport to rehabilitation facilities are communicated through the FWC Field Stations, according to established protocols. The FWS Jacksonville Field Office coordinates the manatee rescue, rehabilitation, and release program to assist these animals. The FWS Jacksonville Field Office conducts this program according to the provisions of an ESA/MMPA marine mammal enhancement permit issued by the FWS DMA. The permit authorizes “take” activities for an unspecified number of manatees for the purpose of enhancing its survival and recovery, consistent with the FWS manatee recovery plan developed pursuant to the ESA.

The FWS Jacksonville Field Office coordinates a network of individuals, facilities, and agencies authorized as subpermittees under their enhancement permit and through LOAs issued under section 109(h) and section 112(c) of the MMPA [16 U.S.C. 1379(h) and 16 U.S.C. 1382(c)] to authorize activities related to the rescue (including temporary capture, possession, transport, and transfer), rehabilitation, and post-release monitoring of manatees.

The following guidelines were first developed by program participants in 1991 and subsequently revised in 2001. They are based on more than twenty years of program history and include the experiences, advice, and expertise of resource managers, field biologists, veterinarians, behavioral experts, animal keepers, and other dedicated individuals. The guidelines are to be used by authorized participants to guide the return of rehabilitated manatees to the wild.

5.2 Overview of Release Categories for Manatees

Manatees undergoing rehabilitation are evaluated by program participants and placed into one of four Release Categories:

1. **"RELEASABLE":** Manatees that have been successfully treated, are of an appropriate size, demonstrate appropriate behaviors, have the skills necessary to thrive in the wild, and do not pose a threat to wild populations will be considered releasable. Additionally, distressed manatees that are assisted in the wild and then released on-site are characterized as "Releasable". These include fit (healthy, non-injured) manatees superficially entangled in fishing gear, animals isolated by high water or detained by structures (such as water control structures, sheet pile walls, booms, and other barriers), seasonally disoriented animals, and others. "Seasonally disoriented" manatees include otherwise fit animals that fail to migrate to appropriate winter habitats during the periods of cold weather. These animals are typically relocated to warm water sites within their region of origin.

2. **"CONDITIONALLY RELEASABLE":** Manatees with a condition and/or circumstances that present a question regarding the success of release or ability to thrive in the wild but likely not pose a threat to wild populations will be considered conditionally releasable. Animals described as "Conditionally Releasable" typically include medically-cleared, captive-reared animals and older, long term-captives. The status of animals considered to be "Conditionally Releasable" may change to "Releasable" if their condition or circumstances improve or to "Conditionally Non-releasable" if their condition or circumstances deteriorate.

3. **"CONDITIONALLY NON-RELEASABLE":** Manatees that cannot be released because their condition and/or circumstances threaten the well-being of the animal and/or may pose a threat to the wild population will be considered conditionally non-releasable. The status of animals considered to be "Conditionally Non-releasable" may change to "Releasable" or "Conditionally Releasable" if their condition or circumstances improve over time. This

category may include individuals with permanently debilitating medical conditions. Because manatees are closely monitored post release (i.e., their normal habitat range is coastal and thus easier to monitor post release) and data have shown that they can survive and thrive post release even after many years in captivity, this category has been added.

4. **"NON-RELEASABLE":** The FWS will review, on a case-by-case basis, requests to establish the non-releasability of certain captive-held manatees. Manatees deemed non-releasable will be medically characterized by a disease process that proves to be a significant risk to the wild population or by significant physical injuries (such as loss of paddle or significant spinal trauma) that would preclude the ability of an animal to thrive in the wild. Petitions to establish non-releasability of individual manatees will be reviewed by an independent panel which will make their recommendations to the FWS. The FWS will consider the request and recommendation and will then determine the status of the animal. Should an animal be deemed non-releasable by the FWS, the receiving facility will need to meet the requirements to receive an enhancement permit in accordance with section 104 (c)(4) of the MMPA (16 U.S.C. 1374(c)(4)), section 10(a) of the ESA (16 U.S.C. 153(a)) and the FWS issuance criteria at 50 CRF 17.22.

5.3 Historical Assessment of Manatees

Efforts are made to maintain complete, detailed records that document rescued manatees from the time of rescue to their eventual disposition. These records generally include information describing the rescue, circumstances surrounding the stranding (e.g., red tide, cold weather, etc.), treatment(s), captive care, and resolution of the case (i.e., death, euthanasia, or release). In the case of previously known wild individuals, these records can include documentation of behavioral and reproductive patterns, migratory habits, and site fidelity. For all released animals, these records should also include all post-release monitoring information.

These records guide the treatment of individual stranded manatees and provide an evaluative tool that allows program managers and participants to assess and improve methods and procedures to better ensure success. As an example, in the case of red tide-related strandings, records detail the rescue of a manatee(s), noting the stranding site in the context of a red tide event, the presentation of the animal (beached, convulsing, etc.), any behaviors noted during transport, appropriate neurologic treatment, post treatment observations, and eventual release. Release plans for the animal should require information characterizing the status of red tide within the planned release area. Such detailed

documentation has helped with efforts to develop effective rescue, rehabilitation, and release methods for red tide stranded animals.

5.4 Developmental Assessment of Manatees

"Releasable" animals must be nutritionally independent (weaned and off of supplemental nutritional support), greater than 200 cm in total length and more than 600 pounds in weight. There should be no concerns regarding the animal's length of time in captivity, relative to its age. On occasion, smaller suckling calves are released with their dam to ensure that the dam's wild experience is passed on to her calf. Based on observations of cow/calf bonding behavior, this will help to improve the calf's wild skills and ability to survive in the wild.

"Conditionally Releasable" manatees should demonstrate nutritional independence, especially in the case of older calves planned for release. Recently weaned juveniles are also considered as release candidates. In both instances, animals should meet "Releasable" criteria for length and weight. Manatees that have spent lengthy periods of time in captivity (relative to their age) also fall into this category. Concern has been expressed that older, long-term captives may have a diminished ability to thrive in the wild (at the extreme are animals that have been in captivity for more than 50 years). While concern for these older animals may be well-placed, it is difficult to know at what age (if any) these animals' condition and lack of wild skills will compromise the success of their release. As such, older animals are considered on a case-by-case basis for release. The release of older manatees is being conducted in the context of a research program that will yield data to help ensure success for subsequently released individuals meeting similar criteria.

"Conditionally Non-releasable" manatees include animals that are not nutritionally independent, do not meet the length and weight criteria for "Releasable" animals, and/or lack the wild skills that are essential for a successful release.

"Non-releasable" manatees will be reviewed by the FWS on a case-by-case basis.

5.5 Behavioral Assessment of Manatees

"Releasable" manatees must exhibit normal behaviors while in captivity and are, therefore, expected to be able to meet behavioral challenges when in the wild. Normal behaviors include typical breathing, swimming, diving, and foraging/drinking patterns. Foraging behaviors include the ability to feed in salt, brackish, and fresh water environments without becoming dehydrated. Manatees must

also demonstrate an ability to feed on natural vegetation located at various levels in the water column. Historically, captive manatees have been fed at the water surface. Naïve animals fed in this fashion have had difficulties finding food on the bottom after release. Current feeding practices include feeding at the bottom and top of the water column.

While abnormal behaviors in manatees have not been defined, animals that exhibit atypical behaviors (as determined by FWS and its advisors) while in captivity will be considered for release on a case-by-case basis. Behaviors that elicit concerns include stereotypic behavioral displays, adaptability or sensitivity to change (including going off feed, shutting down, etc.), and perceived affinities for humans and human activities while in captivity. These affinities should not be confused with the manatee's innate ability to explore their captive environment, including humans, especially in the absence of other engaging stimuli. Efforts should be made to de-condition or extinguish these behaviors before release.

5.6 Medical Assessment of Manatees

Prior to release, release candidates must be examined by a veterinarian experienced in manatee medicine. Examinations should include a review of the animal's complete history, a hands-on physical examination, and diagnostic testing. The exam should include blood work, including CBC and serum chemistries. Serological and bacteriological assessments should be conducted when deemed necessary by the attending veterinarian. Results of analyses should be consistent with known values for animals of similar age, size, and sex and consistent with historical values for that specific animal. A "medically cleared" manatee will be free of medical problems, not limited in its ability to thrive in the wild, and will not pose a threat to wild populations.

Manatees that have unresolved injuries, compromising physical conditions (malnutrition, dehydration, etc.), active/infectious disease processes, injuries that significantly affect mobility and range of motion (e.g., the loss of a paddle, failure to adapt appropriate buoyancy control, etc.) and other debilitating conditions are considered to be "Conditionally Non-releasable". In the event that these concerns are resolved, these animals may be categorized as "Releasable" or "Conditionally Releasable".

5.7 Decision Tree for Release Categories - Manatees

The following is a list of criteria used to help determine the release status of captive manatees. Please note that an animal's status may change as various criteria are met. (These criteria generally apply to all species/subspecies of manatees unless otherwise indicated.)

5.7.1 RELEASABLE

Developmental Stage/Life History

a) Nutritionally independent.
b) For Florida manatees, length must be >200 cm and weight >600 lbs (unless released with dam).
c) No concerns about length of time in captivity relative to age.

Behavioral Assessment

a) Must exhibit normal behaviors, including typical breathing, swimming, and diving patterns while in captivity.
b) Must be able to eat natural vegetation and adapt to salt, brackish, and fresh water regimes.
c) Must demonstrate ability to feed on natural vegetation at various levels in water column.

Medical Assessment

a) No active, demonstrable medical problems.
b) Medically cleared based on examination by a veterinarian experienced in manatee medicine.
c) Poses no threat to wild populations.

Pre-release Requirements

a) The animal must be individually recognizable.
    i. All identifiable markings should be completely documented with sketches and photographs.
    ii. In the absence of individually identifiable markings, the animal should be freeze branded. The brands should be sketched and photographed.
    iii. All released manatees should be PIT-tagged and information recorded and logged.
b) Blood and/or tissue samples must be taken for serum banking and genetics.

c) Ultrasound measurements of blubber layers must be taken as an initial indicator of health status.

Release Logistics (a release plan should be prepared for each released animal)

a) Telemetry should be considered when appropriate, subject to approval by FWS.
b) Animals should be released in close proximity to their point of origin, when appropriate (in the case of previously known animals, suitable sites may be selected within the animal's home range).
c) Release sites should be free of harmful algal blooms and other compromising factors.
d) For captive-reared, naïve animals in Florida, release sites should include natural warm water sites within the animal's home range or that of the parent. Such releases should occur during the winter, thereby improving possibilities for bonding to the site and building associations with cohorts.

5.7.2 CONDITIONALLY RELEASABLE

Developmental Stage/Life History - Developmental considerations include animals that may be characterized by one or more of the following conditions:

a) Partial nutritional independence.
b) For Florida manatees, less than 200 cm in length and/or 600 lbs in weight.
c) Social dependence.
d) Recent weaning (stranded as a neonate, captive weaned, etc.).
e) Extended period of time (relative to age) in captivity.

Behavioral Assessment

a) Exhibits abnormal behavior(s) in captivity.
b) Unable to eat natural vegetation and adapt to salt, brackish, and fresh water regimes.
c) Unable to feed on natural vegetation at various levels in water column.

Medical Assessment: Animals with the following conditions may be considered for release:

a) Physical impairment (may include animals with damage to or loss of appendages, animals with impaired range of motion, etc.)
b) Reproductive condition (may include pregnant females, lactating females with calves, etc.)

Pre-release Requirements

a) The animal must be individually recognizable.
    i. All identifiable markings should be completely documented with sketches and photographs.
    ii. In the absence of individually identifiable markings, the animal should be freeze branded. The brands should be sketched and photographed.
    iii. All released manatees should be PIT-tagged and information recorded and logged.
b) Blood and/or tissue samples must be taken for serum banking and genetics.
c) Ultrasound measurements of blubber layers must be taken as an initial indicator of health status.

Release Logistics

a) Requires radio-tagging and intensive monitoring efforts following guidelines developed by FWS and its advisors (including veterinarians, animal behavior specialists, and researchers).

5.7.3 CONDITIONALLY NON-RELEASABLE

Developmental Stage/Life History - Developmental considerations include animals that may be characterized by one or more of the following conditions:

a) Nutritionally dependent.
b) For Florida manatees, less than 200 cm in length and/or 600 lbs in weight.
c) Extreme concerns about length of time in captivity relative to age.

Behavioral Assessment

a) Exhibits abnormal behavior(s).
b) Unable to eat natural vegetation and adapt to salt, brackish, and fresh water regimes.
c) Unable to feed on natural vegetation at various levels in water column.

Medical Assessment

a) Not medically cleared (animals with active/infectious diseases, permanent, demonstrable physically debilitating injuries, and/or other concerns).
b) Poses a threat to wild populations.

5.7.4 NON-RELEASEABLE

a) Animals deemed permanently non-releasable will be:
   i. Permanently captive
   ii. Euthanized, as deemed necessary, to prevent pain and suffering or in cases with an inevitable outcome.

   If FWS has determined that a manatee is permanently non-releasable, the holding facility may request a permit for permanent placement of the animal as long as the facility meets the requirements under section 104(c)(3) or (c)(4) of the MMPA and section 10 of the ESA.

b) Inbred animals: There are currently two inbred manatees in the U.S. captive manatee population. At the present time, these animals are considered to be conditionally non-releasable due to concerns regarding immunological compromise. Other concerns include observed problems with inbreeding, as seen in the European captive manatee population, which includes high infant mortality and breeding suppression. Given these concerns and questions about the effects of the release of inbred animals into the wild population, these two animals can not be released at this time and are presently considered conditionally non-releasable.

c) Pre-Act animals: The U.S. captive manatee population currently includes four Florida manatees brought into captivity prior to the adoption of Federal prohibitions preventing the display of endangered marine mammals. The care and disposition of these “Pre-Act” animals are the responsibility of their respective owners.

5.8 Pre-release Requirements for Manatees

Prior to release, all animals must be individually recognizable. While many animals are either naturally marked or have scars from encounters with boat propellers, other animals have no markings and should be freeze branded with a unique number/letter combination (the selection of the sequential number/letter combination must be made beforehand in consultation with FWS). All markings (including freeze brands) should be done well in advance of release, if possible, and all markings should be sketched and photographed. PIT tags (one on either side of the shoulders, cranial to each scapula) should also be implanted. Ultrasound measurements of blubber layers must be taken prior to release as a baseline indicator of the animal’s body condition. Blood and/or tissue samples should also be taken prior to release for serum banking and genetics.

5.9 Release and Post-release Logistics for Manatees

If at all possible, animals should be released in close proximity to the site where originally rescued. For captive-reared, Florida manatees with no wild experience, these animals should generally be released within their region of genetic origin and into natural warm-water areas during the winter to encourage winter site fidelity and familiarity with local conditions and association with wild manatees. When appropriate, telemetry may occur, pursuant to approval from FWS. (Current tagging methodologies make it difficult to radio tag and belt manatees less than 220 cm in total length.) In the case of rehabilitated, wild born adults, many of these animals can be released back into areas where researchers actively track wild manatees and can be monitored as part of these projects.

Post-release monitoring is required for all conditionally releasable animals. Such monitoring includes equipping animals with transmitters (satellite, VHF, and/or sonic, as appropriate) for both remote and on-site monitoring, On-site monitoring should include visual observations of the animal once or twice a week; protocols vary between higher and lower risk candidates. At a minimum, biomedical assessments should be conducted within the first three months after release, six months after release, and twelve months after release. If there is any question about the animal's health based on field or remote observations, assessments should occur more frequently. If the animal's well-being has been compromised as determined by these assessments, the animal should be returned to captivity. Biomedical monitoring includes an examination of overall body condition, length and other morphometrics that include girths, weight, blubber thickness, collection of blood, fecal, urine, milk, semen, and tissues samples when possible. Results of analyses should be consistent with known values for animals of similar age, size, and sex and consistent with historical values for that specific animal. While there is no agreed upon definition of success, program participants generally agree that if an animal has thrived in the wild (and met foraging and fresh water needs) for at least a year, if it has demonstrated an ability to successfully winter at a warm water site (Florida manatees), and if it has contributed to the production of offspring, then it is considered a successful release.

Pre-release conditioning may be required for conditionally releasable animals. Such conditioning may include exposing manatees to natural forage positioned at the surface and on the bottom of their tank. Natural forage includes a variety of vegetative types found within the animal's range and may also include palatable exotics such as *Hydrilla*. If an animal is to be released into water that differs from the type of water in their tank of origin, the animal should be acclimated to the type of water best suited to the release environment to minimize post-release stress, especially in the case of naïve

animals. Conditioning may also include minimizing exposure to humans to reduce or eliminate any affinity the animal may have or may potentially develop toward humans and human activity. Trained/learned behaviors must be extinguished to the greatest extent possible prior to release.

In special cases, "soft release" methodologies should be considered as a means to enhance survivorship in the wild. "Soft releases" typically rely upon temporary holding facilities established within the release area. Manatee(s) are kept in these facilities where they are maintained and observed for a period of at least several weeks. This temporary adaptation period allows for acclimation to waters at the release site, introduction to in situ forage, close observation of behaviors, and ease in capture/handling for biomedical assessments prior to release. Supplemented forage can be reduced during the containment period. At release, the "soft release" concept initially encourages brief forays away from the enclosure and allows for the individual to return to the now familiar holding facility. Further reduction in supplemental feeding will promote greater use and exploration of surrounding habitats. Use of this methodology is to be considered where individual cases warrant additional release scrutiny and release locations allow for its implementation.

5.10 Manatee Rescue, Rehabilitation, and Rescue Program Reporting/Requesting Requirements

The FWS uses an electronic database that requires program participants to report events within 24 hours of occurrence. Release requests should be received and requested electronically 30 days prior to the release. The Reporting Requirements are listed in Appendix C.

6. Guidelines for Release of Rehabilitated Sea Otters

6.1 Introduction

Sea otters are found in near shore waters of the North Pacific. Several subspecies and stocks have been identified in California, Washington, Alaska, Canada, and Russia. Sea otters may strand for a variety of reasons including trauma, disease, and the inability to forage. Guidelines for the release of rehabilitated sea otters are intended to address the welfare of these animals and any impacts the rehabilitated animals may have on wild otter populations.

Like many other marine mammals, stranded sea otters are often reported on beaches frequented by humans. In some cases, humans intercede and otherwise healthy pups are removed from the wild. The sea otter's small size makes it relatively easy to transport. However, there are currently few facilities capable of meeting the requirements for successful rehabilitation. These guidelines are intended to be used by facilities authorized to rehabilitate marine mammals under the MMPA and ESA, if applicable, and that are actively involved in the rehabilitation of sea otters for subsequent return to the wild. Questions regarding disposition and release approval of stranded sea otters must be directed to the appropriate FWS specialist as identified in Appendix H.

6.2 Developmental Assessment of Sea Otter Pups

Sea otter pups are generally dependent on their mothers for the first 6 to 12 months of life. Newborn pups are readily distinguished by their natal pelage, small size (generally less than 6 lbs), and inability to care for themselves. Pups prematurely separated from their mothers or found stranded on a beach shortly after weaning are generally less than 20 lbs in weight and typically lack foraging skills necessary for survival.

Successful rehabilitation of stranded sea otter pups for release to the wild requires a significant commitment of time and resources. Facilities that receive a stranded pup and are unable to rear the pup for possible release to the wild must immediately contact the FWS (as identified in Appendix H) to determine the disposition of the animal.

Rehabilitated sea otter pups that are at least 6 months of age, weigh at least 20 lbs, demonstrate adequate foraging, grooming, and social skills may be released to the wild. Rehabilitated sea otter pups must be monitored closely post-release to determine if their transition to the wild is successful (see post-release monitoring below).

6.3 Behavioral Assessment of Sea Otters

Certain behaviors are necessary for survival of rehabilitated sea otters. In addition, aberrant behaviors may preclude release to the wild. Rehabilitated sea otters may be released to the wild if the following behavioral criteria are met in the opinion of rehabilitation personnel familiar with normal sea otter behavior:

1. The rehabilitated sea otter must demonstrate the ability and willingness to forage and capture live prey. This includes the use of tools such as rocks used to pound shelled prey;
2. The rehabilitated sea otter must demonstrate basic survival skills and activities including active foraging, pelage management, diving, and resting;
3. The rehabilitated sea otter must demonstrate "normal" social skills including interest in other sea otters and should exhibit a wariness of humans and anthropogenic activities; and
4. The rehabilitated sea otter must not exhibit any aberrant behavior including behavior that may pose an unusual threat to human health and safety, wild sea otter populations, or other marine mammal populations.

6.4 Medical Assessment of Sea Otters

All rehabilitated sea otters must have a comprehensive, hands-on physical examination by a veterinarian experienced in sea otter medicine prior to release. The attending veterinarian must determine that the sea otter is likely to survive in the wild and must certify that:

1. Blood sampling performed within two weeks of the proposed release date, including a CBC and serum chemistry profile, falls within normal ranges for the species;
2. Medical diagnostic tests performed within two weeks of the proposed release date (e.g., cultures, biopsies, urinalysis, serology, virology, parasitology, immunology, etc) fall within normal parameters for the species or indicate a satisfactory state of health (reference CRC Handbook of Marine Mammal Medicine, 2nd Edition, Dierauf and Gulland 2001);
3. The rehabilitated sea otter should be free of drug residues (excluding sedatives used for transport or to facilitate physical examinations) and maintain good clinical health for two weeks prior to release or for a period that satisfies the attending veterinarian that the animal is healthy;

4. The rehabilitated sea otter must have functional vision and hearing, reasonable dental health, and good control and function of all appendages, at least to the degree that its survival in the wild is not compromised; and
5. The rehabilitated sea otter does not pose a known threat (e.g., transmission of pathogens, congenital defects) to the wild sea otter populations or human health and safety.

6.5 Release Categories for Sea Otters

Despite the best efforts to rehabilitate stranded sea otters, many animals die or can never be released to the wild. The following categories have been identified to help determine the status of sea otters being held for rehabilitation:

1. **"RELEASABLE":** All rehabilitated sea otters meeting the medical and behavioral criteria listed above shall be considered releasable. Every effort should be made to release these animals to the wild as soon as they are deemed fit for release.

2. **"CONDITIONALLY RELEASABLE":** All live-stranded sea otters admitted to a rehabilitation program shall be considered conditionally releasable pending the outcome of rehabilitative treatments and a full medical examination and behavioral evaluation.

3. **"NON-RELEASABLE":** Sea otters that fail to meet one or more of the required criteria for release may be considered non-releasable. Rehabilitation facilities that believe that they may have an animal that is non-releasable must contact FWS (as identified in Appendix H) for concurrence on this finding and eventual disposition of the animal. Once FWS has determined that a sea otter is non-releasable, the holding facility may request a permit for permanent placement of the animal as long as the facility meets the requirements under section 104(c)(7) of the MMPA for non-depleted species, or section 104(c)(3) or (c)(4) and section 10 of the ESA for depleted species.

6.6 Identification of Sea Otters Prior to Release

Rehabilitation facilities must affix colored and numbered "Temple" tags to the rear flippers of each sea otter prior to release. In addition, a PIT tag must be implanted in the right inguinal area of each otter. With an appropriate scientific research permit issued by FWS, the rehabilitation facility may implant an abdominal VHF transmitter to facilitate post-release tracking and monitoring of the animals. In all cases, the selection of identification numbers, tag colors/positions, and VHF

frequencies must be coordinated with other facilities and researchers in the area that sea otters are released.

6.7 Release Site Selection for Sea Otters

All rehabilitated sea otters should be released at or near the site where they originally stranded. In cases where this is not feasible, other release sites may be considered under existing Federal permits, letters of authorization, or through consultation with personnel from the FWS (as identified in Appendix H). In all cases, rehabilitated sea otters must be released into the same stock or population from which they originated.

6.8 Post-Release Monitoring of Sea Otters

All facilities releasing rehabilitated sea otters must establish a post-release monitoring program appropriate for each sea otter. The purpose of post-release monitoring is to determine the success of rehabilitation efforts and provide an opportunity for rescue of animals not able to make the transition back to the wild. Sea otters brought into rehabilitation as young pups must be tracked intensively immediately after release. Juveniles or sub-adults may require a focused effort while adult animals may be tracked opportunistically. Sea otters implanted with VHF transmitters should be tracked and monitored periodically for the duration of the battery life of the transmitters (i.e., 1-3 years).

7. Policies Regarding Release of Rehabilitated Polar Bears

Polar bears occur in most ice-covered seas of the Northern Hemisphere and are circumpolar in distribution, although not continuously. Off the Alaskan coast, they normally occur as far south as the Bering Strait. In the Beaufort and Chukchi seas, polar bears make extensive migrations between the United States and Canada or Russian territories, respectively. These movements are thought to be related to seasonal and annual changes in ice position and condition.

Polar bears normally found stranded in Alaska and subsequently recovered are generally orphaned cubs-of-the-year that are either incapable of fending for themselves or have not yet developed the skills to adequately survive in the wild. While these animals are temporarily placed in facilities for the purposes of rehabilitation and release, in the long term, it is highly unlikely that such cubs would be suitable for release back into the wild. Hunting and survival skills are learned during the 2 ½ year dependence on the mother, are not innate to polar bear cubs, and will not be developed in captivity.

For the reasons noted above, the FWS considers polar bear cubs to be poor candidates for release into the wild. If releases were to occur the predicted likely outcomes would be death by starvation or death caused by a predacious attack of another polar bear. Further, adoption by another family group is unlikely or impractical due to the low probability of encountering a receptive family group. Adoption of cubs into family groups has been attempted in Canada with very poor success and Canada is re-evaluating the feasibility of adoption as a management technique. The process of adoption requires substantial investment in searching out a family group in the wild, capture of the group (assisted by helicopter), and placement and follow-up on the fate of the adoptee. In Alaska, holding facilities co-located near release sites are not available. Therefore, FWS does not consider adoption to be a viable alternative and generally consider polar bear cubs to be non-releasable and more suitable for permanent placement in public display facilities. In these cases, the holding facility may request a permit for permanent placement of the animal as long as the facility meets the requirements under section 104(c)(7) of the MMPA. However, FWS will continue to evaluate potential release into the wild or permanent placement in public display facilities on a case-by-case basis. Questions regarding disposition of stranded polar bears must be directed to the FWS as identified in Appendix H.

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APPENDIX A

Chronology of Development of the Release Criteria

1977 1st Workshop on Marine Mammal Strandings; sponsored by the Marine Mammal Commission - Geraci, J.R. and D. J. St Aubin (eds.) 1979. Biology of marine mammals: Insights through strandings. Marine Mammal Commission. Report. No. MMC-77/13. U.S. Department of Commerce, NTIS Doc. PB 293 890, 343 p. (August 1977- Athens, GA).

One of the workshop objectives was to provide recommendations regarding the handling, care, and disposition of live-stranded animals. A relevant finding that came from this workshop and was published in the proceedings included that if live-stranded animals are rescued and rehabilitated, decisions whether these animals should be released or maintained in captivity must take into account the possibility that the animals may have lost their natural capacity to locate and capture appropriate prey species, avoid predators, and interact normally with other members of the species.

1987 2nd Workshop on Marine Mammal Strandings; sponsored by the Marine Mammal Commission and the National Marine Fisheries Service - Reynolds, J.E. and D.K. Odell (eds.) 1991. Marine mammal strandings in the United States: proceedings of the second marine mammal stranding workshop; 3-5 December 1987, Miami, FL. U.S. Department of Commerce., NOAA Technical Report. NMFS 1998.

A recommendation that came from this workshop and was published in the proceedings was a call to establish guidelines and procedures for determining whether and how live-stranded animals should be marked and returned to the sea, transported to a holding facility, rehabilitated, and subsequently released or maintained in captivity, or euthanized to avoid further pain and suffering.

1991 Workshop on rescue, rehabilitation, and release of marine mammals; sponsored by the Marine Mammal Commission and the National Marine Fisheries Service - St. Aubin, D.J., J.R. Geraci, and V.J. Lounsbury (eds.) 1996. Rescue, rehabilitation, and release of marine mammals: an analysis of current views and practices. Proceedings of a workshop December 3-5, 1991, Des Plaines, IL. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-OPR-8, 65 p.

The participants were charged to address five critical questions as well as discuss other outstanding and relative issues. They made several recommendations to include the assembly a panel of medical and behavioral specialists to recommend criteria for assuring that released animals will prosper humanely and pose no undesirable risk to the wild population. The guidelines should include a recommended set of medical determinations by species, with appropriate reference ranges for blood constituents and other clinical measures, morphometric limits (weight at length and age), a checklist for physical examination, and a means of scoring behavioral attributes that would influence survival in the wild. Minimum values should be set for each of these criteria, such that no animal failing any measure would be released. The panel

would incorporate the recommendations of the group considering the risks associated with specific pathogens, particularly for "carriers" that are otherwise normal and healthy. The participants also made recommendations on disease transmission and monitoring.

1992 Amendment of MMPA Title IV - 16 U.S.C. 1421a, Sec. 402. (a) DETERMINATION FOR RELEASE. The Secretary shall, in consultation with the Secretary of the Interior, the Marine Mammal Commission, and individuals with knowledge and experience in marine science, marine mammal science, marine mammal veterinary and husbandry practices, and marine conservation, including stranding network participants, develop objective criteria, after an opportunity for public review and comment, to provide guidance for determining at what point a rehabilitated marine mammal is releasable to the wild. Sec 402 (b) COLLECTION - The Secretary shall, in consultation with the Secretary of the Interior, collect and update, periodically, existing information on – (1) procedures and practices for – (A) rescuing and rehabilitating stranded marine mammals, including criteria used by stranding network participants, on a species-by-species basis, for determining at what point a marine mammal undergoing rescue and rehabilitation is returnable to the wild.

1994 Expert Panel on Behavior, Life History, and Natural History Criteria for Release of Rehabilitated Marine Mammals

Acting on the findings of the 1991 workshop entitled "Workshop on rescue, rehabilitation, and release of marine mammal," NMFS consulted with the Working Group on Unusual Marine Mammal Mortality Events to develop draft criteria. An expert panel of 12 biologists, veterinarians, and animal care professionals was queried by Dr. Randall Wells of the Chicago Zoological Society in August 1994 to address 12 specific questions on marine mammal behavior, life history, and natural history relative to release. Dr. Wells submitted a report summarizing the panel's responses to NMFS in November 1994, and reported the findings at the annual meeting of the Marine Mammal Commission in November 1994. This report included recommendations for release criteria, preparations for release, release, follow-up monitoring, and dissemination of findings. These recommendations were included in the draft document.

1994 Model for Marine Mammal Medical Criteria for Introduction to the Wild

In 1994, Dr. Gregory Bossart of the University of Miami, School of Medicine established a committee of seven nationally-recognized marine mammal veterinarians to formulate a draft of medical criteria that would act as guidelines for the re-introduction of wild marine mammal species. Marine mammal species included in this draft were cetaceans, pinnipeds, sea otters, and manatees. This draft was submitted to NMFS and became the working template for the present NMFS draft release medical guidelines.

1996 Final Rule NMFS 50 CFR Sec. 216.27(a) require release of a marine mammal held for rehabilitation within six months of capture unless "…the attending veterinarian determines that: (i) The marine mammal might adversely affect marine mammals in the wild (ii) Release of the marine mammal to the wild will not likely be successful given the physical condition and behavior of the marine mammal; or (iii) More time is needed to determine whether the release of the marine mammal in the wild will likely be successful…"

<u>1991-1997</u> Working Group of Marine Mammal Unusual Mortality Events – This group established under Title IV of the Marine Mammal Protection Act closely guided the development of the first draft that was published in 1998.

<u>1998</u> FR Notice Draft NOAA Technical Memorandum - NMFS and FWS Release for Stranded Marine Mammals to the Wild: Background, Preparation, and Release Criteria Vol.63, No. 67/ Wed, April 8, 1998

A notice of availability and request for comments was published in the Federal Register.

<u>2001</u> April 24, 2001 Summary of Public Comments on Draft NOAA Technical Memorandum - NMFS and FWS Release for Stranded Marine Mammals to the Wild: Background, Preparation, and Release Criteria

NMFS received official responses from 20 individuals or organizations. There were several outstanding issues that required more development and clarification. NMFS decided to convene special working groups to address the comments.

<u>2001</u> Working groups on pinnipeds and cetaceans

Three working groups were assembled by NMFS and FWS to address outstanding issues noted during the public comment period. Their recommendations have been incorporated into the current document.

APPENDIX B

Key Legislation: Marine Mammal Rescue, Rehabilitation, and Release to the Wild

- **Marine Mammal Protection Act (MMPA) of 1972**
  - Title I. - Conservation and Protection of Marine Mammals
    - Section 109 (h) - Taking of Marine Mammals as Part of Official Duties
    - Section 112 (c) - Contracts, Leases, and Cooperative Agreements
  - Title IV. - Marine Mammal Health and Stranding Response
    - Sec. 402 (a) - Determination for Release
      (b) (1) – Procedures and Practices

- **Endangered Species Act of 1973, as amended**

- **Code of Federal Regulations, Title 50, part 216 – Regulations governing the taking and importing of marine mammals**
  - Section 22 – Taking by the State or Local Government Officials
  - Section 27 - Release, Non- Releasability, and Disposition Under Special Exception Permits for Rehabilitated Marine Mammals
    - (a) Release Requirements, (b) Non-releasability and postponed determinations, (c) Disposition for special exceptions purposes, (d) Reporting
  - Subpart D – Special Exceptions for Threatened and Endangered Marine Mammals
    - Marine Mammal Health and Stranding Response Program Enhancement Permit

- **Code of Federal Regulations, Title 50, part 18 – Marine Mammals**
  - Section 22 – Taking by Federal, State, and Local Government Officials
  - Section 31 – Scientific Research Permits and Public Display Permits

- **Code of Federal Regulations, Title 50, part 17 – Endangered and Threatened Wildlife and Plants**
  - Section 21 (c)(3) – Endangered Wildlife Prohibitions – Take
  - Section 31 (b) – Threatened Wildlife Prohibitions
  - Section 22 – Endangered Wildlife Permits for Scientific Purposes, Enhancement of Propagation of Survival, or for Incidental Taking
  - Section 32 – Threatened Wildlife Permits - General

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APPENDIX C

REQUIRED REPORTING AND DOCUMENTATION

Marine Mammal Stranding Report - Level A Data (NOAA 89-864, OMB #0648-0178)

Marine Mammal Rehabilitation Disposition Report (NOAA 89-878, OMB #0648-0178)

Manatee Rescue, Rehabilitation and Release Report

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Manatee Rescue, Rehabilitation, and Release Report Fields

Rescue: Reporting Requirements	**Release: Request Information**	**Transfer: Request Information**	**Death: Reporting Requirements**	**Captive Birth: Reporting Requirements**
Name of Reporting Organization Date Report Filed Date Event Occurred Type of Rescue Identification ▪ Name (if any) ▪ Studbook Number ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered) PIT Tag ▪ Right (identifying number) ▪ Left (identifying number) Freeze Brand (yes/no) ▪ Number Sex Weight (lbs/kg) ▪ Actual/estimated Length (cm/inches) ▪ Actual/estimated Ultrasound (yes/no) County Nearest Town/Community Waterbody Latitude/Longitude Probable Cause for Rescue ▪ (Drop down list includes various common causes; additional information is required for entangled animals) Health Status at Time of Report Rehabilitation Facility (if any) Veterinarian Facility Supervisor Rescue Participants Name of Reporter Telephone Number	Name of Requesting Organization Date Request Filed Date Event Proposed Identification ▪ Name (if any) ▪ Studbook Number ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered) PIT Tag ▪ Right (identifying number) ▪ Left (identifying number) Freeze Brand (yes/no) ▪ Number Other Tags Name of Tracker/Affiliation Tracker Telephone Number Sex Weight (lbs/kg) ▪ Actual ▪ Date Taken Length (cm/inches) ▪ Actual ▪ Date Taken Peduncle Girth (cm) ▪ Date Taken Ultrasound (yes/no) County Where Rescued Nearest Town/Community Waterbody Latitude/Longitude Date of Rescue Weight at Time of Rescue Length at Time of Rescue Proposed Date of Release Actual Date of Release County Where Released Nearest Town/Community Where Released Waterbody Where Released Veterinarian Facility Supervisor Release Participants Name of Reporter Telephone Number	Name of Requesting Organization Date Request Filed Date Event Proposed Identification ▪ Name (if any) ▪ Studbook Number ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered) Sex Weight (lbs/kg) ▪ Actual ▪ Date Taken Length (cm/inches) ▪ Actual ▪ Date Taken Date Brought Into Captivity Date of Proposed Transfer Actual Date of Transfer Veterinarian Facility Supervisor Release Participants Name of Reporter Telephone Number	Name of Reporting Organization Date Report Filed Date Died Identification ▪ Name (if any) ▪ Studbook Number ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered) Sex Date Rescued Probable Cause of Death (or Euthanized) Disposition of Carcass Veterinarian Facility Supervisor Name of Reporter Telephone Number	Name of Reporting Organization Date Report Filed Date Born Identification ▪ Name (if any) ▪ Studbook Number ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered) Sex Weight (lbs/kg) ▪ Actual ▪ Date Taken Length (cm/inches) ▪ Actual ▪ Date Taken Present Health Status Origin of Dam Circumstances of Birth Dam Identification ▪ Name (if any) ▪ Studbook Number (if any) ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered) Sire Identification ▪ Name (if any) ▪ Studbook Number (if any) ▪ Identification Numbers (in the case of multiple numbers, all numbers should be entered)

APPENDIX D

DISEASES OF CURRENT CONCERN FOR CETACEANS

The diseases listed below are of current concern for cetaceans. Numerous additional diseases exist among cetaceans and should also be considered during diagnostic work-ups. Testing for specific diseases of cetaceans is not required at this time. However, thorough diagnostic testing of rehabilitated cetaceans is strongly recommended as warranted by their history and clinical signs of illness. Clinicians are particularly encouraged to test cetaceans for brucellosis and morbillivirus. NMFS may require disease testing for specific individuals prior to release if concern for the health of wild marine mammals exists or concern exists regarding the animal's likelihood of survival in the wild. Contact the NMFS coordinator for information regarding the appropriate diagnostic laboratories.

A good resource to obtain updated literature on diseases of marine mammals is through the Animal Welfare Information Center (http://awic.nal.usda.gov), part of the United States Department of Agriculture National Agriculture Library.

BACTERIAL DISEASES	COMMENTS
Brucellosis	Serologic evidence or isolation of this bacterium has been made several species of cetaceans as well as those in captivity. Different serovar than terrestrial species. Current limited understanding of pathophysiology and significance. May cause reproductive illness, isolated from an aborted captive bottlenose dolphin fetus. Zoonotic. Human case followed handling of marine mammal tissues. (Dunn et.al., 2001; Brew et al., 1999; Clavareau, 1998; Miller, et.al., 1999).
Erysipelothrix	Has caused acute septicemia or generalized dermatitis in several cetacean species including wild orca. Believed to be acquired from ingestion of fish contaminated with the organism. Zoonotic, causes dermatitis, arthritis, pneumonia, or septicemia in humans. (Dunn et.al., 2001; Young et.al., 1997; Cowan et.al., 2001.)
Respiratory Illness	Respiratory illness is common among both captive and wild cetaceans. Such disease often involves bacterial pathogens and is frequently fatal. *Staphylococcus areus* and *Pseudomonas aeruginosa* as well as Gram negative bacterial organisms are often involved. Pulmonary parasitism may contribute to development of bacterial respiratory disease. (Dunn et.al., 2001; Howard et.al.1983; Kinoshita et al. 1994).

VIRAL DISEASES

Morbillivirus	Has caused major epizootics with high mortalities in bottlenose dolphins, common dolphins, and striped dolphins. Has also infected other cetacean species. Testing for cetacean morbillivirus is strongly recommended for all cetaceans in rehabilitation centers. (Kennedy-Stoskopf, 2001; Kennedy, 1998; Duigan, 1999).
Poxvirus	Common infection of captive and wild cetaceans characterized by skin lesions. Not known to cause systemic infection. Appearance of lesions may correlate with weaning, poor general health, and/or compromised environmental conditions. (Kennedy-Stoskopf, 2001; Van Bressem and Van Waerebeek ,1996; Geraci et.al. 1979).
Papillomavirus	Has caused lesions of the skin, genital area, stomach ,and tongue of several cetacean species. Sometimes referred to as benign tumors. Genital lesions may be transmitted venereally and may interfere with copulation. (Kennedy-Stoskopf, 2001; Deguise et.al., 1994; Van Bressem et al., 1996).

PARASITIC DISEASES

Toxoplasmosis gondii	Protozoan parasite which has caused serious disease and death in cetacean species. Source of infection not clearly defined. (Dailey, 2001; Migaki, 1990.)
Anasakid nematodes	Family of nematodes which parasitize the cetacean gastrointestinal tract. Infections may cause gastritis and ulceration. (Dailey, 2001; Smith, 1989).
Hepatic trematodes	Heavy infection may cause serious liver disease associated with weight loss, increased susceptibility to bacterial infection. May result in death. (Dailey, 2001; Zam et.al, 1971.)
Nasitrema sp.	Nematode parasite which infects nervous systems of cetaceans. May be a significant cause of stranding in odontocetes. Causes eighth cranial neuropathy, encephalitis, and cerebral necrosis. (Dailey, 2001).
Lungworms	Includes nematode genera such as *Halocercus* which may cause severe respiratory disease and may cause death, depending on severity of infection. (Dailey,2001; Measures, 2001; Moser and Rhinehart, 1993).

NONINFECTIOUS DISEASES

Anthropogenic trauma	Entanglement in debris such as fishing nets and lines, collisions with boats, and underwater detonation of explosives may injure or kill cetaceans. The number of animals affected relative to total population may cause particular concern for some species (i.e. right whales and boat collisions, small odontocetes and fisheries by-catch). (Gulland et al. 2001, Kraus, 1990, Perrin et.al., 1994).
Biotoxins	Toxins naturally produced from dinoflagellates and diatoms have been associated with illness and death in cetaceans. Brevetoxin was a possible cause of bottlenose dolphin mortality in 1946-47 and 1987-1988. Humpback whale mortality was associated with consumption of mackerel containing saxitoxin. (Gunter et.al., 1948; Geraci, et.al., 1989).
Neoplasia	Belugas of the St. Lawrence River have had a concerning rate of neoplasia. Other cases of neoplasia have been reported in several species. Etiology of cetacean tumors is not known. Interplay of physical, chemical, and/or infectious agents with host factors such as age, sex, and genetic make-up likely involved with tumorigenesis. (Gulland et.al., 2001; De Guise et.al., 1994).

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APPENDIX E

DISEASES OF CURRENT CONCERN FOR PINNIPEDS

The diseases listed below are of current concern for pinnipeds. Numerous additional diseases exist among pinnipeds and should also be considered during diagnostic work-ups. Testing for specific diseases of pinnipeds is not required at this time. However, thorough diagnostic testing is strongly recommended for pinnipeds as warranted by their history and clinical signs of illness. NMFS, or in the case of walrus the FWS, may require disease testing for specific individuals prior to release if concern for the health of wild marine mammals exists or if there is significant concern regarding the animal's likelihood of survival in the wild. Contact the NMFS coordinator, or the FWS in the case of walrus, for information regarding appropriate diagnostic laboratories.

A good resource to obtain updated literature on marine mammal diseases is through the Animal Welfare Information Center (http://awic.nal.usda.gov), part of the United States Department of Agriculture, National Agriculture Library.

BACTERIAL DISEASES	COMMENTS
Brucellosis	Serologic evidence or isolation of this organism has been obtained for phocids and walrus. Different serovar than terrestrial species. Current limited understanding of pathophysiology and significance. May cause reproductive illness. Zoonotic. Human case followed handling of marine mammal tissues. (Dunn et.al., 2001; Garner et. al., 1997).
Leptospirosis	Severe systemic illness that frequently affects California sea lions and northern fur seals. Infection may be obtained at sea, in rookeries, or via contact with fresh water sources contaminated by infected terrestrial mammals via contamination of water sources. May be treated with antibiotics. Zoonotic. (Dunn et.al., 2001; Schoenwald et. al., 1971; Gulland et.al., 1996, Stamper et al., 1998).
Mycobacterial Disease	Illness characterized primarily by skin or pulmonary lesions diagnosed in several pinniped species. Caused by organisms which include those responsible for tuberculosis. Recently diagnosed in wild subantarctic fur seals. Zoonotic. (Dunn et. al., 2001, Cousins et.al., 1993, Bastida et.al., 1999).

VIRAL DISEASES

Adenovirus	Caused fatal hepatitis in California sea lions. Source of virus unknown, but may be related to canine adenovirus. (Kennedy-Stoskopf, 2001; Dierauf et.al., 1981).
Calicivirus	Several pinniped species susceptible. Causes skin lesions in California sea lions. Numerous animal species may be infected by calicivirus including fish, reptiles, mammals. Transmission from marine mammals to terrestrial animals and vice versa possible. Unconfirmed as zoonotic but possibility exists. (Kennedy-Stoskopf, 2001; Smith and Boyt, 1990; Gage, et.al., 1990; Barlough et.al., 1998).
Herpes Virus	May infect several pinniped species including walrus. Causes fatal disease in neonatal Pacific harbor seals characterized by severe adrenal gland and liver pathology. (Kennedy-Stoskopf, 2001; Gulland et.al., 1997).
Influenza	Caused high mortality among Atlantic harbor seals. Endemic among this population. Changes in virulence may cause disease outbreaks. Related to avian influenza. Zoonotic. Has caused severe conjunctivitis among humans. (Kennedy-Stoskopf, 2001; Webster et.al., 1981).
Morbillivirus	Endemic in several phocid species. May cause high morbidity and mortality. Seals have been infected by the canine morbillivirus as well as a morbillivirus specific for phocids. (Kennedy-Stoskopf, 2001; Kennedy, 1998; Duignan, 1999).
Pox	Causes skin lesions in several pinniped species. Outbreaks may be associated with stress as with postweanling animals recently introduced to captivity. Zoonotic. May cause skin lesions on humans. (Kennedy-Stoskopf, 2001; Hicks and Worthy, 1987).

PARASITIC DISEASES

Helminths	A variety of nematode, trematode, and cestode parasites infect pinnipeds, causing varying degrees of clinical disease. For instance, the nematode *Contracaecum corderoi* has caused gastrointestinal perforations and fatal peritonitis in California sea lions. (Dailey, 2001; Fletcher, 1998.)

Cryptosporidiosis	Protozoan gastrointestinal parasite recently isolated from several pinniped species. Limited current knowledge of pathophysiology in pinnipeds. Zoonotic. (Miller, et.al., 2001; Deng, et.al., 2000).
Giardia	Protozoan gastrointestinal parasite identified in phocids and the California sea lion. Incidence and severity of clinical illness not fully understood. Zoonotic. (Miller, et.al., 2001; Measures and Olson, 1999.)
Sarcocystis	Protozoan parasite that may cause severe neurologic disease and death. Important cause of mortality among Pacific harbor seals. Organism may be found in waste from humans or their activities. (Miller, et. al., 2001; LaPointe, et.al., 1998).

NONINFECTIOUS DISEASES

Anthropogenic trauma	Gunshot, underwater detonation of explosives, and entanglement in debris such as fishing nets and lines cause morbidity and mortality among pinnipeds. (Gulland, et.al., 2001).
Biotoxins	Harmful algal blooms producing domoic acid have caused significant sea lion mortality. (Gulland, 2000; Schoelin, et.al. 2000).
Neoplasia	Carcinoma, an aggressive tumor often associated with the urogenital system is common in California sea lions. May be linked to viral infections and/or exposure to environmental contaminants. (Buckles, et.al., 1996, Gulland, et.al., 1996, Lipscomb, et.al., 2000).

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APPENDIX F

DISEASES AND ISSUES OF CURRENT CONCERN FOR MANATEES

The diseases and issues listed below are of current concern for manatees. Other diseases exist among manatees and should also be considered during diagnostic work-ups. Testing for specific diseases of manatees is not required at this time. However, thorough diagnostic testing of rehabilitated manatees is strongly recommended as warranted by their history and clinical signs of illness. FWS may require disease testing for specific individuals prior to release if concern for the health of wild marine mammals exists or concern exists regarding the animal's likelihood of survival in the wild. Contact the FWS stranding support staff for information regarding the appropriate diagnostic laboratories.

A good resource to obtain updated literature on marine mammal diseases is through the Animal Welfare Information Center (http://awic.nal.usda.gov), part of the United States Department of Agriculture National Agriculture Library.

BACTERIAL DISEASES	**COMMENTS**
Brucellosis	Antibodies to *Brucella* spp. have been reported in Florida manatees, although lesions consistent with brucellosis have not been observed (Geraci et al., 1999).
Other	Systemic mycobacteriosis due to *Mycobacterium marinum* and *M. chelonei (Boever et al., 1976)*, and mycotic dermatitis (Dilbone, 1965; Tabuchi et al., 1974), have been reported in adult manatees.
VIRAL DISEASES	
Cutaneous papillomatosis	Recently described in a captive population of manatees. PCR analyses has demonstrated a virus consistent with Type I bovine papilloma virus. (Bossart et al., 1998a)
Morbillivirus	Serologic evidence of morbillivirus has been demonstrated in manatees, although signs of clinical disease or active infection has not been observed (Duignan et al., 1995).
Other	Pseudorabies, San Miguel sea lion virus Type I, and eastern, western, and Venezuelan equine encephalitis have been reported in Florida manatees (Geraci et al., 1999). While these are serologically evident, no signs of clinical disease or active infection have been observed.

PARASITIC DISEASES

Meningoencephalitis *Toxoplasma gondii* has caused the death(s) of Florida manatees (Buerguelt and Bonde, 1983).

Other Endoparasites are commonly found in manatees; however, pathological signs or clinical disease are rare (Bossart 2001).

NONINFECTIOUS DISEASES

Anthropogenic trauma Collisions with boats, entanglement in fishing gear (monofilament fishing line, crab float lines, etc.), crushing in water control structures, etc., are sources of injury and mortality

Biotoxins Brevetoxins associated with *Kerenia brevi* and possibly other dinoflagellates have killed dozens of Florida manatees. Suspected vectors include ingestion of toxin-containing ascidians and sea grasses and inhalation of aerosolized toxicants (Bossart 2001).

Cold stress syndrome Exposure to cold for extended periods of time initiates clinical signs and disease processes that characterize manatee cold stress syndrome. Effects include lethargy, anorexia, and terminal hypothermia. Numerous significant cold fronts extending the length of the Florida peninsula have caused deaths and cold stress in dozens of manatees aver the past few decades (Bossart 2001).

APPENDIX G

DISEASES OF CURRENT CONCERN FOR SEA OTTERS

The diseases listed below are of current concern for sea otters. Numerous additional diseases exist among sea otters and should also be considered during diagnostic work-ups. Testing for specific diseases of sea otters is not required at this time. However, thorough diagnostic testing is strongly recommended for sea otters as warranted by their history and clinical signs of illness. FWS may require disease testing for specific individuals prior to release if concern for the health of wild marine mammals exists or if there is significant concern regarding the animal's likelihood of survival in the wild. Contact the FWS coordinator for information regarding appropriate diagnostic laboratories.

A good resource to obtain updated literature on marine mammal diseases is through the Animal Welfare Information Center (http://awic.nal.usda.gov), part of the United States Department of Agriculture, National Agriculture Library.

BACTERIAL DISEASES	COMMENTS
Septicemias	Overwhelming bacterial infections, sometimes from infected wounds, dental problems, and intestinal infections, are a common cause of mortality in southern sea otters, often secondary to infectional perforation by acanthocephalans (California Department of Fish and Game (CDFG) unpublished data), and a significant cause of mortality in northern sea otters in Alaska (FWS unpublished data). Connections with sewage or animal wastes are suspected in some infections; however, for northern sea otters, the source of this infection is often unknown.
Valvular endocarditis	This a sporadic disease secondary to chronic bacterial seeding from a primary source of infection such as a bite wound or tooth abscess. However, northern sea otters in Alaska have been diagnosed with VE without a primary source (FWS unpublished data). These animals have tested positive for the *Streptococcus bovis/equinus* complex. In human cases, there is an association between *S.bovis* endocarditis cases and a malignancy of the GI tract.
Brucellosis	One culture and PCR-confirmed case in a California sea otter with a chronic toe joint infection and low-level systemic disease (CDFG unpublished data). Fastidious in culture and easily missed. Marine Brucellae have demonstrated zoonotic potential, so caution is advised when handling fetal tissues, or live or dead animals with infected joints and wounds.

Dental disease Dental disease is common, particularly in older animals and can lead to systemic bacterial infections.

Leptospirosis Problem common in sea lions (see above pinniped section). Positive serologic titers in southern sea otters (Hanni *et al*. 2003). Cases reported in northern sea otters in Washington State. No clinical case identified in southern sea otters to date, although seropositive animals are observed. No cases reported for northern sea otters in Alaska.

FUNGAL DISEASES

Coccidiomycosis Low levels of infections (less than 1 percent) in southern sea otters, mostly off the San Luis Obispo county coast around the mouth of the Santa Maria River. Cases always fatal. Not reported in northern sea otters. Biohazard for people handling dead sea otters.

VIRAL DISEASES

Morbillivirus Conflicting evidence on whether exposure is relatively common or not in southern sea otters. Canine distemper has been diagnosed in a river otter in coastal British Columbia (Mos *et al*. 2003) and positive serologic titers have been noted in northern sea otters in Washington State. Care must be taken in moving otters if this virus is present in some populations and not others. Seropositivity to both canine and phocine distemper has been identified in northern sea otters in Washington and Alaska (FWS unpublished data).

Papillomavirus Some evidence of this type of viral infection occurs, significance probably not great. Typically presents as small, raised variably pigmented plaques on the lips, tongue, or buccal mucosa. Occurrence often episodic and invariably incidental in southern sea otters (CDFG unpublished data).

Herpesvirus Associated with corneal, oral, and esophageal ulcers, often in debilitated animals in California and Alaska.

PARASITIC DISEASES

Toxoplasma gondii	Protozoan parasite which can cause serious disease and death in southern sea otters (Miller *et al*. 2004) and northern sea otters in Washington State. High prevalence of exposure in California with moderate mortality rate. There is evidence of wide exposure in California and Washington State (Lindsay *et al*. 2001; Miller *et al*. 2002; Dubey *et al*. 2003; Conrad *et al.* 2005). Northern sea otters in Alaska rarely test positive (FWS unpublished data). Source of infection not clearly defined but hypothesized to be associated with freshwater inputs to the ocean in California (Miller *et al*. 2002; Dailey 2001; Migaki 1990).
Sarcocystis neurona	Protozoan parasite that may cause severe neurologic disease and death. Important cause of mortality among southern sea otters and northern sea otters in Washington State. Infections appear to progress more quickly than *T. gondii* (Miller *et al*. 2001; Miller 2006). No evidence of this in northern sea otters in Alaska.
Helminths	A variety of nematode, trematode, and cestode parasites infect sea otters, causing varying degrees of clinical disease. Acanthocephalan thorny headed worms, particularly the *Profilicollis* spp. may be pathogenic when overwhelming infestations occur, particularly in young animals (Mayer *et al.* 2003).
Mites	Nasal mite infestations are uncommon in wild animals, but heavy infections may occur in captive and rehabilitated animals. Heavy infections can result in secondary bacterial nasopharyngitis and pneumonia.
Giardia	Some live, captive northern sea otters in Alaska have tested positive (FWS unpublished data).

NONINFECTIOUS DISEASES

Anthropogenic trauma	Gunshot, boatstrike, oil spills, and entanglement in debris such as fishing nets, fishing lines, and hooks cause morbidity and mortality among sea otters. Alaskan otters have died from impactions with fish bones when feeding at cannery outfalls (FWS unpublished data).
Biotoxins	Harmful algal blooms particularly those producing domoic acid have caused some morbidity and mortality of sea otters in California (Gulland 2000; Jessup *et al.* 2004).

Persistent Organic Pollutants	Levels in southern sea otters and northern sea otters in Alaska adjacent to known military dump sites are high (50-100 times control populations). Potential effects on endocrine and immune functions are a cause for concern, but evidence for this or for acute toxicity are lacking.
Predation	White shark predation on southern sea otters is well documented. Some cases may be secondary to brain infections or intoxications that render otters helpless. Killer whale predation is hypothesized to be very significant in the decline of certain northern sea otter populations in Alaska.
Neoplasia	A number of types of neoplasia have been documented in northern sea otters (FWS unpublished data).
Intestinal Disease	Sea otters have been known to suffer from intestinal intussusceptions, torsions, and impactions not caused by human related causes.
Conspecific Trauma	Territorial males will often attack other male or pups. Males may also injure females during mating.

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APPENDIX H

Contact Information for NMFS and FWS National and Regional Stranding Support Staff

National Marine Fisheries Service

OFFICE	ADDRESS	PHONE
Headquarters	Office of Protected Resources Marine Mammal Health and Stranding Response Program 1315 East-West Highway Silver Spring, MD 20910	Phone: (301) 713-2322 Fax: (301) 427-2522
Northeast Region	Administrator, Northeast Region One Blackburn Drive Gloucester, MA 01930-2298	Phone: (978) 281-9250 Fax: (978) 281-9207
Southeast Region	Administrator, Southeast Region 263 13th Ave. South St. Petersburg, FL 33701	Phone: (727) 824-5301 Fax: (727) 824-5320
Northwest Region	Administrator, Northwest Region 7600 Sand Point Way, NE Bin C 15700, Bldg. 1 Seattle, WA 98115-0070	Phone: (206) 526-6150 Fax: (206) 526-6426
Southwest Region	Administrator, Southwest Region 501 West Ocean Blvd. Suite 4200 Long Beach, CA 90802-4213	Phone: (562) 980-4001 Fax: (562) 980-4018
Alaska Region	Administrator, Alaska Region P.O. Box 21668 Juneau, AK 99802-1668	Phone: (907) 586-7221 Fax: (907) 586-7249
Pacific Islands Region	Administrator, Pacific Islands Region 1601 Kapiolani Blvd., Suite 1110 Honolulu, HI 96814	Phone: (808) 944-2280 Fax: (808) 973-2941

U.S. Fish and Wildlife Service

OFFICE	ADDRESS	PHONE
Headquarters	Division of Habitat and Resource Conservation 4401 N. Fairfax Drive, Room 400 Arlington, VA 22203	Phone: (703) 358-2161 Fax: (703) 258-1869
LOAs and Permits	Division of Management Authority 4401 N. Fairfax Drive, Room 700 Arlington, VA 22203	Phone: (703) 358-2104 Fax: (703) 358-2281
Manatees	Jacksonville Field Office 6620 Southpoint Drive South, Suite 310 Jacksonville, FL 32216	Phone: (904) 232-2580 Fax: (904) 232-2404
Southern Sea Otters in California	Ventura Field Office 2493 Portola Road, Suite B Ventura, CA 93004	Phone: (805) 644-1766 Fax: (805) 644-3958
Northern Sea Otters in Washington	Washington Field Office 510 Desmond Drive SE, Suite 102 Lacey, WA	Phone: (360) 753-9440 Fax: (360) 753-9518
Polar Bears, Pacific Walrus, and Northern Sea Otters in Alaska	Marine Mammals Management Office 1011 E. Tudor Road Anchorage, AK 99503	Phone: (907) 786-3800 Fax: (907) 786-3816

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APPENDIX I

Cetacean – Species Specific Developmental Stages (Age-Length) and Social Dynamics

Scientific Name	Common Name	Approx Length at Birth (cm)	Approx "NEONATE" length (cm)	Approx Length at 1 Year of Age (cm)	Approx Length at 2 Years of Age (cm)	Approx. Age at Weaning (yrs)	Approx Length at Weaning (cm)	Approx. Adult Length (cm)	Typical Group Size	Freq. of Occur. Single Individuals
Delphinapterus leucas	Beluga Whale	160	130-160	216	250	2	250	300-400 F 400-450 M	up to hundreds	uncommon
Delphinus capensis	Long-beaked Saddleback Dolphin	< 100							up to thousands	uncommon
Delphinus delphis	Common Dolphin	80-90	80-100				110-120	230-250	up to thousands	uncommon
Feresa attenuata	Pygmy Killer Whale	80						240-270	1-70	occasional
Globicephala macrorhynchus	Short-finned Pilot Whale	140-185	150			2-3		400-500 F 500-600 M	up to several hundred	rare
Globicephala melas	Long-finned Pilot Whale	177	160-200			2-3	240	450-500 F 450-600 M	up to several hundred	rare
Grampus griseus	Risso's Dolphin	110-150	120-160					300-400	single to several hundred	occasional
Kogia breviceps	Pygmy Sperm Whale	120	100-120			1		300 - 370	1-6	not uncommon
Kogia sima	Dwarf Sperm Whale	95	100			1		210-270	1-10	not uncommon
Lagenodelphis hosei	Fraser's Dolphins	100	100					240	100-1000	uncommon
Lagenorhynchus acutus	Atlantic White-sided Dolphin	108-122	100-130	142-156	176-190	1.5	180	240-270	2-500	uncommon
Lagenorhynchus albirostris	White Beaked Dolphin	110-120	110-130					300-320	1-100 (to 1500)	occasional
Lagenorhynhchus obliquidens	Pacific White-sided Dolphin	92	80-100					220-230	tens to thousands	uncommon
Lissodelphis borealis	Northern Right Whale Dolphin	80-100	80-100					220-230 F 260-300 M	100-200	occasional
Mesoplodon densirostris	Blainville's Beaked Whale	200						450-470	1-7	occasional
Mesoplodon europaeus	Gervais' Beaked Whale	210	210					450-520	small groups	uncommon
Orcinus orca	Killer Whale	183-228	210-250			1.5-2.0	400	700-800 F 800-950 M	2-100	infrequent - adult males
Peponocephala electra	Melon-Headed Whale	100						270	150-1500	uncommon
Phocoena phocoena	Harbor Porpoise	70	70-90	110-135	115-155	0.3 - 1.0	100 - 110	140-170	small groups	not uncommon

Scientific Name	Common Name	Approx Length at Birth (cm)	Approx "NEONATE" length (cm)	Approx Length at 1 Year of Age (cm)	Approx Length at 2 Years of Age (cm)	Approx. Age at Weaning (yrs)	Approx Length at Weaning (cm)	Aprox. Adult Length (cm)	Typical Group Size	Freq. of Occur. Single Individuals
Phocoenoides dalli	Dall's Porpoise	100	100			0.3-2.0		180-220	2-12	uncommon
Physeter macrocephalus	Sperm Whale	400	350-500		670	2+	670	1100-1300 F 1500-1800 M	20-40 (50)	adult males
Pseudorca crassidens	False Killer Whale	160	170-200			1.5-2.0		500 F 550-600 M	10-20+	rare
Stenella attenuata	Pantropical Spotted Dolphin	85	80-100	129-142		1-2	140	120	<100 to thousands	uncommon
Stenella clymene	Clymene Dolphin							180-200	1-50	occasional
Stenella coeruleoalba	Striped Dolphin	93-100	100	166	180		170	220-260	10-100s	uncommon
Stenella frontalis	Atlantic Spotted Dolphin	100	80-120				140	200-230	1-15	uncommon
Stenella longirostris	Spinner Dolphin	76-77	70-80	133-137		1-2		180-220	up to thousands	uncommon
Steno bredanensis	Rough-toothed Dolphin	100						240-270	10-20	uncommon
Tursiops truncatus	Bottlenose Dolphin	117	100-130	170-200	170-225	1.5-2.0	225	220-300 (coastal) 250-650 (offshore)	2-15	occasional
Ziphius cavirostris	Cuvier's Beaked Whale	270	200-300					670 - 700	1-7	not uncommon

Pinniped – Species Specific Developmental Stages (Age-Length) and Pupping Information

Scientific Name	Common Name	Approx Length at Birth (cm)	Approx "NEONATE" length (cm)	Approx. Age at Weaning	Approx Length at Weaning (cm)	Approx. Adult Length (cm)	Pups Born	Peak of Pupping
Arctocephalus townsendi	Guadalupe Fur Seal	60	60	9-11 months		140-170 F 180-240 M	June	June
Callorhinus ursinus	Northern Fur Seal	60-65	60	3-4 months		100-150 F 190-230 M	June-July	June-July
Cystophora cristata	Hooded Seal	90-100	90-110	4-12 days		200-230 F 230-290 M	Late March	Late March
Erignathus barbatus	Bearded Seal	130	130	12-18 days	150	210-250	Mid-October to Mid-November	End of October
Eumetopias jubatus	Steller Sea Lion	100	100	Within 1 yr	180	220-290 F 240-330 M	Mid-May to Mid-June	Mid-June
Halichoerus grypus	Gray Seal	90-110	80-110	16-21 days	110	180-210 F 220-250 M	January-February	January
Histriophoca fasciata	Ribbon Seal	80-90	80-90	3-4 weeks	90-110	150-180	April-May	Early April
Mirounga angustirostris	Northern Elephant Seal	125	120-140	28 days	150	200-320 F 380-410 M	January	End of January
Monachus schauinslandi	Hawaiian Monk Seal	100	100	3-7 weeks	100	230-240 F 210-220 M	December-August	March- May
Odobenus rosmarus	Walrus	100-120	100-140	2+ years	200	230-260 F 270-320 M	April-June	May
Pagophilus groenlandicus	Harp Seal	85	80-110	12 days	100	160-190	February-March	March
Phoca larga	Spotted Seal	77-92	80-90	4-6 weeks	110	160-170	Early April-Early May	Early April
Phoca vitulina	Harbor Seal	70-100	70-90	3-6 weeks	90	150-190	May-June	May
Pusa hispida	Ringed Seal	60-65	60-70	6-8 weeks	80	120-150	Mid-March to Mid-April	Early April
Zalophus californianus	California Sea Lion	75	70	10-12 months		150-200 F 200-240 M	June	June

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APPENDIX J

"Recommended" Standard Checklist to Determine Release Category of all Rehabilitated Cetaceans

Yes = true statement, No= untrue statement (shaded areas may not be applicable)

	Release Determination Assessment (within 2 weeks of release)		Pre-Release Assessment (within 72 hours of release)	
History	**Yes**	**No**	**Yes**	**No**
1. The release candidate has NOT previously stranded				
2. Stranding was NOT associated with a Marine Mammal Unusual Mortality Event or ongoing epidemic				
3. Stranding was NOT associated with anthropogenic environmental accident (e.g., hazardous waste spill, acoustic insult)				
4. Stranding was NOT associated with an environmental event of NMFS concern (e.g., harmful algal bloom, fish kill, etc.)				
5. Stranding was NOT associated with an El Niño event				
6. The animal is NOT evidence or part of a human interaction or criminal case				
7. Stranding was NOT associated with a mass stranding				
8. The animal was NOT part of a "permitted" research project				
Developmental Stage				
9. The release candidate is of sufficient size and age to be nutritionally dependent				
10. The release candidate is NOT a female with calf				
11. The release candidate is NOT a geriatric animal and is NOT compromised due to age related conditions.				
12. There is NO evidence that the release candidate was exposed to terrestrial wild or domestic animals prior to and during rehabilitation				
Behavioral Clearance				
13. The release candidate demonstrates appropriate breathing, swimming, and diving				
14. The release candidate does NOT exhibit aberrant behavior including attraction to or desensitization to the presence of humans				
15. The release candidate does NOT exhibit auditory or visual dysfunction				
16. The release candidate demonstrates appropriate foraging ability				
17. The release candidate did NOT strand as a direct result of a failure to avoid predators				

	Release Determination Assessment (within 2 weeks of release)		Pre-Release Assessment (within 72 hours of release)	
Behavioral Clearance (continued)	**Yes**	**No**	**Yes**	**No**
18. The release candidate did NOT strand as a result of taking food from humans in the wild				
19. The release candidate did NOT strand as a direct result of a demonstrated inability to obtain sufficient food in the wild				
20. The release candidate did NOT strand as a direct result of a conspecifics injury				
Medical Clearance				
21. The attending veterinarian has reviewed the release candidate's history and medical records, including records from other facilities that have previously held the animal.				
22. The attending veterinarian has examined the release candidate within two weeks of release				
23. The required health screen and assessments were conducted with good results				
24. Hands-on physical exam to be performed by attending veterinarian within 72 hours of release				
25. NO congenital defects				
26. CBC compatible with good health				
27. Chemistry profile compatible with good health				
28. Serum banked upon admission and prior to release (3 ml)				
29. Additional testing requested and reviewed by NMFS and no apparent concerns				
30. Free of drugs (exclusive of sedatives used for transport) minimum of 2 weeks prior to release				
31. Veterinarian's signature on health statement				

Health Statement

I have examined the cetacean (Species and ID#)_____ on (Date) _____ and have determined that the animal is medically and behaviorally suitable for release in accordance with the release criteria in that the animal will not pose a risk to the wild population and is likely to survive upon reintroduction to the wild.

_____ _____

Signature of the Attending Veterinarian *Printed Name of the Attending Veterinarian*

_____ _____

Signature of the Authorized Representative *Printed Name of the Authorized Representative*

"Recommended" Standard Checklist to Determine Release Category of all Rehabilitated Pinnipeds (except walrus)

Yes = true statement, No= untrue statement (shaded areas may not be applicable)

	Release Determination Assessment (within 2 weeks of release)		Pre-Release Assessment (within 72 hours of release)	
History	**Yes**	**No**	**Yes**	**No**
1. The release candidate has NOT previously stranded				
2. Stranding was NOT associated with a Marine Mammal Unusual Mortality Event or ongoing epidemic				
3. Stranding was NOT associated with anthropogenic environmental accident (e.g., hazardous waste spill, acoustic insult)				
4. Stranding was NOT associated with an environmental event of NMFS concern (e.g., harmful algal bloom, fish kill, etc.)				
5. Stranding was NOT associated with an El Niño event				
6. There is NO evidence that the release candidate was exposed to terrestrial wild or domestic animals prior to and during rehabilitation				
7. The release candidate is NOT known to have inflicted a bite on human(s)				
8. The animal is NOT evidence or part of a human interaction or criminal case				
9. The animal was NOT part of a "permitted" research project				
Developmental Stage				
10. The release candidate is weaned, and has a proven ability to feed itself				
11. The release candidate is sufficiently robust, having adequate reserves to survive readjustment in the wild				
12. The release candidate shows no sign of molt				
Behavioral Clearance				
13. The release candidate demonstrates appropriate breathing, swimming, diving, and locomotion on land				
14. The release candidate demonstrates an absence of aberrant behavior including attraction to or desensitization to the presence of humans				
15. The release candidate does NOT exhibit auditory or visual dysfunction				

	Release Determination Assessment (within 2 weeks of release)		Pre-Release Assessment (within 72 hours of release)	
Behavioral Clearance (continued)	**Yes**	**No**	**Yes**	**No**
16. The release candidate demonstrates a capacity to chase and capture live prey				
Medical Clearance				
17. The attending veterinarian has reviewed the release candidate's history and medical records, including records from other facilities that have previously held the animal.				
18. The attending veterinarian has examined the release candidate within two weeks of release				
19. The required health screen and assessments were conducted with good results				
20. Hands-on physical exam to be performed by attending veterinarian within 72 hours of release				
21. NO congenital defects				
22. NO nonfunctional or damaged appendages				
23. NO defects in vision				
24. CBC compatible with good health				
25. Chemistry profile compatible with good health				
26. Serum banked upon admission and prior to release (3 ml)				
27. Additional testing requested and reviewed by NMFS and no apparent concerns				
28. Free of drugs (exclusive of sedatives used for transport) minimum of 2 weeks prior to release				
29. Veterinarian's signature on health statement				

Health Statement

I have examined the pinniped (Species and ID#)_____ on (Date) _____ and have determined that the animal is medically and behaviorally suitable for release in accordance with the release criteria in that the animal will not pose a risk to the wild population and is likely to survive upon reintroduction to the wild.

_____ _____

Signature of the Attending Veterinarian *Printed Name of the Attending Veterinarian*

_____ _____

Signature of the Authorized Representative *Printed Name of the Authorized Representative*

NATIONAL MARINE FISHERIES SERVICE (NMFS) CRITERIA FOR DISENTANGLEMENT ROLES AND TRAINING LEVELS

Levels of Participation in the Disentanglement Network – Definitions

Roles	Levels
First Responder	1-5
Primary First Responders	3-5
Primary Disentanglers	4-5

First Responder is a general term that is used to describe anyone in the Network with any level of training who may respond to an entanglement report under Network protocols and authorization. At a minimum they will voluntarily attempt to standby with an entangled whale and, depending on training, experience, authorization and equipment available, may also assess and perhaps tag the whale. Individuals with higher Network ratings (Levels 3-5) may act as **Primary First Responders** in local areas. Primary First Responders direct efforts locally and, under certain conditions and authorization, may attempt disentanglements during first response. These individuals have rapid access to vessels and specialized equipment. Additionally, Primary First Responders are on call full-time or at least during those times when there is a high likelihood of an entanglement report in their area of responsibility.

A First Responder's anticipated range of tasks is generally dependent on their classification in the Network. Classifications to various levels are determined on an individual basis and are based on a number of factors including, but not limited to the following:

- Preexisting experience and skills
- Willingness and commitment to build experience and improve skills
- Training
- Opportunity and available resources
- Location
- Commitment to being “on-call”
- Commitment to respond as needed

Primary Disentanglers are individuals who can perform all of the responsibilities of a first responder, but who also meet the criteria used by NMFS for selecting individuals who may undertake the very dangerous activity of disentangling (i.e. attaching to, stopping and cutting a whale free). Primary Disentanglers must have the experience, training, support and proper equipment at the time of the event to conduct a full disentanglement with a high likelihood of success. Primary Disentanglers are those rated at Level 4-5 in the Disentanglement Network. A summary of the various levels of certification follows.

DISENTANGLEMENT NETWORK CERTIFICATION

LEVEL 1

Targeted Individuals: Professional mariners (*i.e.* fishermen, naturalists, Marine Patrol Officers) Boating experience and/or experience around whales is highly suggested (*i.e.* professional fishing, field biology, marine law enforcement, whale watching, etc.)

Responsibilities

Level 1 activities: report, standby, and assess (within experience)

- Rapidly alert Disentanglement Network of first-hand and/or second-hand knowledge of local entanglements
- Depending on experience, stand by an entangled whale until backup arrives, and/or
- Communicate with crew on the vessel that is directly standing by the entangled whale and offer to replace the stand by vessel until additional backup or the response team arrives (if needed and within experience)

Criteria for certification

- Completed Level 1 classroom training, or
- Viewed Provincetown Center for Coastal Studies (PCCS) Training Video and demonstrated equivalent knowledge and experience (submit resume)

LEVEL 2

Targeted Individuals: Professional mariners (*i.e.* fishermen, naturalists, Marine Patrol Officers). There is a higher expectation of commitment and participation from Level 2 responders.

Responsibilities

Level 2 activities: report, stand by, and assess at a higher level (within experience)

- Provide a thorough assessment of the nature of the entanglement and the species, condition and behavior of the whale
- Provide local knowledge, transportation, and assistance to Primary First Responders, as needed, on a voluntary basis
- Be on call, as available, to assist in planned disentanglement operations on telemetry tagged whales

Criteria for certification

Level 1 certification in addition to the following:

- Completed Level 2 on-water training, or
- Viewed PCCS Training Video and demonstrated equivalent knowledge and experience (submit resume)

LEVEL 3

Targeted Individuals: Whale researchers and naturalists, fishermen, natural resource agency personnel, Marine Patrol Officers.

Responsibilities

Level 3 activities- report, stand by, assess, document and attach a telemetry buoy. Other activities may include:

- Be on call 24 hours and should respond if conditions allow
- Initiate and maintain preparedness with local fishing industry, Coast Guard, and other resources
- Prepare local disentanglement action plan
- Provide entanglement assessment, documentation and recommendations to Primary
- Disentanglers during events
- Attach telemetry equipment to entangling gear if needed and authorized
- May be asked (depending on experience) to disentangle a minor entanglement with potential to adversely affect any whale other than right whales under the supervision/authorization of

Level 4 or 5 network members. Authorization and supervision may be given over the phone or radio depending on the circumstances and level of experience.

Criteria for certification

Level 1 and 2 certification and experience in the following elements:

- Large whale species identification and behavior, and the ability to safely follow a free swimming, entangled whale
- Boat handling and safety including basic seamanship, driving, and close approaches to whales
- Line handling and safety including knowledge of knots, handling lines under pressure, and an understanding of how working lines behave
- Follows instructions and response plans

Note: Each candidate will be evaluated for each element and any deficiencies must be supplemented with adequate training and/or experience.

Additionally, all Level 3 responders must have:

- Basic Level 3 training, or
- Advanced Level 3 training - an apprenticeship with PCCS

LEVEL 4

Targeted Individuals: Whale researchers and naturalists, fishermen, natural resource agency personnel, Marine Patrol Officers.

Responsibilities

Level 4 activities-

- Report, stand by, assess, document, attach a telemetry buoy, consult on an action plan and disentangle all large whales except right whales
- Report, stand by, assess, document and attach a telemetry buoy to right whales
- On a case by case basis and after consultation (see commitment to consult under Level 5 below), certain cuts on known entangled right whales may be permitted at level 4 ***if the proposed action is first approved by level 5 disentanglers and NMFS***

Please Note: Entangled whale behavior varies considerably by species. However, Level 4 Disentanglers should routinely be able to attempt disentanglement of all large whales other than right whales.

Criteria for certification

Basic or Advanced Level 3 Certification and:

- Direct experience in a supervised (by PCCS/Network coordinators or NMFS) large whale disentanglement, documentation of that experience, and a positive evaluation from NMFS using information provided by PCCS/Network Coordinators and any hard documentation (*i.e.* video)
- When possible, commitment to consultation as detailed in Level 5 below

LEVEL 5

Targeted Individuals: Level 4 Responders

Responsibilities

Level 5 activities - report, stand by, assess, document, attach a telemetry buoy, consult on an action plan and disentangle all large whales including right whales.

Please Note: Right whales are aggressive and therefore generally the most difficult whales to disentangle. North Atlantic right whales are among the most critically endangered large whales in the world. Certification at this level is highly selective and specialized.

Criteria for certification

Level 4 certification and:

- Experience w/ right whale behavior and/or includes a person on the team directly involved in the whale disentanglement (in the boat with the whale) that is experienced in right whale behavior
- Documented participation in a right whale disentanglement and/or NMFS/PCCS review of video of participation in a right whale disentanglement that followed NMFS protocol
- Commitment to Consultation to include:

- Immediate Consultation: when possible, use satellite/cell phones to bring in additional ideas/experience from other level 5s and level 4s (and vets and behaviorists if appropriate) while on scene with an entangled right whale
- Action Plan Development: For a tagged right whale, consultation required with NMFS, level 5s and 4s, veterinarians, behaviorists, etc.

Rationale for consultation: First assessments and strategies almost invariably change with more discussion or information. Consultation will likely help to increase human safety and critical choices regarding risks to whale health must be made with the best available information.

Best Practices for Marine Mammal Response, Rehabilitation, and Release

Glossary of Terms

Animal Care Supervisor– Responsible for overseeing prescribed treatments, maintaining hospital equipment, and controlling drug supplies. The person should be adequately trained to deal with emergencies until the veterinarian arrives, be able to direct the restraint of the animals, be responsible for administration of post-surgical care, and be skilled in maintaining appropriate medical records. It is important that the animal care supervisor should communicate frequently and directly with the attending veterinarian to ensure that there is a timely transfer of accurate information about medical issues.

Assessment Team – The team of individuals who collectively assess the rehabilitation case and make a release determination recommendation. This team could include the attending veterinarian, lead animal care supervisor, and/or consulting biologist with knowledge of species behavior and life history).

Attending Veterinarian - U.S. licensed veterinarian [i.e., graduated from a veterinary school accredited by the American Veterinary Medical Association Council on Education, or has a certificate by the American Veterinary Graduates Association's Education Commission for Foreign Veterinary Graduates or has received equivalent formal education as determined by NMFS Administrator (adapted from the Animal Welfare Act Regulations 9 CFR Ch. 1)] who has the responsibility to oversee veterinary medical aspects of live animal care and is also responsible for assuring the health of marine mammals released back to the wild following rehabilitation.

Authorized Representative- Individual with signatory authority for the stranding organization. This individual may be the signatory of the stranding agreement (e.g., Executive Director, President, CEO, etc.).

Bite - An injury from an animal that results in a break in the skin (epidermis).

Cohorts- Belonging to same species.

Conspecifics- Belonging to same species.

Diseases of Public Health and Safety Concern- Diseases that have been identified by Federal and State agencies (e.g., Centers for Disease Control and Prevention and state public health agencies) that pose a significant risk to public health.

Diseases of Zoonotic Concern- Diseases that are transmitted from animals to humans.

Ecological Status- A concept to consider when making release determinations. This concept attempts to integrate the medical and behavioral evaluations into an extrapolation of how the animal would likely do in the wild when exposed to typical ecological pressures

Emerging Diseases- Newly recognized serious disease, the cause of which may or may not yet be established, that has the potential to spread within and between populations.

Epidemic (adjective)- Affecting or tending to affect an atypically large number of individuals within a population, community, or region at the same time.

Epizootic (noun)- An outbreak of disease affecting many animals of one kind at the same time (similar to epidemic and term typically used in for animals)

ESA- Endangered Species Act

Ethogram- A catalogue of the discrete behaviors typically employed by a species. These behaviors are sufficiently stereotyped that an observer may record the number of such acts, or the amount of time engaged in the behaviors in a period of time.

FWC – Florida Fish and Wildlife Conservation Commission

FWS (U.S. Fish and Wildlife Service) - The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

FWS Division of Management Authority (DMA)- The Division of Management Authority implements domestic laws and international treaties to promote long term conservation of global fish and wildlife resources. In response to ever-increasing global pressures of wildlife trade and habitat loss on species worldwide, the office dedicates its efforts to conserving species at risk through trade and implementing policies that have a broad impact on conservation overall.

FWS Field Offices- The program operations of the FWS are performed at various types of field installations within FWS Regional Offices. The FWS Field Offices that are involved with health and stranding of marine mammals under jurisdiction of the FWS are identified in Appendix H.

FWS Letter of Authorization (LOA) - LOAs are issued by the FWS Division of Management to authorize under a "permit" network individuals, facilities, and agencies to rescue, rehabilitate, and release species under their jurisdiction that are in need of assistance. Authorizations and requirements are specific to the species, the organization, and the activity being conducted.

Humane Care- Treatment of an animal in such a way to both minimize pain and suffering and (by providing for proper care and use of the animal) to maximize well being of the individual and the population into which it is to be released.

Human Interaction- Physical signs or evidence (e.g., wounds, marks, gear, etc.) of direct human associated interaction that may or may not be related to the stranding.

Key Personnel – Individuals who represent the stranding organization and serve in key positions such as the authorized representative, primary responder, animal care supervisor, and attending veterinarian.

Letter of Concurrence from the NMFS Regional Administrator (RA) - The official notification from the NMFS regional office that concurs with the release determination recommendation.

Letter of Intent- A letter from a prospective permanent care facility requesting custody of a non-releasable animal. This letter must be sent to the NMFS Office of Protected Resources, Permits, Conservation and Education Division (http://www.nmfs.noaa.gov/pr/permits/mmpa_permits.htm).

MMPA- Marine Mammal Protection Act

MMPA/ESA Permit No. 932-1489-09- A permit issued by the NMFS Office of Protected Resources, Permits, Conservation and Education Division to the Marine Mammal Health and Stranding Response Program (MMHSRP). The permit covers some of the MMHSRP's activities, including emergency response activities for threatened and endangered species, large whale disentanglement activities, health assessment studies, and other research projects.

Marine Mammal Unusual Mortality Event- A stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response.

Necropsy Team Leader- A NMFS approved team leader, responsible for all aspects of the necropsy. The Necropsy Team Leader assigns task during the necropsy and is responsible for the gross report and final necropsy report.

NMFS- National Marine Fisheries Service

NMFS National Stranding Coordinator- Develops national policy and guidance and oversees the national marine mammal stranding program (part of the NMFS Marine Mammal Health and Stranding Response Program)

NMFS Office Director- Office Director for the National Marine Fisheries Service, Office of Protected Resources

NMFS PR1- NMFS Office of Protected Resources, Permits, Conservation and Education Division

NMFS Regional Director- Regional Administrator for the National Marine Fisheries Service Regional Office (regional specific)

NMFS Regional Stranding Coordinator- Coordinates administration of the stranding program within the region.

NMFS Stranding Agreement- The official written agreement between NMFS and Stranding Network Participant as allowed under section 112(c) of the Marine Mammal Protection Act.

Primary Responder – Oversees all aspects of each stranding response and be on-site or supervising when live or dead animals are being examined or handled (i.e., paid staff and unpaid staff). If working with live animals, be in direct contact with the attending veterinarian if necessary.

Panmictic- Referring to unstructured populations (random mating).

Pre-Release Health Screen- Required to be completed prior to release of animals following rehabilitation in accordance with these guidelines

Reasonable Social Group- Refers to in association with conspecifics of similar age, sex, and/or relatedness as would be found in social groups observed in the wild.

Release Determination Recommendation- The official written recommendation for release or non release signed by the attending veterinarian and signatory rehabilitation facility and sent to the NMFS Regional Director.

Release Plan- If release is recommended and NMFS concurs, the release plan will include a timeline, release site, method of transport and tagging/post release monitoring. Conditional releases will require an expanded release plan including a justification and detailed description of the logistics, tagging, location, timing, crowd control, media coordination (if applicable), and post release monitoring. NMFS may require contingency plans, should the release be unsuccessful, including recapture of the animal following a specified time after release.

Reportable Diseases- Diseases that pose a significant concern to public health, agriculture, and marine mammal populations and are required to be reported to NMFS and state agencies.

Responsible Party of Record- This is the official who has the legal authority to make acquisition and disposition decisions on behalf of an organization, institution, or agency that is holding marine mammals in captivity. This person's signature is required on the Letter of Intent to permanently retain or acquire a nonreleasable animal.

Signatory- The individual who signed the official stranding agreement between the stranding organization and NMFS (e.g., Executive Director, President, CEO).

Stranding Network Participant - A nongovernmental entity authorized by an agreement (Stranding Agreement) with NMFS to respond to stranded marine mammals under section 112(c) of the Marine Mammal Protection Act, which provides special exemption from the take prohibition.

Sub Designee- An entity acting under the authority and oversight of the Stranding Network Participant.

Surveillance Program- A method of surveillance that generates a source of information on the animal health status of populations.

Transfer Authorization Letter- The letter issued by NMFS PR1 to the receiving facility which authorizes retention or acquisition of a marine mammal that has been deemed nonreleasable.

USGS – United States Geological Survey

Working Group on Marine Mammal Unusual Mortality Events- An official panel of scientific experts established by the Marine Mammal Protection Act to who advise the NMFS and FWS regarding unusual mortality events.

109(h) Stranding Participant- State or local government official who can respond to a stranded marine mammal for the protection or welfare of the marine mammal and protection of public health and welfare during the course of their official duties. Section 109(h) of the Marine Mammal Protection Act provides special exemption from the take prohibition.

Zoonotic- Diseases caused by infectious agents that can be transmitted between (*or are shared by*) animals and humans.

NATIONAL MARINE FISHERIES SERVICE POLICY DIRECTIVE 02-308 **March 9, 2012**
Protected Resources Management
MARINE MAMMAL HEALTH AND STRANDING RESPONSE PROGRAM
NOTICE: This publication is available at: http://www.nmfs.noaa.gov/directives/.
OPR: F/PR2 (H. Braham) **Certified by:** F/PR (J. Lecky) **Type of Issuance:** Initial

Introduction

With the passage of the Marine Mammal Protection Act (MMPA) of 1972, the Secretary of Commerce granted the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) jurisdiction over all cetaceans and all pinnipeds, except walrus, in U.S. waters. The MMPA also granted NMFS the authority to take stranded marine mammals in a humane manner, if such taking is for the protection or welfare of the mammal, the protection of the public health and welfare, or the nonlethal removal of nuisance animals. Following the passage of the MMPA, the marine mammal stranding network was formally established and organized as independent volunteer organizations coordinated through each of the NMFS jurisdictional regions.

Objective

Mounting concerns over marine mammal health and deteriorating ocean conditions prompted the passage of the Marine Mammal Health and Stranding Response Act (MMHSRA) in 1992, which was codified as Title IV of the MMPA. Title IV established the Marine Mammal Health and Stranding Response Program (MMHSRP) with three primary purposes to:

1. facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild;
2. correlate the health of marine mammals and marine mammal populations, in the wild, with available data on physical, chemical, and biological environmental parameters; and
3. coordinate effective responses to unusual mortality events (UME) by establishing a process in the Department of Commerce in accordance with Section 404 of the MMPA.

This directive establishes the framework for the implementation of the MMHSRP by NMFS. MMPA Title IV and implementing regulations are adopted by reference as the NMFS Policy on Marine Mammal Health and Stranding Response.

Authorities and Responsibilities

Title IV of the MMPA and delegations of its authority establish the following programs and responsibilities overseen by the NMFS Office of Protected Resources, NMFS Regional Offices and NMFS Science Centers:

- National Marine Mammal Stranding Network
- National Marine Mammal UME Investigation Program
- National Marine Mammal Tissue Bank (NMMTB) and Quality Assurance Program

- Marine Mammal Health Biomonitoring, Research, and Development Program
- National Marine Mammal Entanglement Response Program
- John H. Prescott Marine Mammal Rescue Assistance Grant Program
- Information Management and Dissemination Program.

The National Marine Mammal Stranding Network consists of organizations nationwide that respond to stranded or entangled marine mammals. These organizations are authorized by NMFS to respond to stranding events under the authority of Section 112(c) or Section 109(h) of the MMPA.

Under a Scientific Research and Enhancement Permit issued under the MMPA and the Endangered Species Act (ESA) by the NMFS Office of Protected Resources' Permits Division, the MMHSRP authorizes stranding response by the National Marine Mammal Stranding Network members for ESA-listed marine mammal species, marine mammal entanglement response efforts, and a variety of marine mammal health-related research, monitoring or investigative activities. The MMHSRP obtains health information and samples from marine mammals that are stranded, undergoing rehabilitation, by-caught, subsistence hunted, remotely accessed, and live captured and released.

Measuring Effectiveness

This Policy will be reviewed and updated annually in accordance with the NMFS Policy Directive System procedures. Under MMPA, stock assessments are used to assess progress in protecting marine mammals and preventing them from diminishing below their optimal sustainable population. These reports are produced annually and data from the MMHSRP are reviewed and used in these reports. Effectiveness of Unusual Mortality Event investigations is reviewed annually by the Working Group on Marine Mammal Unusual Mortality Events.

In addition, NMFS will hold quarterly conference calls and annual retreats with the regional stranding coordinators to discuss MMHSRP updates and needs. NMFS invites stranding networks to annual or biennial regional conferences to discuss stranding data, conduct training, provide information, and assess the effectiveness of current policies and procedures. NMFS continues to process new Stranding Agreement applications, as well as review and renew expiring Stranding Agreements on an as needed-basis according to the appropriate regional timetable.

Procedural directives will be issued to implement this policy as needed.

_____/s/ _____2/24/2012_____
Samuel D. Rauch III Date
Acting Assistant Administrator for Fisheries

Department of Commerce $ National Oceanic & Atmospheric Administration $ National Marine Fisheries Service

NATIONAL MARINE FISHERIES SERVICE INSTRUCTION 02-308-01 ***March 14, 2012***
Protected Resources Management ***Marine Mammal Health and Stranding Response Program***
NMFS FACILITY STANDARDS FOR REHABILITATING ESA-LISTED SPECIES
NOTICE: This publication is available at: http://www.nmfs.noaa.gov/directives/.
OPR: F/PR2 (H. Braham) **Certified by:** F/PR (J. Lecky) **Type of Issuance:** Initial
Signed _____/s/ Lecky 2/29/2012_____ James H. Lecky Date Director, Office of Protected Resources

Procedural Directive
Facility Standards for Rehabilitating ESA-Listed Species Under the MMHSRP Scientific Research and Enhancement Permit

Background

Under the authority of Section 112(c) of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) may enter into a Stranding Agreement with a person or organization for marine mammal stranding response and rehabilitation. The Stranding Agreement authorizes the taking of marine mammals under Section 109(h) of the MMPA, but does not provide authorization for take of species listed as endangered or threatened under the Endangered Species Act of 1973 (ESA), as amended. Authorization under section 10(a)(1)(A) of the ESA to take ESA-listed marine mammals under NMFS' jurisdiction for enhancement purposes is currently provided under NMFS Permit No. 932-1905/MA-009526, issued to the NMFS National Marine Mammal Health and Stranding Response Program (MMHSRP). Take of ESA-listed marine mammals under the MMHSRP permit for stranding response and rehabilitation by Stranding Agreement holders requires Co-Investigator authorization and direction from the NMFS MMHSRP Coordinator and the appropriate Regional Stranding Coordinator in the event of a stranding involving a threatened or endangered species of marine mammal.

In this procedural directive, NMFS outlines the necessary facility standards for rehabilitating ESA-listed species. If the facility does not comply with this Procedural Directive's standards, then NMFS will make arrangements to transfer the ESA-listed species to a facility in compliance. The minimum standards for all marine mammal rehabilitation facilities are described in NMFS' *Policies and Best Practices for Marine Mammal Response, Rehabilitation, and Release – Standards for Rehabilitation Facilities*. Additional requirements for ESA-listed species are included below.

Short-Term (<96 hours) Rehabilitation Facilities

- NMFS has determined that the facility meets minimum standards for rehabilitation facilities and has specific accommodations available in the facility for each ESA-listed species and for ESA-listed species with a specific medical condition.

- At the request of the Principal Investigator for the MMHSRP's Permit No. 932-1905/MA-009526 (hereinafter "PI"), a facility that may not meet minimum rehabilitation standards for long-term holding can serve as a temporary stabilization location prior to transferring the animal to a long-term holding facility. The facility must comply with all requests and recommendations for stabilization care from NMFS or consulting veterinary/wildlife experts. Facility needs to be pre-approved by the PI prior to holding an animal for temporary stabilization.

- Exceptions to the <96 hour short-term holding timeframe may be made on a case-by-case basis with agreement from NMFS (at a minimum, the PI and the Regional Stranding Coordinator), the short-term facility and the long-term rehabilitation facility receiving the animal.

Long-Term (>96 hours) Rehabilitation Facilities

- NMFS has determined that the facility meets minimum standards for rehabilitation facilities and has specific accommodations available in the facility for each ESA-listed species and for ESA-listed species with a specific medical condition. In addition, the facility implements specific modifications as defined by the PI, attending veterinarian or NMFS consulting veterinarian/wildlife experts.

- Facility has dedicated space to use for individually housing ESA-listed species or to provide an appropriate social environment with adequate room for more than one animal of a social species if needed or appropriate as deemed by the attending veterinarian. (For example, if the attending veterinarian believes that a Steller sea lion pup should be co-housed with another animal and no other Steller sea lions of appropriate age or medical condition are available, then the attending veterinarian may deem it appropriate to house the animal with an appropriate age/medical class California sea lion.) This dedicated space may be used for other non-listed species when ESA-listed animals are not on-site and at the discretion of the attending veterinarian as long as appropriate disinfectant and other procedures to prevent transmission of disease are in place.

Staffing Standards

- Facility meets the minimum standard that appropriate veterinary medical care is provided as needed and requested 7 days a week.

- Attending veterinarian and animal care personnel have prior experience with subject ESA-listed species and specific expertise for treatment of medical conditions present in each ESA-listed species held, or consult experts with specific expertise. Attending veterinarian is available and actively consults with the PI and consulting veterinarian. Recommended treatments discussed during consultations with the NMFS MMPA/ESA permit holder and consulting veterinarian are addressed as advised by the PI or consulting veterinarian. Attending veterinarian and animal care staff are available on-site full-time if needed and promptly implement activities requested by the PI.

- Attending veterinarian is available on-call 24 hours a day and is on-site at least 20 hours per week, or more if needed. Whenever procedures are conducted on ESA-listed species, they must be under the direct supervision of professional staff and the attending veterinarian. The attending veterinarian or animal care staff notifies the PI prior to conducting major medical procedures (*e.g*. procedures requiring sedation/anesthesia and/or surgery). Recommendations from the PI or NMFS consulting veterinarian(s) are implemented in accordance with the time frame determined by the PI or consulting veterinarian(s).

- Attending veterinarian consults with the PI and the appropriate Regional Stranding Coordinator regarding the recommendation for release and the release plan for ESA-listed species. The MMHSRP Permit (No. 932-1905/MA-009526) is conditioned to require that the PI approve release determinations for rehabilitated threatened and endangered marine mammals. These Permit conditions are included in Appendix A. After the PI approves the

release determination, the appropriate NMFS Regional Administrator will issue a letter of concurrence for the release of the marine mammal.

References

Endangered Species Act (ESA) – 16 U.S.C. §1531 et. seq.

Marine Mammal Protection Act (MMPA) 16 U.S.C. §1421 et. seq.

Marine Mammal Protection Act Implementing Regulations 50 C.F.R. §216.27(a)(3)

Policies and Best Practices - Marine Mammal Stranding Response, Rehabilitation and Release – Standards for Rehabilitation Facilities, NOAA National Marine Fisheries Service, February 2009.

Supported by references

This procedural directive is supported by the reference listed in Policy Directive 02-308.

Appendix A
Permit No. 932-1905/MA-009526 Enhancement Conditions for Activities on Threatened and Endangered Species under NMFS Jurisdiction Conducted Pursuant to ESA Section 10(a)(1)(a) and MMPA Sections 109(h), 112(c), and Title IV

1. Response, rescue, disentanglement, rehabilitation, release, euthanasia, and necropsies of threatened and endangered cetaceans and pinnipeds under NMFS jurisdiction must be conducted in accordance with the following:
    a. "*Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release*" (hereinafter "*NMFS Policies and Best Practices*") in Appendix C of the Programmatic Environmental Impact Statement for the Marine Mammal Health and Stranding Response Program - Final Programmatic Environmental Impact Statement [FEIS]: http://www.nmfs.noaa.gov/pr/pdfs/health/eis_appendixc.pdf; and "*Marine Mammal Oil Spill Response Guidelines*" in Appendix L of the FEIS: http://www.nmfs.noaa.gov/pr/pdfs/health/eis_appendixl.pdf.

    b. The Permit Holder or PI may request exceptions to these requirements from the Permits Division on a case-by-case basis.

    c. Release determinations for rehabilitated threatened and endangered marine mammals must be approved by the PI.

    d. Euthanasia of stranded (e.g., sick, injured, entangled) or rehabilitating threatened and endangered marine mammals must be approved by the PI.

2. In order to avoid, minimize, or eliminate impacts on the affected species, non-target species, and the environment, mitigation measures described in Chapter 5 of the FEIS must be followed for the activities authorized by this permit as listed in (1) above: http://www.nmfs.noaa.gov/pr/pdfs/health/eis_chapter5.pdf. These mitigation measures must also be followed with regard to ensuring human health and safety.

3. The PI must notify the Permits Division prior to disentanglements of pinnipeds on or near rookeries and on densely populated haul outs. Such activities must be conducted in a manner to minimize danger to non-target animals. If standard protocols have been submitted for prior approval, notification is not required.

4. Hazing protocols for threatened and endangered species must be developed and updated based on the best available science. Such protocols must be submitted to the Permits Division.

5. The Permit Holder must provide annual updates to protocols for all response activities involving threatened and endangered species authorized by this permit. These should be included with the permit annual reports.

Department of Commerce $ National Oceanic & Atmospheric Administration $ National Marine Fisheries Service

NATIONAL MARINE FISHERIES SERVICE INSTRUCTION 02-308-02 ***March 14, 2012***
Protected Resources Management ***Marine Mammal Health and Stranding Response Program***
NMFS PLACEMENT PROCESS FOR NON-RELEASABLE MARINE MAMMALS
NOTICE: This publication is available at: http://www.nmfs.noaa.gov/directives/.
OPR: F/PR2 (H. Braham) **Certified by:** F/PR (J. Lecky) **Type of Issuance:** Initial
Signed _____s/ 2/29/2012_____ James H. Lecky Date Director, Office of Protected Resources

Procedural Directive
Process for Placing Non-Releasable Marine Mammals from the Stranding Program into Permanent Care Facilities

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Background

As intended by the Marine Mammal Protection Act (MMPA), the Marine Mammal Stranding Network (MMSN) attempts to successfully rehabilitate and release back to the wild each stranded marine mammal that is admitted into rehabilitation. The majority of rehabilitated animals are in fact, released back into the wild. However, in some cases, the attending veterinarian may determine that (1) release of a rehabilitated marine mammal could adversely affect wild marine mammal populations, and/or (2) release is not likely to be successful given the physical condition and behavior of the animal. In these cases, the animal may be considered non-releasable by the National Marine Fisheries Service (NMFS) Regional Administrator (RA) in the region where the rehabilitation facility resides. Once a marine mammal is deemed non-releasable by the RA, its permanent placement is determined by the NMFS Office of Protected Resources (OPR) in Silver Spring, MD.

In this procedural directive, NMFS outlines the process for determining permanent disposition for marine mammals deemed non-releasable by a RA. In some cases, multiple facilities are interested in receiving custody of a non-releasable animal. A systematic placement process ensures equitable, transparent, and fair consideration for all institutions requesting permanent custody of non-releasable animals.

Authority

NMFS has authority under 16 U.S.C. 1374, Section 104 of the MMPA, to regulate the acquisition and disposition of marine mammals (cetaceans and pinnipeds) through public display and research facilities and is responsible for maintaining the national marine mammal inventory. Coordination with U.S. Department of Agriculture (USDA)/Animal and Plant Health Inspection Service (APHIS) on non-releasable animal placements ensures compliance with Animal Welfare Act (AWA) requirements by receiving facilities. Manatees, sea otters, polar bears, and walrus are under the jurisdiction of the Department of the Interior (DOI) – U.S. Fish and Wildlife Service (USFWS), and are not included in this procedural directive.

Disposition Determination Process

A. Required Criteria for Marine Mammals Under NMFS Jurisdiction (Pinnipeds and Cetaceans)

For a facility to be eligible to receive a non-releasable marine mammal, they must provide NMFS with documentation that they:

(1) hold an Exhibitors License (public display) or be registered as a research facility under the Animal Welfare Act (AWA) from APHIS (7 U.S.C. 2131 et seq.);
(2) comply with the MMPA for public display or scientific research/enhancement (16 U.S.C. 1374, Section 104 of the MMPA);
(3) agree to hold the animal in conformance with all requirements and standards for public display or scientific research/enhancement as applicable;
(4) have thoroughly reviewed the animal's medical history;
(5) are able to provide adequate quarantine if needed; and
(6) are willing to arrange and incur all costs associated with transport.

B. Facility Placement File

NMFS OPR Permits Division maintains a file of U.S. public display and research facilities who have expressed interest in obtaining non-releasable marine mammals from the MMSN. For pinnipeds, NMFS OPR Permits Division maintains a National Placement List of interested facilities. It is the responsibility of each facility to: (1) notify NMFS of their interest in obtaining a non-releasable marine mammal; (2) ensure their contact information is current; (3) ensure their species request(s) are current; and (4) notify NMFS OPR Permits Division if they are no longer interested in obtaining non-releasable animals. This list is used to contact facilities when animals become available for permanent placement. All the above information must be provided to NMFS OPR Permits Division in writing via email or letter. For cetaceans, NMFS OPR Permits Division notifies all facilities holding captive cetaceans of non-releasable animals as they become available for placement for submission of the placement questionnaire.

C. Case Specific Criteria for Pinnipeds

For a facility to be considered for the placement of a non-releasable pinniped, the facility must be on the National Placement List (unless no other facilities on the list are interested) and meet the MMPA requirements (16 U.S.C. 1374, Section 104 of the MMPA) for holding marine mammals for either public display or scientific research/enhancement. While efforts are made to place animals in the order of the facilities on the National Placement List, placement will be dependent on matching animals with facilities based on sex, age, physical or behavioral limitations, and the time in which a facility can accept the animal(s).

D. Case Specific Criteria for Cetaceans

Each rehabilitated, non-releasable cetacean case is unique; thus, for each cetacean deemed non-releasable, NMFS will identify case-specific criteria that reflect that animal's needs (e.g., spinner dolphins are not easily transported long distances and there are few conspecifics currently in captivity, young dependent calves are more likely to thrive in maternal social groups,

chronically-ill dolphins may require special veterinary care, etc.). In some cases, NMFS will consult with veterinarians, behavior experts, and/or species experts to determine the most appropriate criteria. Some examples of case-specific criteria include, but are not limited to: (1) qualification and experience of staff relevant to animal's needs (e.g., experience with neonates and bottle-feeding); (2) composition of animal groups by species, sex, age, to accommodate animal's specific social needs (e.g., a juvenile male is more likely to thrive in social group of female adults and other juvenile males/females, versus only other adult males, or spinner dolphins are more likely to thrive with conspecifics); (3) on-site veterinary care (for calves, or cetaceans with chronic medical conditions, missing appendages, or sensory limitations); (4) transport method and distance (e.g., offshore cetaceans have difficulty being transported long distances, as do chronically ill, or very young cetaceans); and (5) time frame the receiving facility can arrange for and complete transport (e.g., in some cases it may be necessary to move an animal quickly, as in the case of an ongoing oil spill when additional rehabilitation space may be required).

E. Evaluation of Criteria

Facilities proposing to receive custody of a non-releasable cetacean should provide information to NMFS that demonstrates their plan for meeting the criteria (per the process outlined below). Appendix A provides one example of information NMFS OPR may request from facilities. In some cases, criteria are weighted to reflect the most important criteria in order of priority (e.g., transport time for offshore cetaceans such as spinner dolphins may be significant and weighted more heavily than with a more robust species such as a bottlenose dolphin). If criteria are weighted, it will be noted on the questionnaire provided to facilities. Each proposal will be reviewed by NMFS OPR and Regional staff to determine how well the established criteria are met and will be given an overall score by averaging the scores of each reviewer.

F. Requesting Authorization to Retain Custody of a Rehabilitated, Non-Releasable Marine Mammal

Some licensed public display facilities and authorized research facilities are also authorized under Section 112(c) of the MMPA to rehabilitate stranded marine mammals. When an animal undergoing rehabilitation is deemed non-releasable, the facility may request authorization from NMFS OPR to retain custody of the non-releasable animal for their public display or research program. NMFS OPR will consider these requests first and may authorize the facility to retain the animal, provided placement criteria are sufficiently met for that animal (see process steps above). If placement criteria are not met by the facility rehabilitating the marine mammal, NMFS may authorize transfer of custody to another facility based on the disposition process outlined below. Rehabilitation of a non-releasable marine mammal by a public display facility under the authority of Section 112(c) of the MMPA does not guarantee that the animal will be permanently placed at that facility.

G. Notification to Public Display Facilities Regarding Availability of a Non-Releasable Marine Mammal

When a marine mammal is determined non-releasable and needs placement at a facility other than where the animal is being rehabilitated, NMFS OPR will coordinate placement from the

National Placement List for pinnipeds or the placement questionnaire for cetaceans. See Step 4 for additional details.

Step-by-Step Process for Placing Non-Releasable Marine Mammals

During any step of this process, NMFS may consult with veterinarians, behavior experts, and/or species experts regarding placement criteria.

Step 1. The rehabilitation facility's attending veterinarian (in consultation with their Assessment Team) submits a written and signed release determination request to the appropriate NMFS RA requesting that an animal be deemed either releasable, conditionally releasable, or non-releasable based on the criteria outlined in NMFS' *Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release*. This report must provide a basis for the veterinarian's recommendation, and in some cases, should include copies of the most recent medical data such as blood work.

Step 2. The NMFS RA reviews the recommendation and makes a final disposition determination. If the RA determines that an animal is non-releasable, a letter is written to the stranding rehabilitation facility stating that the animal is non-releasable, and the facility has 30 days to request authorization to (a) retain custody of the marine mammal; (b) transfer custody; or (c) arrange any other disposition authorized by the RA. It is important to note that the RA or Office Director (OD), in their sole discretion, may order the release, continued rehabilitation, or any other disposition as authorized (*see* 50 C.F.R. 216.27 (b)). Furthermore, in order for a facility to request retention of custody of a marine mammal, they must meet the specific criteria for that animal as described in Section III of this Procedural Directive.

Step 3(a) (Pinnipeds). Because these species have fewer case specific considerations, placements are based on an institution's position on the National Placement List as well as matching animal specifics (e.g. age, sex, or other limitations) with appropriate facilities.

Step 3(b) (Cetaceans). Criteria for cetaceans are established for each case by (1) using required criteria (e.g., must be licensed for public display); (2) using criteria from previous similar cases (e.g., dependant calves); (3) consulting with marine mammal veterinarians, behavior and/or species experts to determine case-specific criteria (e.g., uncommon rehabilitated species such as a spinner dolphin). In some cases, criteria are weighted to ensure that the most important criteria for a particular animal's needs are met (e.g., time frame that an animal can be accepted due to extenuating circumstances at a rehabilitation facility, or availability of a lactating female (surrogate mother) for a neonatal animal).

Step 4(a) (Pinnipeds). Institutions are considered in the order they are placed on the National Placement List taking into account the specific animal criteria they have identified as part of their initial request. If the first matched institution is not interested in the particular animal(s) available, then the next institution on the list is contacted and so on, until the animal has been placed.

Step 4(b) (Cetaceans). NMFS OPR notifies via email all interested U.S. facilities regarding the availability of a non-releasable cetacean. The notification typically includes: (1) required criteria; (2) specific criteria and weighting; (3) deadline for proposals; and (4) any other relevant

information or requests for that particular case. Deadlines for proposals typically range from 1-2 weeks depending on case-specific needs.

Step 5(a) (Pinnipeds). Pinniped placement is coordinated by NMFS OPR.

Step 5(b) (Cetaceans). NMFS reviewers consisting of biologists from NMFS OPR, Regional Offices, and/or Science Centers, conduct an integrated assessment of all proposals to determine how well they meet the criteria. Each proposal is given an overall score by averaging the scores of each reviewer. NMFS' review of proposals is typically completed within 1-2 weeks after the proposal deadline but largely depends on case-specific needs.

Step 6(a) (Pinnipeds). APHIS is consulted regarding the AWA compliance history of the receiving facility. NMFS will consider the input received from APHIS and make a final decision on disposition. The receiving facility is notified and is required to submit a letter of intent to retain/acquire the pinniped.

Step 6(b) (Cetaceans). NMFS OPR ranks the proposals by averaging the scores of the reviewers, identifying primary candidate facilities for receiving custody of the non-releasable cetacean, and contacts APHIS to ensure the primary candidates are in compliance with AWA requirements. Once NMFS OPR receives this information from APHIS, a final disposition decision is made. NMFS will (1) notify the facility that they will be transferred custody of the cetacean; and (2) notify the rehabilitation facility regarding transfer of custody decision. If a facility is not currently in compliance with APHIS standards, NMFS will pursue the secondary candidate and so forth, to ensure the receiving facility meets the required criteria. The receiving facility is required to submit a letter of intent to acquire the cetacean. All other facilities who submitted a proposal are notified by NMFS via email that their proposal was not selected. Proposals need to be submitted each time there is a non-releasable cetacean; NMFS will not retain proposals from previous cases.

Step 7. NMFS OPR issues a letter of transfer to the receiving facility, authorizing the change of custody and requesting verification of transfer with the return of a Marine Mammal Data Sheet. The animal is then transported to the receiving facility and put in quarantine (if appropriate). There shall be no remuneration associated with any transfer of a rehabilitated, non-releasable marine mammal. The transferee, should they choose to do so, may reimburse the rehabilitation facility for costs associated with the rehabilitation and transport of the animal (*see* 50 C.F.R. 216.27 (c)). However, reimbursement may not be requested or demanded by the transferor.

Step 8. Upon verification of the transfer from the animal holder, the NMFS OPR Permits Division provides the receiving facility with an updated Marine Mammal Data Sheet reflecting the species and sex of the marine mammal, along with the date of transport. The animal is then added to the Marine Mammal Inventory maintained in the NMFS Permits Division.

Exportation of Non-Releasable Marine Mammals

The current NMFS policy is for non-releasable marine mammals to be placed first within the U.S. as long as there are facilities interested and able to accept them. Should it become

necessary to consider placement of non-releasable of marine mammals outside the U.S. the following guidance is provided:

- The MMPA provides NMFS the authority to transfer non-releasable marine mammals to qualified U.S. facilities for permanent captivity; however, there is no clear mechanism within the MMPA for NMFS to export marine mammals directly to facilities outside the U.S.
- The MMPA allows marine mammals that have been placed in public display facilities to be exported by the permitted facility, without an additional permit, to a facility in another country provided that the receiving foreign facility meets standards that are comparable to those required of U.S. facilities (*See* 16 U.S.C. § 1374(c)(2)(B) and (c)(9)).
- To ensure the legal transfer of non-releasable marine mammals to interested facilities outside of the U.S., NMFS would have to transfer custody of the animal to a U.S. facility which, in turn, could export the animal to qualified facilities in other countries.

Appendix A

Sample Questionnaire Provided to Facilities Interested in Obtaining Custody of a Non-Releasable Cetacean

Case Example:

This questionnaire was created for the placement of a healthy, non-releasable, male bottlenose dolphin that was a dependent calf, estimated to be ~ 2 year old.

Questionnaire for <u>Field#451</u>

Please provide the following --
Facility Name:
Point of Contact:
Phone:
Email:

Questions Regarding Social Needs (weight 50%)

1. These questions address the social groupings that your facility has for consideration of the placement of this animal:

    a. How many dolphins does your facility currently maintain and how many social groups (by age and sex) are they maintained in?

    b. Does your facility have an older female(s) or female(s) who have experience with calves and may act to protect the individual from others?

    c. Does your facility have a small group of similarly aged males this animal could be introduced to during non-breeding season before being introduced into a larger group?

d. Does your facility have a nursery area (mothers with independent calves) that this animal could be introduced to?

e. What would be your plan for incorporating this animal into a social group?

f. What would be your contingency social group(s), if introduction to target group was unsuccessful?

2. These questions address quarantine/isolation of the animal:

   a. Based on this animal's history, do you feel quarantine/isolation is necessary?

   b. Indicate the expected duration of quarantine/isolation?

   c. Please briefly describe your plans for quarantine.

Questions Regarding Transport (weight 30%)

3. Is your facility willing to arrange and incur all costs associated with transport?

4. What is the estimated time for transport ('door-to-door") from the rehabilitation facility to your facility?

5. What type of transportation and methods would you use (e.g., plane, truck; wet, dry?)

6. Will your veterinarian or another veterinarian experienced with marine mammal transports attend to the animal during transport?

7. Would you be able to send staff to the rehabilitation facility to become familiar with the animal and to assist with training for transport? If yes, what would be the ideal duration of staff presence?

8. How soon could you arrange to transport this animal and receive him/her at your facility? Please be realistic with your time frame, and please note there is an expectation that you would receive the animal no later than one month after receiving the transfer paperwork from NMFS unless an exception is clearly outlined in your response.

Other Questions (weight 20%)

9. Has your veterinary staff thoroughly reviewed the medical history and records of this animal? Are there any concerns among your animal care or veterinary staff?

10. How many days per week is your attending veterinarian on site? Does he/she reside locally for close medical monitoring and evaluation?

11. Is your facility part of a breeding program?

12. Does your facility have the experience, resources, and staff to care for this animal? Please describe.

13. Is your facility accredited by the Association of Zoos and Aquariums (AZA), the Alliance of Marine Mammal Parks and Aquariums (AMMPA), or another comparable professional society with animal care standards?

14. Please provide any other information about your facility or program that you feel may aid us in making a permanent placement decision.

Please return Questionnaire by DATE (TIME Eastern) to: NMFS Point of Contact at email address. Questions regarding the placement process should be directed to NMFS (NAME) via email or phone**.** Questions regarding this animal and its medical history can be directed to point of contact at Rehab Facility via email or phone.

References

Animal Welfare Act (AWA) - 7 U.S.C. §2131 et. seq.

Marine Mammal Protection Act (MMPA) 16 U.S.C. §1374 et. seq.

Marine Mammal Protection Act (MMPA) 16 U.S.C §1421 et. seq.

Marine Mammal Protection Act Implementing Regulations 50 C.F.R. §216.27(b)(2). Upon receipt of a report under paragraph (b)(1) of this section, the Regional Director or Office Director, in their sole discretion, may:

(i) Order the release of the marine mammal;
(ii) Order continued rehabilitation for an additional 6 months; or
(iii) Order other disposition as authorized.

Marine Mammal Protection Act Implementing Regulations 50 C.F.R. §216.27(c)(4). There shall be no remuneration associated with any transfer, provided that, the transferee may reimburse the transferor for any and all costs associated with the rehabilitation and transport of the marine mammal.

Policies and Best Practices - Marine Mammal Stranding Response, Rehabilitation and Release – Standards for Rehabilitation Facilities, NOAA National Marine Fisheries Service, February 2009.

Policies and Best Practices - Marine Mammal Stranding Response, Rehabilitation and Release – Standards for Release, NOAA National Marine Fisheries Service, February 2009.

Supported by references

This procedural directive is supported by the reference listed in Policy Directive 02-308.