Seamamms

Southeast and Mid-Atlantic Marine Mammal Symposium

Hosted by: Hollings Marine Laboratory Partners and NOAA Fisheries Office of Protected Resources
Charleston, South Carolina
March 28-30, 2008

Abstract Book

HOLLINGS MARINE LABORATORY

MUSC MEDICAL UNIVERSITY OF SOUTH CAROLINA

NOAA

NIST

ORAL PRESENTATIONS

Keynote Speaker

Health Threats for Marine Mammals of the West Coast

Frances M. D. Gulland

The Marine Mammal Center, 1065 Fort Cronkhite, Sausalito, CA 94965, USA

California sea lions (*Zalophus californianus*) are common along the California coast, they share a food supply and mammalian physiology with humans, and regularly strand so are accessible for health examinations. This talk will describe changing prevalences of diseases resulting from exposure to pathogens, chemical contaminants and biotoxins in sea lions over the last 20 years, demonstrating the health concerns for marine mammals along the west coast of the U.S., and the value of stranded animals as sentinels of ocean change.

Domoic acid toxicosis was first identified in California sea lions in 1998, when a cluster of 70 animals stranded showing seizures. Since then, sea lions showing a variety of neurological signs have stranded in California, and efforts have focused on identifying the role domoic acid exposure may play in more subtle disease pathogenesis. Examination of 715 sea lions with neurological signs between 1998 and 2006 revealed two separate clinical syndromes: acute domoic acid toxicosis and a novel chronic epileptic syndrome characterized by behavioral changes, seizures and atrophy of the hippocampal formation. Atrophy of the hippocampal formation and parahippocampal gyrus results from a combination of neuronal loss and astrocytosis and may be a result of the initial toxic insult and the progressive and cumulative effects from seizure propagation.

California sea lions are susceptible to epizootics of leptospirosis, a bacterial disease affecting the kidneys with a mortality rate of about 60%. Periodic outbreaks in sea lions appear to be related to changes in population immunity rather than environmental factors.

California sea lions also have an unusually high incidence of cancer: approximately 17% of sexually mature stranded animals examined have highly aggressive urogenital carcinomas. These cancers are associated with a novel herpesvirus, Otariine herpesvirus 1, as well as with exposure to anthropogenic contaminants (PCBs, DDTs) persisting in the sea lion's feeding grounds off the California coast. Sea lions that are more genetically inbred and those with a specific MHC genotype are more likely to develop cancer, suggesting that interactions occur between genes, toxins and viruses resulting in cancer in this marine mammal that shares its coastal California environment with humans.

Confirmation of the harmful algal toxin, domoic acid, in *Kogia spp.* stranded in mid-Atlantic waters of the U.S.

Spencer E. Fire[1], Zhihong Wang[1], Wayne E. McFee[1], William A. McLellan[2], R. Wayne Litaker[3], Patricia A. Tester[3], Aleta Hohn[4], Gretchen Lovewell[4], David S. Rotstein[5], Susan G. Barco[6], Alex Costidis[7], Gregory D. Bossart[8], Steve L. Morton[1], and Frances M. Van Dolah[1]

[1] Center for Coastal Environmental Health and Biomolecular Research, National Ocean Service, NOAA, 219 Fort Johnson Rd, Charleston, SC 29412
[2] Biological & Marine Biology, University of North Carolina Wilmington, 601 South College Road, Wilmington, NC 28403
[3] National Ocean Service, NOAA, 101 Pivers Island Rd., Beaufort, NC 28516
[4] National Marine Fisheries Service, NOAA, 101 Pivers Island Rd., Beaufort, NC 28516
[5] NOAA Center for Marine Mammal Health/ University of Tennessee College of Veterinary Medicine, 2407 River Drive, Knoxville, TN 37996
[6] Virginia Aquarium & Marine Science Center, 717 General Booth Blvd., Virginia Beach, VA. 23451
[7] College of Veterinary Medicine, University of Florida, Gainesville, FL 32611
[8] Marine Mammal Research and Conservation Program, Harbor Branch Oceanographic Institution, 5600 U.S. 1 North, Fort Pierce, FL 34946

The presence of 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*) stranded along the U.S. Atlantic coast from 1997-2007. Of the 27 animals analyzed from Virginia, North Carolina, South Carolina and Florida, 17 (63%) tested positive for DA. This toxin, which is produced naturally by the harmful algae *Pseudo-nitzschia spp.*, was confirmed by liquid chromatography-mass spectrometry (LC-MS) at maximum concentrations of 1.6 ng DA/mL in urine and 456 ng DA/g in feces. Feces appeared to be the best indicator of DA exposure in *Kogia spp.*, with 93% of all feces samples analyzed testing positive for this toxin. 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 was no observed *Pseudo-nitzschia* bloom in the region during the time of strandings, nor is there a documented history of large scale DA producing blooms on the southeast U.S. coast. The feeding habits of *Kogia spp.* are poorly documented; thus the vector for DA exposure to these species remains to be identified. Toxin accumulation in these poorly known whale species may be an indication of unrecognized harmful algal bloom activity in offshore areas not currently being monitored. This study highlights the need for better understanding of the role of toxin producing algae in marine mammal morbidity and mortality globally.

Depletion of high abundance proteins from California Sea Lion (*Zalophus californianus*) plasma using commercially-available depletion columns

Jason A. Ferrante[1], Frances M. Gulland[3], John Arthur[2], Frances Van Dolah[4], Michael G. Janech[1,2]

[1] Grice Marine Laboratory, College of Charleston, Charleston, SC
[2] Medical University of South Carolina, Charleston, SC
[3] The Marine Mammal Center, Sausalito, CA
[4] Marine Biotoxins Program, CCEHBR/NOS/NOAA, Charleston, SC

Domoic acid (DA) is a neurotoxin produced by the marine diatoms *Pseudo-nitzschia sp*. The goal of this study is to determine if there are proteins in *Z. californianus* plasma that can be used as biological indicators, or "biomarkers", of DA exposure. We hypothesize that changes in the plasma protein profile can be utilized as a discovery tool for biomarker selection in animals exposed to DA. These protein profiles are made visible by using gel proteomic techniques. About 97% of the total protein content of human plasma is comprised of twenty high abundance proteins: e.g. albumin and immunogloblulins. Depletion of high abundance proteins allows for increased detection of low abundance proteins. Commercial antibody depletion columns have been used for plasma protein depletion in humans, rats, and mice; however the effectiveness of these columns for sea lion samples has not been determined. A plasma sample from a healthy sea lion was depleted using three commercial columns, and proteins were separated by two-dimensional gel electrophoresis. The Beckman Coulter ProteomeLab IgY-12 column appeared to deplete albumin effectively, whereas the Bio-Rad Aurum and Sigma-Aldrich columns did not appear to deplete sea lion albumin (normalized albumin intensities relative to the undepleted sample: Beckman coulter, 6%; BioRad Aurum, 86%; Sigma-Aldrich ProteoPrep 20, 183%). These preliminary data suggest the Beckman Coulter ProteomeLab IgY-12 columns will be most suitable to deplete albumin from sea lion plasma. Further studies that assess the ability of commercially available columns to deplete other high abundance proteins from sea lion plasma are ongoing.

Womb of Doom: Examples of Uterovarian Disease Among Small Cetaceans and Pinnipeds From the Gulf of Mexico and Eastern Seaboard

David S. Rotstein[1,2,3], D Ann Pabst[4], W A McLellan[4], A Bogholmoni[5], K Pugliares[6], Stephen Kania[3], Rupal Brahmbhatt[3], and Forrest Townsend[7]

[1] NOAA Cooperative Center for Marine Animal Health, 2407 River Dr, Room A201, Knoxville, TN 37996
[2] University of Tennessee College of Veterinary Medicine, 2407 River Dr, Room A201, Knoxville, TN 37996
[3] University of Tennessee Cooperative for Wildlife Health
[4] University of North Carolina Wilmington, 601 South College Road, Wilmington, NC
[5] Woods Hole Oceanographic Institution, Mail Stop #50 Woods Hole, MA 02543
[6] Cape Cod Stranding Network, 290 Summer Street, Yarmouthport, MA 02675
[7] Bayside Hospital for Animals, 251 N.E. Racetrack Road, Fort Walton Beach, Florida 32547

Perturbations in hormonal cues, physical obstructions, exposure to toxic agents or toxins, and infections can lead to infertility, fetal death or abortion. In free living species, the diagnosis of such conditions is likely observed at necropsy, though in monitored populations, the lack of reproductive success may hint at an underlying male or female reproductive factor. Tumors include, reproductively active such as ovarian luteoma, or physically obstructive such as fibroleiomyoma (fibroid). Infections in the reproductive tract including endometritis, metritis, and pyometra can be the direct result of exposure to bacteria (*Brucella, Leptospirosis*), viruses, and protozoa (*Toxoplasma gondii*) or associated with hormonally-stimulated conditions like cystic endometrial hyperplasia. In examining our database consisting of approximately 300 necropsied female marine mammals, disease of the reproductive system represents approximately 10% (30/300) of all systemic disease. Overall, endometritis was a common finding (9%; 27/300) and ranged from mild to severe. Specific examples include uterine fibroleiomyoma (n = 2) with osseous metaplasia (n =1) in a *Steno bredanensis* and *Phoca groenlandica*, ovarian luteoma with associated cystic endometrial hyperplasia (n = 1) in a *Stenella attenuata*, and suppurative bacterial endometritis and fetal death (n = 1) in a *Tursiops truncatus*. Since all of these cases were from dead stranded or rehabilitation animals, it is not possible to say with certainty what the effects of the fibroleiomyomas and luteoma would be upon reproductive success, however, based upon terrestrial species, infertility is likely. In the case of suppurative endometritis, septicemia and endotoxemia are likely. Speciation of the bacteria is ongoing through molecular diagnostics. Continual evaluation of the uterus and ovaries along with diagnostics such as hormone analysis, bacterial culture, pathogen PCR, and histopathology may assist in providing a complete picture of the reproductive health of a stranded cetacean or pinniped.

A Review of 14 Years of Causes of Death of Bottlenose Dolphins in South Carolina

Wayne E. McFee[1] and Thomas P. Lipscomb[2]

[1] NOAA, National Ocean Service/ CCEHBR, 219 Ft. Johnson Rd. Charleston, SC 29412
[2] Armed Forces Institute of Pathology, Department of Veterinary Pathology, Washington, D.C. 20306

While 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 causes of death of bottlenose dolphins over a 14 year period for the entire state of South Carolina. Causes of death for 97 cases were reviewed based on histopathology results with an additional 30 cases drawing conclusions from gross pathology results. Of the 97 dolphins examined grossly and histologically, 30 (31%) died of infectious disease, 46 (47%) died of non-infectious disease and the cause of death was unknown in 21 (22%). Of the 30 dolphins examined grossly, 23 died from human interaction and seven involved stingray spine inflictions. Bacterial infections accounted for the large majority (63.3%) of fatal infections and emaciation was the leading cause of non-infectious mortality based on histological examination. This study has broad implications in establishing baseline data on causes of death of bottlenose dolphins for future studies to compare and for the detection of emerging diseases that humans may need to be concerned about.

Photo-identification for Estimation of Prevalence, Spatial Distribution and Temporal Trends of Lobomycosis in Bottlenose Dolphins from the Indian River Lagoon, Florida

Elizabeth Murdoch[1], John S. Reif[2], Marilyn Mazzoil[1], Stephen D. McCulloch[1], Patricia A. Fair[3], and Gregory D. Bossart[1]

[1] Marine Mammal Research and Conservation, Harbor Branch Oceanographic Institution, Fort Pierce, FL, USA
[2] Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO, USA
[3] Center for Coastal Environmental Health and Biomolecular Research, NOAA, NOS, Charleston, SC

Lobomycosis is a chronic fungal disease of the skin of dolphins and humans. Previous studies have identified the Indian River Lagoon, Florida (IRL) as having a high prevalence of dolphin lobomycosis. We studied the occurrence and distribution of lobomycosis in the IRL using photo-identification data collected between 1996 and 2006. Our objectives were to determine the sensitivity of photo-identification for diagnosis of lobomycosis in free-ranging dolphins, and assess the spatial distribution and temporal occurrence of lobomycosis in the IRL. A single investigator reviewed all photographs of distinctly marked dolphins encountered during sightings between 1996 and 2006. Photographs containing skin lesions compatible with lobomycosis were verified through blind analysis. We compared the results of prior photographic analysis of 102 dolphins captured during the Dolphin Health and Risk Assessment and 3 stranded dolphins with histologic examination of lesion biopsies. Twelve of 16 confirmed cases were previously identified from photographs yielding a sensitivity of 75%. Among 89 dolphins without disease, all 89 were considered disease free on photographs, a specificity of 100%. The prevalence of lobomycosis estimated from photographic data was 7.2%. The spatial distribution was determined by dividing the IRL into 6 segments based on hydrodynamics and geographic features. The prevalence ranged from less than 1% in the Mosquito Lagoon to 19.8% in the South Indian River. The incidence of lobomycosis varied but did not increase over the 11-year period. In summary, photo-identification is a useful tool to monitor the course of individual and population health for this enigmatic disease.

Bartonella species as a potential cause of disease in marine mammals: Current status

Ricardo G. Maggi[1], Craig A. Harms[1], Edward B. Breitschwerdt[1], Patricia E. Mascarelli[2], Rick W. Kasten[3], Bruno B. Chomel[3], Stephen A. Raverty[4], Martin Haulena[4], Verena A. Gill[5]

[1] North Carolina State University, Raleigh, NC
[2] Caribbean Center for Marine Studies, San German, PR
[3] University of California at Davis, Davis, CA
[4] Vancouver Aquarium, Vancouver, BC
[5] U.S. Fish and Wildlife Service, Anchorage, AK

After detection of *Bartonella henselae* in blood samples from two stranded harbor porpoises in 2005, our laboratories began efforts to define the extent of potentially persistent, intravascular infection with *Bartonella* species in marine mammals. Based on PCR amplification of organism-specific DNA sequences from blood or tissue samples, from BAPGM enrichment blood cultures or from subculture isolates, *Bartonella* species have been detected or isolated from several marine mammal species. To date, *B. henselae* has been documented in six Odontocete species, *B. bovis* and *B. quintana* in two Pinniped species and *B. bovis* and an uncharacterized *Bartonella* species in sea otters. Of as yet unknown clinical relevance, infection with a *Bartonella* species has been detected in marine mammals with thrombocytopenia, anemia, endocarditis and encephalitis. Other animals were tested because of mild, non-specific clinical signs such as lethargy or decreased activity. Due to sample availability, most *Bartonella* species have been detected in blood samples; however, *Bartonella* DNA has been amplified from lymph nodes, spleen, brain, and lung tissues. The mode of transmission, pathogenicity, and reservoir potential of various *Bartonella* species has not been established for marine mammals. *Bartonella* induces a persistent, relapsing and highly adapted intravascular infection that is generally not accompanied by pathology, unless an individual is subjected to severe stress, malnutrition, increased exposure to toxins, or concurrent infection with other microorganisms. The recent isolation of *Bartonella* species from the blood of immunocompetent veterinarians and veterinary technicians indicates that additional precautions may be warranted when processing tissues from stranded marine mammals.

Bartonella species detection in captive and stranded versus healthy free-ranging dolphins and porpoises in the southeastern United States

Craig A. Harms[1], Ricardo G. Maggi[1], Edward B. Breitschwerdt[1], Connie L. Clemons-Chevis[2], Mobashir Solangi[2], Patricia A. Fair[3], Larry J. Hansen[4], Aleta A. Hohn[4], Gretchen G. Lovewell[4], William A. McLellan[5], D. Ann Pabst[5], Teri K. Rowles[4], Lori H. Schwacke[3], Forrest I. Townsend[6], Randall S. Wells[7]

[1] North Carolina State University
[2] Institute for Marine Mammal Studies
[3] National Ocean Service, National Oceanic and Atmospheric Administration
[4] National Marine Fisheries Service, National Oceanic and Atmospheric Administration
[5] University of North Carolina at Wilmington
[6] Bayside Hospital for Animals
[7] Chicago Zoological Society

We compared prevalence of *Bartonella* species detection in cetaceans among a captive facility with animals experiencing debility of unknown origin, stranded animals, and wild-caught free-ranging animals. One hundred two (102) cetaceans including 86 bottlenose dolphins (*Tursiops truncatus*, 71 free-ranging, 14 captive from one facility, one stranded), 10 stranded striped dolphins (*Stenella coeruleoalba*), three stranded Risso's dolphins (*Grampus griseus*), and three stranded harbor porpoises (*Phocoena phocoena*) were sampled. Whole blood (n = 91 live animals) and tissues (n = 14 freshly dead animals) were screened by PCR of the *Bartonella* 16S-23S ITS region and PAP31 gene (n = 102 animals), PCR of enrichment cultures (n = 46 animals), and subcultures (n = 46 animals). *Bartonella* species were detected from 15 animals, including 11 by direct PCR, 5 by PCR of enrichment cultures, and 4 by subculture isolation. *Bartonella* species were more commonly detected from the captive population (6/14, 43%) and stranded animals (7/17, 41%) than from free-ranging animals (2/71, 2.8%). Sequencing identified a *Bartonella* species most similar to *B. henselae* San Antonio 2 in eight cases (four bottlenose dolphins, two striped dolphins, and two harbor porpoises), *B. henselae* Houston 1 in two Risso's dolphin cases, and untyped in five cases (four bottlenose dolphins and one striped dolphin). Although causation has not been established, *Bartonella* species were detected at a higher prevalence from cetaceans that were overtly debilitated or cohabiting with debilitated animals than from free-ranging apparently more healthy animals. The detection of *Bartonella* species from cetaceans may be of pathophysiological concern.

Stomach content analysis of bottlenose dolphins (*Tursiops truncatus*) stranded in South Carolina

S. Michelle Pate[1, 2], William A. Roumillat[3], and Wayne E. McFee[4]

[1] College of Charleston
[2] NOAA Fisheries Marine Mammal Health and Stranding Response Program
[3] South Carolina Department of Natural Resources
[4] National Ocean Service, NOAA

The stomach contents of 136 bottlenose dolphins (*Tursiops truncatus*) stranded dead or incidentally caught in South Carolina between 2000 and 2006 were examined. Eighty-two dolphin stomachs contained food items and were the basis for this study. Fish and cephalopods represented the main diet components. Forty-two prey species representing 24 families were recovered from the stomach contents. The dolphins fed predominantly on smaller-sized benthic and demersal fish species. Importance of prey species in the dolphin diet was measured in terms of abundance and frequency of occurrence. Important prey species in the diet included star drum (*Stellifer lanceolatus*), bay anchovy (*Anchoa mitchilli*), spot (*Leiostomus xanthurus*) and brief squid (*Lolliguncula brevis*). Prey species consumed among different locations helped separate those individuals that belonged to one of two management units considered to be found in South Carolina. Additionally, this study was used to determine if prey species observed in dead, stranded bottlenose dolphins were representative of living bottlenose dolphin populations—through a comparison of bottlenose dolphins that exhibited signs of human interaction (presumed healthy) and those that appeared to have died from other causes (presumably natural mortalities or unknown causes). Both groups of animals consumed similar prey species, however shrimp occurred significantly more frequently in human interaction cases. Many of the species consumed were also bycatch species of the local shrimping industry suggesting further studies to determine the extent to which bottlenose dolphins interact with and rely on fisherman as a food resource. This study was the first quantitative analysis of prey species comprising the diet of bottlenose dolphins in South Carolina.

Temporal and ontogenetic variation in the nutritional value of Atlantic herring (*Clupea harengus*), an important prey species in the Bay of Fundy, Canada

Hillary A. Lane and Heather N. Koopman

University of North Carolina Wilmington

Atlantic herring (*Clupea harengus*) are abundant in the Bay of Fundy, representing important prey for apex predators, such as marine mammals. Surprisingly, little is known about their nutritional value. Understanding spatial and temporal variation in the nutritional quality of prey will provide insight into the foraging strategies of predators reliant on these species. Using total lipid content and composition as proxies for nutritional value, we evaluated seasonal, inter-annual, and ontogenetic variation in the fat content and composition of Atlantic herring from the Bay of Fundy. We detected considerable variability in herring lipid content and composition during 2005 and 2006. Fish from 2005 had significantly ($p < 0.001$) lower mean total lipid content (5.86 ± 0.27 wt%) than 2006 fish (8.92 ± 0.21 wt%). We also detected a trend of lower lipid content in fish caught in the winter compared to summer fish. Within each year, however, ontogeny was the most important factor in determining lipid content, with larger fish yielding significantly higher lipid concentrations ($p < 0.001$). Fatty acid composition also varied with fish length, with higher levels of omega-3 fatty acids in small fish and more monounsaturated fatty acids in large fish. Data from this study support the hypothesis that the nutritional value of Bay of Fundy Atlantic herring increases as fish grow, but underscores the fact that considerable inter- and intra-annual variability exist in prey quality. These results may help to explain the variable distribution of predators in this ecosystem between seasons and years.

Differences in energy expenditures of coastal and estuarine bottlenose dolphins (*Tursiops truncatus*)

Robert Earl Clelland and Robert Young

Coastal Marine and Wetland Studies Graduate Program and Department of Marine Science, Coastal Carolina University

Behavioral budgets, swimming speeds, and energetic expenditures of bottlenose dolphins, *Tursiops truncatus*, were compared between estuarine (salt marsh creeks) and oceanic (near-coastal) habitats. Variations in community composition and habitat characteristics may favor different behavioral strategies and energy expenditures by dolphins. These differences, in turn, have consequences in terms of predatory impacts by dolphins or the dolphin carrying capacity for each habitat. We hypothesized that behavioral budgets would differ between the two habitats and that travel swimming speeds and associated energetic expenditures would be less in the estuarine habitat. Data collection occurred at North Inlet/Winyah Bay National Estuarine Research Reserve, the Cape Romain National Wildlife Reserve, and the near coastal waters between Murrells Inlet and North Inlet, SC. Behavioral data were collected during group focal follows, with behaviors defined by four major behavioral categories: traveling, foraging, milling, and socializing. Traveling speeds were estimated during energetic surveys which recorded the position and timing of all surfacings and corrected for current speeds as recorded by a Marsh-McBirney portable current meter. Analysis of the data indicated that a significant difference existed between the energetic costs associated with traveling for the two habitats, with individuals in the oceanic habitat expending 2.26 times more energy while traveling than their estuarine counterparts. Also, the allocation of time spent among the four behavioral categories differed between the two habitats, but traveling was the most common behavior for both habitats.

Using mitochondrial DNA to examine the differences between coastal and offshore populations of bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico

Nicole L. Vollmer[1,2] and Patricia E. Rosel[2]

[1] University of Louisiana at Lafayette, Lafayette, LA
[2] NOAA Fisheries Service/SEFSC, Lafayette, LA

Threats to bottlenose dolphins (*Tursiops truncatus*), both natural and anthropogenic, are present in many habitats, but they may not be evenly distributed across all areas. For example, in the Gulf of Mexico (GOM), oil drilling is prevalent in the western areas, while harmful algal blooms are common in the eastern and northern sections. Therefore, to successfully manage and maintain *Tursiops* in the GOM, it is imperative to gain an understanding of the degree of differentiation existing among populations so that the varied impacts can be properly assessed. In the Gulf, morphological variation and geographical boundaries separating potential dolphin populations are not obvious; however, genetic differentiation can be used to identify discrete populations. This research compares the genetic composition of the five coastal and offshore stocks currently designated in the GOM. Skin samples from 603 bottlenose dolphins were collected between 1994 and 2007 from both coastal and offshore areas, including 301 females and 297 males. Genomic DNA was extracted and a segment of the mitochondrial control region was sequenced for every sample resulting in 24 coastal haplotypes and 31 offshore haplotypes. Evidence for population differentiation was investigated using an analysis of molecular variance to compute both F_{ST} and Φ_{ST} estimates and through construction of a median-joining network. Preliminary results show that genetic differentiation is present and a significant amount of the variation is attributable to differences among the five designated stocks. These findings will help ensure that current stock delineations accurately represent the existing biological populations.

Paternity Assessment of Atlantic Spotted Dolphins (*Stenella frontalis*) in the Bahamas

Michelle L. Green, Denise L. Herzing and John D. Baldwin

Florida Atlantic University, 2912 College Ave., Davie, FL 33314

Atlantic spotted dolphins (*Stenella frontalis*) readily engage in mating behavior and are often observed mating with multiple individuals. Since males do not participate in rearing young, it is impossible to determine paternity without a genetic aspect. The objective of the study was to assess paternity within a group of free-ranging Atlantic spotted dolphins. Fecal samples (n=88) were collected from individual dolphins including mother-calf pairs and candidate fathers. A fragment of the mitochondrial (mtDNA) control region and ten microsatellite loci were amplified to test for haplotype and allele sharing between mothers and calves. In all cases, mtDNA and microsatellite data supported mother-calf pairs previously assigned by observation in the field. Potential paternal genotypes and the minimum number of males necessary to produce an array of maternal half-siblings was constructed using GERUD v1.0. In cases where more than two offspring from the same mother were sampled, a minimum of two males were necessary to generate the observed set of alleles among the half-siblings, indicating promiscuous mating by these females. Individual paternity was assessed using a likelihood-based approach (CERVUS v3.0). Although the proportion of potential fathers sampled affects assignment, paternity was successfully assigned in four calf-mother-father trios (strict confidence, 95%) and two additional trios were assigned with relaxed confidence (80%). Based on estimates of the male's ages at conception, all males assigned paternities were considered old adults (range 20-30+ yrs). Molecular evidence of promiscuity in females coupled with older males as fathers has important implications for understanding the mating systems of free-ranging dolphins.

Factors influencing variation in age at independence for free-ranging bottlenose dolphin calves in Sarasota Bay, Florida

Katherine A. McHugh[1,2], Suzanne Hofmann[2], Jason B. Allen[2], Michael D. Scott[3], Randall S. Wells[2]

[1] Animal Behavior Graduate Group, University of California Davis
[2] Chicago Zoological Society, Sarasota Dolphin Research Program, c/o Mote Marine Laboratory, 1600 Ken Thompson Pkwy, Sarasota, FL, 34236, USA
[3] InterAmerican Tropical Tuna Commission, 8604 La Jolla Shores Drive, La Jolla, CA 92037 USA

Bottlenose dolphins (*Tursiops truncatus*) exhibit a prolonged and highly variable period of calf dependence, but little is known about factors influencing variation in the timing of independence. We used multiple linear regression models to examine factors influencing age of independence for 92 bottlenose dolphin calves (41 male, 41 female, 10 unknown sex) born from 1980 to 2005 in Sarasota Bay that achieved independence prior to February 2007. Age of separation ranged from 1 to 9 years (mean = 4, sd = 1.7) based on when the calf-mother half-weight coefficient of association (COA) first fell below 0.5. Three types of predictors were included: 1) life history (sex, birth order, birth date, age of mother, and whether separation coincided with birth of subsequent calf), 2) body condition (mass, length, girth, and blubber thickness relative to averages for the same age and sex during the same season), and 3) social factors (number of associates, group size, number of calves, average COA of top associates). The overall regression model accounted for nearly 40% of the variance in age at independence ($R^2 = 0.397$, $p < 0.001$). Age of independence was older for calves born later in the year ($p < 0.001$) and younger when separation coincided with the birth of a new calf ($p < 0.01$). Body length, number of associates, and number of calves in groups also contributed to predicting age of separation (all $p < 0.05$). Thus, age of calf independence is affected by several factors, including the timing of birth for both the calf and its next sibling, calf body size, and the social environment of mother-calf pairs.

The Impacts of Two Major Hurricanes on the Socail Structure of Bottlenose Dolphins, *Tursiops truncatus*, in the Bahamas

Cindy A. Rogers[1,2] and Denise L. Herzing[1,2]

[1] The Wild Dolphin Project P.O. Box 8436 Jupiter, FL 33468
[2] Florida Atlantic University 777 Glades Road Boca Raton, FL 33431

Environmental disturbances can affect the social aspects of marine mammal populations. Changes in ranging patterns and loss of individuals can influence the population's social structure. The objective of this study was to determine the affects of two major hurricanes in 2004 on the social structure of approximately 100 resident bottlenose dolphins, *Tursiops truncatus*, in the Bahamas. The two data sets used include: pre-hurricanes: 2002-2004 and post-hurricanes: 2005-2007. Thirty regularly seen individuals have disappeared after 2004, and 27 new dolphins were seen in 2005. Using the half-weight index, coefficients of association (COA) were determined with SOCPROG 2.3 for individuals of known sex with six or more sightings per data set. Both data sets revealed non-random associations, indicating preferred/avoided companions. Same-sex COA were significantly higher than mixed-sex COA for the post dataset, but not for the pre data set. In the post data set, female-female COA was 21% versus 44 % in the pre data set; however the post data set mean (x=.20) was higher than the pre data set mean (x=.13). In the post data set, male-male COA was 28% versus 11% in the pre data set, however the means were similar (post: x=.16; pre: x=.17). In the post data set, COA with at least one new individual represented 47%, with the majority involving new males. New individuals have taken the places in the community of those lost after the hurricanes, however there are changes in the association patterns: fewer, but stronger, female-female COA and more, but similar strength, male-male COA.

Predictive Modeling of Right Whale (*Eubalaena glacialis*) Calving Habitat in the Atlantic Ocean

Caroline P. Good[1], Andrew J. Read[1], Pat Halpin[1], Song Qian[1], C. Taylor[2], P. Naessig[2], M. Zani[3], L.I. Ward-Geiger[4]

[1] Duke University Marine Lab, 135 Duke Marine Lab Road, Beaufort, NC 28516
cpg2@duke.edu
[2] Wildlife Trust, 460 West 34th Street, New York, NY 10001
[3] New England Aquarium, Central Wharf, Boston, MA 02110
[4] Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg FL 33701

Each winter, a subset of the North Atlantic right whale (*Eubalaena glacialis*) population migrates from feeding grounds off New England and Nova Scotia to a well documented calving area along the South Atlantic Bight. The area is characterized by physical conditions that are warmer, calmer and shallower their foraging grounds. We used sightings data collected from aerial surveys between January 2000 and March 2005 to develop a model of optimal calving habitat based on the depth, surface temperature and surface roughness associated with calf presence. Physical data was obtained from satellite derived and directly measured sources. We employed a Bayesian probability density function to identify habitat associations and an ROC curve to determine optimal thresholds. The model was also compared to calving areas in the South Atlantic and historic calving grounds in the North Atlantic to investigate its broader applicability. Our findings indicate that suitable calving habitat along the east coast may extend much farther to the north than is currently recognized. The Gulf of Mexico also appears to offer a broad extent of quality calving habitat but this region may be difficult for right whales to access due to thermal constraints. Our model correctly identified several well documented current and historic calving grounds in the eastern Atlantic but failed to fully identify a heavily used calving area off Argentina, which is characterized by lower surface water temperatures than the other calving regions.

Temporal and spatial distribution of the Atlantic bottlenose dolphin, *Tursiops truncatus*, along the Southeast coast of the United States

Meghan Bills[1*], Edward Keith[1], Lance Garrison[2]

[1]Nova Southeastern University Oceanographic Center, Dania Beach, FL
[2]NOAA Southeast Fisheries Science Center, Miami, FL
* Current Address: University of Florida Aquatic Animal Health Program, Gainesville, FL

A series of mass strandings caused by a morbillivirus epizootic in 1987/88 were estimated to have caused the mortality of between 10 and 50 percent of the Atlantic bottlenose dolphin, *Tursiops truncatus,* population along the Atlantic coast of the United States. Prior to the stranding aerial sightings were recorded seasonally from April 1982 to August 1984 along the continental shelf from Cape Hatteras, NC to Key West, FL. These data were collected in conjunction with the Southeast Turtle Surveys (SETS) conducted by the National Marine Fisheries Service along random aerial line transects. These datasets were analyzed using the computer program Distance v5.0 to determine population density and abundance across locations, seasons, and years. Numbers were pooled to determine population abundance prior to the 1987 mass stranding event to determine density change, if any. To visually demonstrate density the sightings and tracklines were mapped using the computer program Global Mapper v7.0. Results demonstrate the dolphins follow similar migratory patterns as currently observed including a shift of animals north in the summer and south in the winter. The total abundance of dolphins in this area in the 1980's was significantly less than that found in the 1995 ($p = 0.0456$) SECAS and 2002 ($p = 0.0014$) dolphin surveys. These abundance estimates indicate that the mortality caused by the morbillivirus in 1987/88 did not significantly decrease the overall population of bottlenose dolphins in United States' waters south of Cape Hatteras, NC.

An analysis of *Kogia* stranding data from the southeastern United States

Nicole M. Knauer O'Brien[1], Edward O. Keith[1], and Daniel K. Odell[2]

[1] Nova Southeastern University Oceanographic Center
[2] Hubbs-SeaWorld Research Institute

Pygmy (*Kogia breviceps*) and dwarf (*Kogia sima*) sperm whales strand frequently in the southeastern United States (SEUS). *Kogia* strandings from 1977-2005 were segregated by month and similar coastline orientation. Most regions display a peak in strandings in summer and a smaller peak in winter. The correlation (R^2) between Multivariate ENSO Index (MEI) and *Kogia* strandings in Georgia and eastern Florida was 0.1794 during 1977-2005 and 0.4125 during 1985 to 2005, suggesting that approximately 18% and 41%, respectively, of the variance of the *Kogia* strandings is due to the influence of MEI. Analysis of the frequency of *Kogia* strandings during the lunar cycle revealed no significant correlation between strandings and lunar day. Along Florida's Atlantic coast, distances to isobaths from stranding sites were not significantly different from distances from randomly selected sites to the same isobaths, however, there was a trend towards shorter distances to isobaths and smaller seafloor angles. In Georgia, South Carolina and North Carolina, distances to isobaths from stranding sites were significantly different from distances from randomly selected sites to the same isobaths, and there was a tendency towards both shorter and longer distances to isobaths and smaller angles of the seafloor. Distinctive bathymetry may contribute to *Kogia* strandings throughout the SEUS Atlantic coast. The influence of wind direction and velocity and water movement on *Kogia* strandings was examined, revealing six general patterns. Strandings occurred more often when winds shifted from downwelling favorable to upwelling favorable in the week before the stranding. Water movements paralleled the wind changes.

Social structure of bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida leads to habitat partitioning and fine-scale spatial variation in dolphin organochlorine concentrations

Jenny A. Litz[1,2], Joseph P. Contillo[1], Lynne A. Fieber[2], and Lance P. Garrison[1]

[1] NOAA Fisheries Service, Southeast Fisheries Science Center
[2] University of Miami, Rosenstiel School

The social structure of a population influences many aspects of life history including gene flow, habitat use, spatial patterning, and competition. The ongoing NOAA Fisheries Biscayne Bay Photo-identification (Photo-ID) study has identified individual dolphins that inhabit Biscayne Bay, FL year round and appear to be long-term residents. Certain dolphins within the Biscayne Bay community are sighted primarily in the northern, metropolitan half of the Bay, while others are sighted primarily in the southern, more rural half. We evaluated the social structure underlying these apparent spatial patterns using photo-ID data from 1995 – 2003. Association Indices (AI) were calculated using the Half Weight Index method. The AI's for this community were significantly higher than those expected by chance, indicating that dolphins had preferred associates. Multiple statistical techniques confirmed that Biscayne Bay dolphins form at least 2 separate social units with overlapping home ranges. These 2 social units correspond to groups that have significantly different organic pollutant concentrations, with animals in the north having higher concentrations than those in the south. This study demonstrates that fine-scale variation of organochlorine concentrations within a dolphin population is likely influenced by habitat partitioning due to social structure. The social structure in the Biscayne Bay bottlenose dolphin population leads to differing degrees of exposure to anthropogenic impacts over relatively small spatial scales.

Location, location, location …… or what can the transcriptome tell us about populations of free-ranging bottlenose dolphins, *Tursiops truncatus*?

Annalaura Mancia[1], Gregory W. Warr[1], Jonas Almeida[2], Randall Wells[3], Artur Veloso[4], Robert W. Chapman[5]

[1] Department of Biochemistry and MBES Center, MUSC, Charleston SC
[2] Department of Bioinformatics and Computational Biology, MD Anderson Cancer Center, Houston TX
[3] Chicago Zoological Society & Mote Marine Laboratory, Sarasota, FL
[4] Marine Biology Program, College of Charleston, SC
[5] South Carolina Department of Natural Resources

Peripheral blood leukocyte (PBL) samples were collected from 151 bottlenose dolphins (*Tursiops truncatus*) in the course of capture/release health evaluation studies at 4 different sites: Charleston Harbor SC, Indian River Lagoon FL, Sarasota Bay, FL and St Joseph bay FL. RNA was extracted and hybridized to a first-generation dolphin microarray. We tested the hypothesis that individual dolphins could be assigned (by machine-learning approaches including artificial neural networks, ANNs) to their home regions using only their transcriptomic signatures as classifiers. ANNs could correctly classify dolphins according to sex, with an accuracy depending on the number of genes used and the geographical location. Thus, male and female populations at each location were considered separately. Both ANNs and Support Vector Machines were able to correctly classify dolphins according to their site of sampling with a high degree of confidence. The basis for this result may lie in genetic differences between populations, or in environmental factors (such as diet, infection, exposure to toxins or contaminants etc) or in combinations of these factors. These results suggest that a combination of microarrays and machine-learning analytical approaches will be a powerful approach to understanding the interaction of marine environment/organism interactions.

Distribution of organohalogen contaminants between blubber and blood in wild bottlenose dolphins: Implications for biomonitoring and health

Jennifer Yordy[1, 2, 3], Randall Wells[4], Brian Balmer[4], Lori Schwacke[3, 5], Teri Rowles[6] and John Kucklick[2, 3]

[1] Medical University of South Carolina, Charleston, SC
[2] National Institute of Standards and Technology, Charleston, SC
[3] Hollings Marine Laboratory, Charleston, SC
[4] Chicago Zoological Society, c/o Mote Marine Laboratory, Sarasota, FL
[5] Cooperative Center for Marine Animal Health, NOS, Charleston, SC
[6] Marine Mammal Health and Stranding Response Program, NMFS, Silver Spring, MD

Contaminant biomonitoring of wild cetaceans requires the collection of non-lethal tissue samples that are indicative of whole body burdens. Lipid-rich blubber can store >90% of an individual's burden of organic contaminants (OCs), and therefore is frequently used to assess contaminant levels in free-ranging populations. However, when lipid is mobilized from blubber to blood in response to various environmental and physiological factors, the distribution and bioavailability of OCs within an individual may also change. Therefore, in order to use contaminant biomonitoring data to predict potential health effects from OC exposure, an understanding of the dynamic relationship between blubber, blood and lipid mobilization is needed. To establish the association between blubber and blood OC levels, 58 matched blubber and plasma samples were collected from a wild bottlenose dolphin population in Sarasota Bay, FL and analyzed for polychlorinated biphenyls, brominated flame retardants and organochlorine pesticides using gas chromatography-mass spectrometry. These analyses indicate that although blood concentrations are approximately 1% of blubber concentrations (wet weight), the lipid normalized tissue concentrations are significantly and strongly positively correlated ($r^2 \geq 0.96$, $p<.0001$) indicating that a predictive relationship exists between blubber and blood OC concentrations, regardless of age and sex. A significant negative relationship was also observed between blubber lipid content and the proportion of OCs within the blood of matched tissue samples, suggesting that depleted lipid stores are associated with increased bioavailability of OCs within an individual and that animals which have exhausted lipid stores during periods of nutritional stress, disease, and from seasonal temperature changes may be at a higher risk for OC-related health effects.

Depredation and Fishing Interactions involving Bottlenose Dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida

Jessica R. Powell[1,2], Randall S. Wells[2,3], David Mann[1,2]

[1] University of South Florida, College of Marine Science, St. Petersburg, Florida 33701
[2] Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236
[3] Chicago Zoological Society, c/o Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236

Interactions between bottlenose dolphins (*Tursiops truncatus*) and recreational fishing gear have increased dramatically in recent years in Florida. In Sarasota Bay alone during 2006, 2% of the long-term resident dolphin community died from ingestion of recreational fishing gear and numerous non-fatal interactions were also observed or reported. During summer 2007, in an effort to understand the behavior of dolphins around recreational anglers, we evaluated conditions when dolphins were most likely to approach piers as a function of fishing effort. We found no significant relationship between dolphin presence and the number of fishing lines at piers. We also utilized boat-based focal animal behavioral follows to observe the activity, habitat selection, dolphin associates, and proximity to fishing lines or boats of previously identified fishing interaction animals against an equal set of control dolphins. We found that fishing interaction and control animals were significantly different in the percentages of time spent in specified habitats and engaging in defined activities (e.g. mill, travel, feed). Furthermore, fishing interaction animals were seen within 50 m of fishing lines on 51 instances compared to only 9 instances involving control animals. Of the 42 depredation acts we witnessed from piers and by boat, 60% were the result of direct feeding of a dolphin by a boater or angler. The results suggest that certain animals may be more likely to engage in depredation and highlight the need for angler and boater education in Sarasota Bay and the surrounding area.

Boat-based Anthropogenic Impacts on Dolphins in the Indian River Lagoon, Florida

Sarah E. Bechdel[1], John S. Reif[2], Marilyn Mazzoil[1], M. Elizabeth Murdoch[1], Elisabeth Howells[1], David S. Kilpatrick[1,4], Stephen D. McCulloch[1], and Gregory D. Bossart[1]

[1] Marine Mammal Research and Conservation, Harbor Branch Oceanographic Institute at Florida Atlantic University, Ft. Pierce, FL
[2] Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO
[3] Southside Veterinary Hospital, Vero Beach, FL

Anthropogenic impacts continue to increase in U.S. coastal environments. In 2004, Florida, having been in the top five boating states for over a decade, soared to the nations' leader in the number of registered boats. The increased number of boaters has impacted man and the resources of the Indian River Lagoon (IRL), FL, regarding threats to human safety, property, habitats and wildlife. As an Estuary of National Significance, a Comprehensive Conservation and Management Plan identified key living resources for implementation of management and protection actions. Currently, no data exist to examine boating impacts on the resident population of dolphins inhabiting this shallow water estuary.

Vessel-based impacts were investigated by quantifying visible physical injuries to dolphin dorsal fins from photo-identification data collected from 1996-2006. Forty-three dolphins were identified with dorsal fin damage from propeller or blunt impact trauma, and 33 with $\geq$6 sightings were used for home range analyses. The IRL was divided into 6 segments based on hydrodynamics and geographic features and dolphins were assigned to a segment(s) and corresponding surrounding county according to ranging patterns. The highest rate 5.3% of boat strikes, including two fatalities, was found on dolphins in segment 4 South IRL, within St. Lucie and Martin counties. These counties also had the highest number of registered boaters per km^2 of habitat. Our data suggest that vessel impacts on dolphins occur disproportionally in the IRL and should be considered a high priority management issue for local governments. Implementing slow zones are recommended in these high-strike rate counties.

Understanding the landscape and informing conservation: A case study of Florida manatees and Florida boaters

Janet G. Gannon, Jay Gorzelany, Kerri Scolardi, and John Reynolds.

Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, FL 34236.

Distribution of and habitat selection by the Florida manatee, *Trichechus manatus latirostris*, vary markedly with season, but range-wide and year-round, one of the most serious threats to the manatee is interactions with boats, which cause roughly one fourth of mortalities and an undocumented number of injuries annually. Management of the species focuses on reducing negative interactions with boats by regulating boat speeds and access in areas of high use by manatees, creating refuges in which no boating is allowed, and educating boaters. We applied landscape ecology techniques to characterize the waters of Sarasota, Florida, and to investigate the influence of landscape on the behavior of both boaters and manatees. Our assessments used data from summer aerial surveys for manatees (2003-2007) and boats (2005). A hierarchical clustering algorithm and multiresponse permutation procedure identified 5 habitat types within the coastal waters of the study area. Classification and regression trees (CARTs) and mantel tests were conducted to link boats and manatees to habitat attributes. Both approaches identified seagrass cover as the most important factor affecting distribution of manatees; other factors important to manatee distribution included (a) abundance of boats, and (b) distance to marine facilities, the Intracoastal Waterway, and boat speed regulatory zones. Distribution of boats was linked to distance to several features: channels, canals, marine facilities, deep areas besides channels, and seagrasses. Our results geographically represent areas of critical importance to inform and focus efforts of managers interested in the balancing and ensuring conservation of manatees and human use of coastal waterways.

Evidence of a low reporting rate of entangled whales

Scott Landry[1], Robert Bowman[2], David Mattila[3] and Jooke Robbins[1]

[1] Provincetown Center for Coastal Studies, 5 Holway Ave., Provincetown, Massachusetts, 02657
[2] Marine Wildlife Associates, P.O. Box 398, Mount Desert, ME 04660
[3] Hawaiian Islands Humpback Whale National Marine Sanctuary, 726 S. Kihei Rd, Kihei, Hawaii, 96753

Large whale entanglement is a serious and chronic conservation issue, and mitigation measures are hampered by limited information. Scar-based studies of North Atlantic humpback and right whales indicate that many whales become entangled annually but only a small proportion of cases are reported. Although some whales may shed entanglements quickly, we investigated the hypothesis that many entangled whales are simply not seen and/or reported, even when carrying entanglements over extended periods and distances. We examined 15 entanglement cases on the East Coast, including five animals in the Southeast and Mid-Atlantic, for which a telemetry buoy was attached to the entangling gear by the Atlantic Large Whale Disentanglement Network. Four humpback and 11 right whales were outfitted with a brightly painted buoy marked with a toll free number, trailing 12-23m behind the flukes. The number of days the whales carried a buoy was compared to a database of entanglement reports within the same region and time span. The average elapsed time and minimum distance traveled per case was 13.5-days and 1,404km. During the 203 cumulative elapsed days of carrying buoys, only one of these whales was reported as entangled. Based on these results, the average reporting rate per known entangled whale was 0.0077 reports per day per case (sd 0.02979). One tagged whale traveled over 8,900km without being reported. Furthermore, even when an entangled whale is seen, it is not necessarily reported. This low rate of entanglement reporting reaffirms the urgent need for significant entanglement reduction and continued outreach efforts.

POSTER PRESENTATIONS

Multiple Cardiac Abnormalities in an Atlantic Bottlenose Dolphin (*Tursiops truncatus*) Neonate

Ryan Archibald[1,2], Cheryl Cross[1,2], Wayne Mcfee[3], James Powell[3], Valerie Soop[4], D. S. Rotstein[2,5,6]

[1] University Corporation for Atmospheric Research, Department of Pathology, University of Tennessee, College of Veterinary Medicine, Knoxville TN
[2] Center for Wildlife Health
[3] USDOC, NOAA, NOS
[4] College of Charleston, South Carolina
[5] NOAA Cooperative Center for Marine Animal Health
[6] Department of Pathobiology, University of Tennessee College of Veterinary Medicine, Knoxville, TN

On 17 November 2007, a male neonate, 105cm, 16.8kg, Atlantic bottlenose dolphin (*Tursiops truncatus*) stranded on Folly Beach, Charleston Co., SC (32.6509N, -79.9475W). The necropsy was conducted at the Center for Coastal Environmental Health & Biomolecular Research (CCEHBR). Gross observations for this Code 3 neonate included fair body condition, two large, concave areas covered in pox-like lesions mid-laterally, caudal to left and right pectoral fin, hemorrhagic and moderately congested lungs, hepatic lobular atrophy, hydropericardium, and a malformed heart. Gross changes to the heart included a common atrium, hypoplastic pulmonary artery, atrioventricular septal and ventricular septal defects, hypoplastic mitral valve, patent foramen ovale, closed ductus arteriosus, and right ventricular hypertrophy. The heart weighed 144.5g and was 0.86% BW which was greater than the average of comparison *Tursiops truncatus* neonates (n = 4) with an average heart weight of 113.8g ± 32.17g and 0.80% BW. Few reports of cardiac malformations are reported in marine mammals and those observed in this case has no terrestrial animal or human correlate.

A plan to monitor abundance, site-fidelity, and habitat utilization patterns of bottlenose dolphins *(Tursiops truncatus)* near a National Priority List (NPL) polluted site and an adjacent pristine reference site in Georgia

Brian C. Balmer[1,2,3], Randall S. Wells[2], Suzanne M. Lane[3], Lori H. Schwacke[3], Todd R. Speakman[3], Eric S. Zolman[3], William A. McLellan[1], R. Clay George[4] and D. Ann Pabst[1]

[1] University of North Carolina Wilmington
[2] Chicago Zoological Society
[3] National Ocean Service, NOAA
[4] Georgia Department of Natural Resources

NOAA is currently taking the lead on a multiagency research project to assess and compare the health and contaminant exposure in bottlenose dolphins, an apex predator and sentinel species for ecosystem health, in two spatially complex salt marsh estuaries; a National Priority List polluted site in Brunswick, Georgia [Turtle/Brunswick River estuary (TBRE)] and a nearby, pristine, reference site [Sapelo Island National Estuarine Research Reserve (SINERR)]. An understanding of dolphin abundance, site-fidelity, habitat utilization within each area, and movement patterns of dolphins between the two areas, is critical for both accurate interpretation of health data and making informed management decisions. The plan is to perform quarterly mark-recapture surveys utilizing photo-identification to determine bottlenose dolphin abundance at both sites. Photo-identification data will also be used to identify bottlenose dolphin site-fidelity in each area and quantify movements between locales. The ability to quantitatively link cetacean habitat utilization to abiotic and biotic factors has proved difficult, especially in complex estuaries receiving inputs from numerous tributaries. Strahler Stream Order is a quantitative technique used to classify stream habitat based on the number of upstream tributaries. This technique has not been used previously to quantify habitat selection of any marine mammal species. This project will evaluate the efficacy of Strahler Stream Order as a technique to characterize habitat utilization of bottlenose dolphins within a complex salt marsh estuary.

The Phenology of Strandings: Twenty Years of *Tursiops truncatus* Strandings in Virginia, US

Susan G. Barco[1], Ari S. Friedlaender[2], William A. McLellan[3], W. Mark Swingle[1], D. Ann Pabst[3]

[1] Virginia Aquarium Stranding Response, 717 General Booth Blvd, Virginia Beach, VA ,USA 23451
[2] Duke University Marine Lab, 135 Duke Marine Lab Rd, Beaufort, NC, USA 28516
[3] Department of Biology and Marine Biology, University of North Carolina Wilmington, 601 S. College Rd., Wilmington, NC, USA 28403
S. Barco 757.437.7765 email sgbarco@virginiaaquarium.com

On the US Atlantic coast, cetacean strandings from southeastern Virginia have been consistently reported since the late 1980s, resulting in a 20 year historic database. In Virginia, *Tursiops truncatus* strandings occur seasonally and are correlated with latitudinal movements of coastal dolphins, building each spring and tapering off in fall. Although the stock structure of bottlenose dolphins in the mid-Atlantic region is complex, one proposed stock, the northern migratory coastal stock, most likely represents the majority of the *Tursiops* in Virginia waters. We investigated the timing of the first and last appearance of stranded *Tursiops* over the past 20 years. There was a significant linear relationship between Julian day of stranding events and year. The day of first spring *Tursiops* strandings has decreased (R^2=0.443; P=0.001) from 28 May to 12 May and the date of last *T. truncatus* strandings increased (R^2=0.565; P<0.001) from 10 Oct to 28 Nov. Stranding data must be viewed with caution concerning population parameters. If we assume, however, that strandings are correlated with arrival and departure of animals, these data suggest that the occurrence of *Tursiops* in southeastern Virginia has expanded, with animals appearing more than two weeks earlier and leaving over a month later than 20 years ago. The stranding day was not significantly correlated with local sea surface temperature, however, regional temperatures have risen over the past 20 years. Alternatively, *Tursiops* population in the mid-Atlantic has been recovering from a 1987 epizootic, and this seasonal expansion may be related to population number.

Identification, Coordination, and Training of Marine Mammal Stranding Response Network

Denise M. Boyd, Deirdre J. Grant, Michele E. Good, Carissa S. Carpenter

Florida Fish and Wildlife Conservation Commission (FWCC)

The Florida Marine Mammal Stranding Network (FMMSN) is a group of biologists and volunteers dedicated and trained to respond to marine mammal stranding events in the state of Florida. The FMMSN has maintained a long-standing presence in Southwest Florida, but due to changes in staff and funding, has had varying levels of coordination and membership. Recently, the Florida Fish and Wildlife Conservation Commission's Charlotte Harbor Field Lab (FWCC-CHFL) was awarded a Prescott Grant to edify the existing marine mammal response network of Southwest Florida (SWFL) thereby improving response to live/dead stranding events. Increasing the geographic coverage area, and the number of trained stranding responders within Lee and Collier counties will enhance the care the animals receive and improve the quality and quantity of data collected. To achieve this goal, biologists at FWCC-CHFL are 1) identifying and obtaining current contact information for all local law enforcement (LE), Florida Fish and Wildlife Conservation Commission Law Enforcement (FWCC-LE), FMMSN volunteers, national and state park employees, city and county employees, and local rehabilitation facilities in Collier and Lee counties; 2) polling these organizations/individuals to identify those willing to assist with cetacean carcass salvage, data collection, and rescue; 3) identifying the geographic coverage area for each cooperating agency/individual and collecting information such as availability, level of support, and equipment needs; and (4) providing all cooperating organizations/individuals with training, supplies, and outreach material. This work is currently underway and is expected to enhance the management of live, dead, and mass-stranded cetaceans in SWFL.

A Visual Assessment Tool to Evaluate Skin Diseases in Wild Bottlenose Dolphin (*Tursiops truncatus*) Populations: A Proposed Methodology

Leslie G. Burdett[1], David S. Rotstein[2], Teri K. Rowles[3], Lori H. Schwacke[1,2,4], Forrest I. Townsend[5], Randall S. Wells[6], and David G. Hoel[1]

[1] Department of Biostatistics, Bioinformatics, and Epidemiology, The Medical University of South Carolina
[2] NOAA/NMFS Cooperative Center for Marine Animal Health
[3] NOAA/NMFS Marine Mammal Health and Stranding Response Program
[4] NOAA/NOS Hollings Marine Laboratory
[5] Bayside Animal Hospital
[6] Chicago Zoological Society

Recent efforts to assess the health of wild populations of small cetaceans have used capture and release methods; however such methods require substantial effort, risk and cost, and are not appropriate across a broad geographic or temporal scale. We are developing a visual assessment approach for evaluating small cetacean health based on the prevalence, extent, and etiology of observed skin lesions. Epidermal lesions can result from anthropogenic causes such as boat strikes and fishery entanglements, as well as biological factors such as bacteria, viruses and fungi. The distinction between anthropogenic and biologic etiologies of various skin abnormalities will be determined by histological analyses of lesions obtained from stranded carcasses and ongoing capture-release programs. Etiologies will be matched with visual characteristics of the lesions to develop a field guide that can be used to assess stranding cases and monitor live populations. We will then classify lesion images from multiple bottlenose dolphin (*Tursiops truncatus*) photo-identification projects across the southeast United States, and epidemiological methods will be used to examine the prevalence, persistence, and resolution of skin diseases of varying etiologies. Dolphins included in the analyses will belong to populations with varying degrees of exposure to contaminants and harmful algal bloom events. By comparing skin disease among populations, associations between disease and environmental risk factors will be developed. Examining skin disease in wild dolphin populations utilizing this visual assessment tool will provide us with a non-invasive, "early-warning" approach for examining health indicators of both the dolphins and their marine environment.

Bottlenose Dolphins, *Tursiops truncatus*, in Boca Ciega Bay: No evidence for a separate winter population

Max D. Carnes-Mason, Ashley L. Hibbard, Kimberly A. McCallister, and Shannon Gowans

Eckerd College

Bottlenose dolphins (*Tursiops truncatus*) in Boca Ciega Bay, Florida, were photo-identified from 1993-2006. Seven hundred and twenty seven distinctively marked animals exist in the resulting catalog; however sighting rates vary greatly (43% were observed in only 1 year, 20% in 5+ years). Previous mark-recapture estimates indicate approximately 85 dolphins are resident dolphins. The majority of the field surveys were conducted in June, July and August (436 survey days), although there was limited effort during the rest of the year (68 survey days). This study investigates if there is a separate group of dolphins that is present in Boca Ciega Bay only during the non-summer months (Sept-May). During Sept-May 174 four dolphins were identified and for 18 (10.3%) of these dolphins this represents their only sighting. The remaining 156 dolphins were photographed again during the study. Out of the 156 dolphins photographed on at least two occasions including on the non-summer months, only 3 (1.9%) were not photographed during the summer. All dolphins photographed more than three times had at least one sighting during the summer months. Therefore there is no evidence suggesting movement of a separate group of dolphins into Boca Ciega Bay during the non-summer months.

Hydrocephalus in a Pygmy Sperm Whale (*Kogia breviceps*)

Cheryl A. Cross[1,2], David Rotstein[2,3], William McLellan[4], and D. Ann Pabst[4].

[1] University Corporation for Atmospheric Research
[2] Center for Wildlife Health, University of Tennessee, Knoxville
[3] NOAA Center for Marine Animal Health, University of Tennessee College of Veterinary Medicine, Knoxville
[4] University of North Carolina, Wilmington

Hydrocephalus is an accumulation of excess cerebrospinal fluid in the brain that can result from obstruction within the ventricular system (noncommunicating hydrocephalus) or from communication between the ventricles and the subarachnoid space (communicating hydrocephalus). There are few reports in the literature of hydrocephalus in aquatic mammals, with most cases describing the lesion in pinnipeds and one case report in a newborn bottlenosed dolphin (*Tursiops truncatus*). Reports in mysticetes or large odontocetes are lacking. We present a case of noncommunicating hydrocephalus in an adult male pygmy sperm whale (*Kogia breviceps*) that live stranded in Holden Beach, North Carolina in August 2005. Gross findings included marked dilation of the lateral and third ventricles. Microscopically there was a lack of inflammation or neoplasia in the brain. Differentials for the hydrocephalus in this case, the speculative role of hydrocephalus in the stranding and death of this animal, and a review of the literature describing hydrocephalus in cetaceans and pinnipeds will be discussed.

Composting as an Option for Marine Mammal Carcass Disposal

Greg Early[1], Keith Matassa[2], Mark King[3,6], Bill Seekins[4,6], Mark Hutchinson[5,6], Janet Whaley[5], Kerra Gearringer[2]

[1] Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236
[2] University of New England's Marine Animal Rehabilitation Center (MARC) 11 Hills Beach Road, Biddeford, Maine 04005
[3] Residuals Utilization Unit, Maine DEP, 17 Statehouse Station, Augusta, Maine 04333
[4] Maine Department of Agriculture, Food and Rural Resources, 28 Statehouse Station, Augusta, Maine 04333
[5] Associate Extension Professor, University of Maine Cooperative Extension, 377 Manktown Road, Waldoboro, Maine 04572
[6] Maine Compost School, Highmoor Farm, Route 202, Monmouth, Maine
[7] NOAA Fisheries Service, 1315 East-West Highway, Silver Spring, Maryland 20910

Disposal of marine mammal carcasses can prove challenging particularly for large whales, mass whale and dolphin strandings or during mass mortalities. In the past, options for disposal have included leaving at the site, burial on site or removal and translocation for incineration, rendering or sinking at sea. All disposal options have drawbacks and advantages and no single solution has emerged as ideal.

Composting is a process of controlled aerobic decomposition. Successful composting involves promoting the growth of a variety of organisms – including aerobic bacteria, fungi yeasts and, in later stages, invertebrates. It has been successfully used both as a method for disposal of large and small-scale farm animal mortalities and for cleaning and preparing whale and other marine mammal skeletons for museum collections. It has not, however, been widely used as a general disposal method for marine mammal carcasses.

The University of New England has constructed a test facility to compost marine mammal carcasses brought to the campus for examination. Facility and field trials are underway to test composting as a disposal option and to determine the fate of contaminating compounds including euthanasia solution (sodium pentobarbital). Results show that properly constructed compost piles can produce bacterialcidal temperatures and produce a safe and stable end product with a composition similar to conventional compost.

A better understanding of disposal options is an important part of routine and emergency planning. Composting offers one potential solution to both in-house and field carcass disposal problems.

The impact of environmental stressors on the vitamin D3 pathway in the skin of the Atlantic bottlenose dolphin (*Tursiops truncatus*)

Blake C. Ellis[1,2], Mark S. Kindy[1,2,3], Annalaura Mancia[1], Gregory W. Warr[1,4], and Sebastiano Gattoni-Celli[1,3,5]

[1] Marine Biomedicine and Environmental Sciences Center, 331 Fort Johnson Rd, Charleston, SC 29412, USA
[2] Department of Neurosciences and Neuroscience Institute, Medical University of South Carolina, 171 Ashley Ave, Charleston, SC 29425, USA
[3] Ralph H. Johnson VA Medical Center, 109 Bee St, Charleston, SC 29401, USA
[4] Department of Biochemistry and Molecular Biology, Medical University of South Carolina, 171 Ashley Ave, Charleston, SC 29425, USA
[5] Department of Radiation Oncology, Medical University of South Carolina, 171 Ashley Ave, Charleston, SC 29425, USA

The Atlantic bottlenose dolphin has attracted attention as a potential sentinel for human health. Greater knowledge of how the dolphin responds to environmental stress is needed, but such studies are limited by its protected species status. We previously established cell strains and lines from dolphin skin as an *in vitro* tool for measuring the molecular-level impact of the environment on this marine mammal. These cell models are being used to investigate the role of the vitamin D3 pathway within dolphin skin. Vitamin D is of interest because of its acknowledged chemopreventative and immunomodulatory properties within terrestrial animals. Whether aquatic mammals also possess this pathway and gain the same immune benefits from vitamin D3 as terrestrial mammals is unknown. The bioactive, hormonal form of vitamin D, 1,25-dihydroxyvitamin D3 (1,25D3), interacts with the vitamin D receptor (VDR), a potent ligand-activated regulator of gene transcription. We have detected expression of VDR in dolphin skin cells and found the cells to be sensitive to exogenous 1,25D3 administration. The interest is whether environmental stressors interfere with the vitamin D3 pathway in dolphin skin, proposing a possible mechanism for the detrimental impact of environmental fluctuations on marine mammal health. Very few studies have investigated the impacts of environmental factors on the vitamin D3 pathway within any animal model. We show that the stress of ambient temperature increases altered levels of VDR and expression of various VDR gene targets within dolphin skin cells. Such findings may help elucidate the role of vitamin D on innate immunity in dolphin skin.

Organohalogen contaminant concentrations in bottlenose dolphins from Mississippi Sound

A. Guichard[1, 2], L. Schwacke[3], T. Rowles[4], C.S. Barry[5], P.E. Rosel[6], O.F.X. Donard[2], J. Kucklick[1]

[1] National Institute of Standards and Technology, Hollings Marine Laboratory, Charleston, SC
[2] Laboratoire de Chimie Analytique BioInorganique et Environnement-UMR 5034, Pau, France
[3] National Oceanic and Atmospheric Administration (NOAA), Cooperative Center for Marine Animal Health, Hollings Marine Laboratory, Charleston, SC
[4] NOAA, National Marine Fisheries Service (NMFS), Marine Mammal Health and Stranding Response Program, Silver Spring, MD
[5] NOAA, NMFS Southeast Fisheries Science Center, Pascagoula MS
[6] NOAA, NMFS Southeast Fisheries Science Center, Lafayette, LA

Bottlenose dolphins are common coastal dolphins that have been shown to reflect local or regional trends in environmental conditions. The National Institute of Standards and Technology (NIST) has been collaborating with the National Oceanic and Atmospheric Administration (NOAA) to provide data on persistent organohalogen pollutants (POPs) in many different bottlenose dolphin groups inhabiting in shore or near shore areas of the U.S. East Coast and Gulf of Mexico. The present study provides new information on POPs in dolphins sampled by remote dart biopsy from the Mississippi Sound (MS) area. Samples (n = 53 and n = 27, males and females, respectively) were collected between July 2005 and October 2005. Blubber biopsy samples were analyzed for polychlorinated biphenyls, organochlorine pesticides and brominated flame retardants by gas chromatography-mass spectrometry. PCB, organochloride, pesticide and PBDE concentrations for males were (geometric mean 217.0 ug/g wwt sterror: 4.7 ug/g wwt, 12.4 ug/g wwt stdev: 1.0 ug/g wwt, 117.6 ug/g wwt stdev: 22.4 ug/g wwt, 12.4 ug/g wwt stdev: 9.7 ug/g wwt). Most POP concentrations varied significantly with location, with dolphins sampled near Biloxi, MS, having generally higher concentrations. This study confirms previous work showing that POP concentrations in bottlenose dolphin groups in close proximity (tens of km) to each other can vary significantly probably reflecting local habitat contamination.

OBIS-SEAMAP Version 2.0: Improvements in Mapping Marine Megavertebrates

Patrick N. Halpin[1], Andrew J. Read[2], Benjamin D. Best [1], Ei Fujioka[1], Lucie J. Hazen[2], Benjamin Donnelly[1], Erin LaBrecque[1], Connie Kot[2], Kim Urian[2]

[1] Marine Geospatial Ecology Lab, Nicholas School of the Environment & Earth Sciences, Duke University, Durham, NC, USA
[2] Center for Marine Conservation, Duke University Marine Laboratory, 135 Duke Marine Lab. Road, Beaufort, NC, USA

We report on the ongoing development and improvement of a digital information system which provides critical data on the distribution of marine megavertebrates to scientists, managers and educators. The OBIS-SEAMAP (Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Populations) program (http://seamap.env.duke.edu) is designed to make high-quality data sets, ecological models and expert knowledge available to these communities. The archive currently hosts 212 datasets including over 1.15 million observations. We are in the midst of a comprehensive inventory and data exploration, so these numbers will markedly increase in the near future. Now in its fifth year, the project provides a suite of advanced web services for the storage, analysis and visualization of geospatial datasets related to the biogeography of marine mammals, seabirds and sea turtles. Boat, shore and aerial surveys and telemetry data are submitted by government, academic, industry and non-profit providers through an automated data content management system. With three additional years of funding secured from the National Oceanographic Partnership Program and the National Science Foundation, we are working to enhance this archive by incorporating new data types (acoustics, photo-id, 3D dive profiles), model outputs, web services, environmental sampling capabilities, and automated population of metadata clearinghouses. We encourage you to contribute your data sets to OBIS-SEAMAP and to contact us with suggestions of how to refine and improve the archive.

Composition and Structure of the Bacterial Community of an Atlantic Bottlenose Dolphin, *Tursiops truncatus*

Wesley Johnson[1,2], Gregory D. Bossart[1,3], Patricia A. Fair[4], and Pamela J. Morris[1,2,4,5]

[1] Marine Biomedicine and Environmental Sciences Center, Medical University of South Carolina, Charleston, SC
[2] Hollings Marine Laboratory, Charleston, SC
[3] Harbor Branch Oceanographic Institute, Ft. Pierce, FL
[4] Center for Coastal Environmental Health and Biomolecular Research, NOAA National Ocean Service, Charleston, SC
[5] Department of Cell Biology and Anatomy, Medical University of South Carolina, Charleston, SC

Microorganisms play vital roles in the health of all mammals, as pathogens and as symbionts, yet the structure and ecology of microbial communities associated with mammalian hosts remain largely unexplored. An understanding of the "normal" flora associated with healthy Atlantic bottlenose dolphins (*Tursiops truncatus*) is an important first step in elucidating the host/microbe interactions and developing models of pathogenesis and disease transmission in dolphins. In this work, we investigated the microbial community associated with the upper respiratory tract of a healthy dolphin to assess its diversity and structure. A bacterial clone library of 16S rDNA genes was generated from upper respiratory tract fluids of a healthy male dolphin that was sampled in 2005 as part of the Health and Risk Assessment (HERA) bottlenose dolphin project. Sequences analysis revealed taxa representing only three of the more than fifty described phyla of bacteria: Firmicutes (3.6%), Bacteroidetes (38.6%), and Proteobacteria (57.8%). While the diversity of bacteria was low at the phylum level, there were numerous, closely-related sequences at the species level that accounted for most of the diversity within the library. Comparisons to 16S databases showed the majority of sequences to be most closely related to the pathogens *Cardiobacterium valvarum* and *Suttonella ornithicola*, yet the homologies are sufficiently low to suggest that these sequences may represent two or more novel genera. Additionally, these sequences showed high intra-specific diversity, suggesting this may be a stable, symbiotic community that has coevolved with its host rather than a collection of opportunists derived from the marine environment.

Using the U.S. National Marine Mammal Tissue Bank to Measure Temporal Trends of Emerging Contaminants

Jennifer M. Keller[1], William K. Reagen[2], Barb Porter[3], Rebecca Pugh[1], Michael Ellisor[1], Amanda Moors[1], Steven O'Connell[1], John R. Kucklick[1], Paul Becker[1]

[1] National Institute of Standards and Technology, Hollings Marine Laboratory, Charleston, SC
[2] 3M Environmental Laboratory, Maplewood, MN
[3] National Institute of Standards and Technology, Gaithersburg, MD

Two classes of halogenated organic contaminants of emerging concern are the perfluorinated compounds (PFCs) and brominated flame retardants (BFRs). Both have been manufactured for more than 50 years and are currently used in many modern materials. PFCs are used in stain-resistant treatments for paper and fabrics, in lubricants, and in foam fire extinguishers. BFRs are used in plastics, foams, and textiles to slow the spread of accidental fires. Both PFCs and BFRs are found in the global environment and some can bioaccumulate into animal tissues. As their production and use changes, it is important to monitor their concentrations in sentinel species, like marine mammals. The U.S. National Marine Mammal Tissue Bank (NMMTB) is an important source of archived samples and is being used to monitor these emerging classes of contaminants. Liver samples from white-sided dolphins (*Lagenorhynchus acutus*) that stranded in Massachusetts from 1993-2005 were analyzed for PFCs. Perfluorooctane sulfonate (PFOS) was found to be the most abundant PFC and its concentrations were stable over the entire time period, but declined from 1999-2005. Another PFC (perfluorononanoic acid) showed an increasing temporal trend with a doubling time of ≈8 y. BFRs were recently measured in blubber from adult male beluga whales (*Delphinapterus leucas*) from two populations in Alaska collected from 1990-2000. BFRs increased in concentration during this decade and a spatial difference was observed for one class of the BFRs. These studies provide additional baseline values for marine mammal exposure to emerging contaminants and assess temporal trends as well as population and sex differences.

Wandering Whale Watches: Their Effectiveness as a Platform of Opportunity for Data Collection

Stacie M. Koslovsky[1,2], Dr. Andrew J. Read[1], Dr. Patrick N. Halpin[1], Mason T. Weinrich[2]

[1] Duke University, Nicholas School of the Environment
[2] Whale Center of New England

Most data used to assess the distribution and abundance of whales are derived from scientific surveys that are designed carefully to minimize sources of variation and reduce the potential for bias. Gathering data in this fashion tends to be both time consuming and costly. However, similar data can also be collected from platforms of opportunity, including commercial vessels, ecotourism operations and whale watch vessels. The goal of the current project was to make recommendations for data collection procedures aboard whale watch vessels so that such observations are as comparable as possible to data collected from scientific surveys. To accomplish this goal, a sightings data set was obtained from three whale watch companies on Stellwagen Bank, Massachusetts during summer 2007. Vessel and sightings data were obtained via GPS for the duration of whale watches out of Gloucester and Boston, Massachusetts. Whale sighting information was combined with vessel trackline data to calculate species-specific sightings-per-unit-effort (SPUE). These SPUE values can then be compared to similar data derived from scientific surveys conducted in the same area. Whale watch vessels offer a large, valuable and largely untapped source of data on the distribution and abundance of whales. Whale watch data collected in a standardized fashion could contribute significantly to scientific and conservation efforts.

Concentrations and Patterns of Lipophilic Pollutants in Bottlenose Dolphins (*Tursiops truncatus*) as a Function of Geographical Scale and Implications to Dolphin Health

John Kucklick[1], Aurore Guichard[2], Jennifer Yordy[1,3], Jenny Litz[4], Randall Wells[5], Brian Balmer[5,6], Aleta Hohn[7], Eric Zolman[8], Lori Schwacke[8], Teri Rowles[9], Larry Hansen[7], Carrie Berry[10], Patricia Rosel[11]

[1] National Institute of Standards and Technology, Charleston, South Carolina 29412, USA
[2] Laboratoire de Chimie Analytique BioInorganique et Environnement-UMR 5034, Pau, France
[3] Medical University of South Carolina, Charleston, South Carolina 29412, USA
[4]National Marine Fisheries Service (NMFS), Miami, Florida 33149, USA
[5]Chicago Zoological Society & Mote Marine Laboratory, Sarasota, Florida 34236, USA
[6]University of North Carolina at Wilmington, Wilmington, North Carolina 28403, USA
[7]NMFS, Beaufort, North Carolina 28516, USA
[8]National Ocean Service, Charleston, South Carolina 29412, USA
[9]NMFS, Silver Spring, Maryland 20910, USA
[10]NMFS, Pascagoula, Misssissippi 39567, USA
[11]Lafayette, Louisiana 70506, USA

The bottlenose dolphin (*Tursiops truncatus*) is one of the most cosmopolitan toothed whales inhabiting temperate and tropical waters around the world. Because of the high degree of site fidelity exhibited by some bottlenose dolphins, this species has been suggested for use as an indicator of local or regional environmental conditions. A large project has been undertaken in the U.S. to non-lethally sample bottlenose dolphins in order to understand how persistent organic pollutant concentrations differ spatially and the implications of these differences to dolphin health. Blubber samples were obtained from bottlenose dolphins inhabiting seven locations on the U.S. East Coast and four locations on the Gulf of Mexico and analyzed for persistent organic pollutants (POPs) including legacy compounds, such as PCBs and DDTs, and currently-use brominated flame retardants, such as PBDEs and HBCDs. Data from males and juveniles were combined for the analyses. There were generally higher concentrations of most POPs in East Coast versus Gulf of Mexico bottlenose dolphins. Within a subpopulation of dolphins inhabiting the same embayment, groups occupying different habitats can have up to five-fold differences in POP concentration. These results indicate that exposure of dolphins to POPs varies spatially and impact of these contaminants on dolphin health also likely varies by location.

Marine Mammal and Sea Turtle Sightings from Aerial Surveys in the Proposed Undersea Warfare Training Range (USWTR) in Onslow Bay, North Carolina for June - December 2007

Peter B. Nilsson, Ryan J. McAlarney, William A. McLellan, D. Ann Pabst

University of North Carolina Wilmington

Onslow Bay, off the coast of North Carolina, is currently the US Navy's preferred site for an undersea warfare training range (USWTR). To determine the abundance and distribution of marine mammals and sea turtles within the USWTR, a monitoring program that includes aerial, vessel and passive acoustic survey techniques is currently being undertaken by Duke University, St. Andrews University and the University of North Carolina Wilmington. We report here the results for the aerial survey component from June through December 2007. Surveys were flown in a Cessna 337, at 305 m altitude and 185 km/hr speed, with a pilot, co-pilot and two observers. The survey, consisting of ten 74 km long track-lines spaced 6.5 km apart, creating a 5 km boundary around the USWTR site, was flown 1 – 2 times a month. Beaufort Sea State (BSS) ranged from 1 to 4, with most surveys flown in a BSS 2 or 3. Fifteen cetacean sightings were made in the survey area: bottlenose dolphins, *Tursiops truncatus* (n=8); unidentified delphinids (n=6); spotted dolphins, *Stenella frontalis* (n=1); and short-finned pilot whales, *Globicephala macrorhynchus* (n=1). Most sightings occurred in November (n=9). Encounter rates were strongly linked to BSS, with 13 sightings made in a BSS 2 (5.24 encounters/1000 km flown), two in a BSS 3 (0.43 encounters/1000 km flown) and zero sightings in a BSS 4. Additionally, 95 sea turtle sightings were made, 75% of which occurred in a BSS 2 or below. Surveys will continue through at least May 2008.

A morphometric analysis of kogiids in the mid-Atlantic

Casey L. Personius[1],William A. McLellan[1], Sentiel A. Rommel[1], Susan G. Barco[2], Gretchen Lovewell[3], Wayne E. McFee[4], D. Ann Pabst[1]

[1] University of North Carolina, Wilmington
[2] Virginia Aquarium Stranding Response Program
[3] NOAA Fisheries Service
[4] National Ocean Service, NOAA

The pygmy and dwarf sperm whales (*Kogia breviceps and K. sima*) are morphologically similar species that have proven to be difficult to differentiate. Barros and Duffield (2003) proposed a dichotomous key to separate these species based on three external measurements (total length, dorsal fin height, and snout to blowhole length). This study utilized 160 *Kogia* stranding records from the mid-Atlantic (Virginia, North Carolina, and South Carolina) to test whether the dichotomous key yielded species identifications that matched their original field identifications. For 126 records (79%) the key species identifications matched those assigned in the field. Twenty two records (14%) could not be determined due to missing morphometric data, and 12 records (8%) did not match. All but two of the mismatches were identified as *K. breviceps* in the field and *K. sima* by the key. These results suggest that either the proposed key is not entirely accurate for mid-Atlantic *Kogia*, that some of the initial field identifications were incorrect, or a combination of both. A review of the morphometric data suggests that some measurements are either not taken or are not directly comparable, both between and within stranding response agencies over time, and that these inconsistencies are localized to the head region. Responders have modified morphometric datasheets designed for cetaceans with pronounced bony rostra for use with kogiids, species with an overhanging snout and an under-slung jaw. Therefore, a *Kogia* specific morphometric datasheet will be presented for review and recommendation for use in measuring these uniquely shaped cetacean species.

A plan to compare thoracic morphology in a shallow (*Tursiops truncatus*) and deep diving (*Kogia breviceps*) cetacean

Marina A. Piscitelli, William A. McLellan, Sentiel A. Rommel, D. Ann Pabst

University of North Carolina Wilmington

It has been hypothesized that deep diving cetaceans possess enhanced thoracic flexibility to accommodate pressure-induced changes in lung volume at depth. To date, though, the limited number of studies on thoracic functional morphology have focused on coastal bottlenose dolphins (*Tursiops truncatus*), relatively shallow divers (1-10 m). The bottlenose dolphin thorax is a flexible unit that includes derived bony sternal ribs, which are connected by mobile synovial joints to both the vertebral ribs and sternum. Our previous mechanical tests have demonstrated that the dolphin thorax can undergo an approximate 50% change in volume. No study has yet measured potential thoracic shape change in any deep diving cetacean. Pygmy sperm whales (*Kogia breviceps*) are relatively deep divers (400-800 m). Based on Boyle's and Pascal's gas laws, they could experience an approximate 97% decrease in lung air volume at depth. Thus, the thorax of the pygmy sperm whale has the potential to undergo large changes in volume. The presence of cartilaginous sternal ribs and likely absence of synovial joints in *K. breviceps*, though, bring into question the hypothesis that the specialized dolphin thoracic morphologies, which enhance flexibility, are adaptations to diving. Instead, deep diving cetaceans may limit thoracic collapse by decreasing lung volume, which would decrease the amount of air volume within the thoracic cavity. Our poster will present Piscitelli's master's research, which will test these alternative hypotheses by comparing thoracic morphologies and mechanics of the shallow diving coastal bottlenose dolphin and deeper diving pygmy sperm whale.

The National Marine Mammal Tissue Bank

Rebecca S. Pugh[1], Amanda J. Moors[1], Barbara J. Porter[2], Paul R. Becker[1], Stephen A. Wise[2], and Teresa K. Rowles[3]

[1] National Institute of Standards and Technology, Analytical Chemistry Division, Hollings Marine Laboratory, 331 Ft Johnson Rd., Charleston, SC 29412 USA
[2] National Institute of Standards and Technology, Analytical Chemistry Division, 100 Bureau Dr.,Gaithersburg, MD 20899 USA
[3] National Oceanic and Atmospheric Administration, National Marine Fisheries Service, PR2, 1315 East-West Highway, Silver Spring, MD 20910 USA

The National Marine Mammal Tissue Bank (NMMTB), developed in 1989 and established by Federal legislation in 1992 (PL 102-587), is maintained by the National Institute of Standards and Technology (NIST). Marine mammal tissue are collected for the NMMTB from animals taken by Alaska Native subsistence hunters (through the Alaska Marine Mammal Tissue Archival Project) and from animals that are taken accidentally in fishing operations and that strand along the coast of the 48 contiguous United States (through the Marine Mammal Health and Stranding Response Program). Principal collaborators and sponsors are the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA/NMFS), the U.S. Geological Survey (USGS), and the Minerals Management Service (MMS). Samples are collected and processed following well-documented and standardized protocols. A portion of each tissue is archived for long-term archival and a portion is processed and aliquoted into sub-samples for eventual analysis. The NMMTB enables researchers to look at environmental trends over long periods of time through retrospective analyses of archived sub-samples and provides valuable baseline data on contaminant levels in marine mammals. In addition, a formal Tissue Access Policy has been developed to allow researchers the ability to request tissues from the NMMTB. Currently there are approximately 3,000 specimens that have been collected from over 1,000 animals representing 43 species of marine mammals. The NMMTB samples are located at the National Biomonitoring Specimen Bank (NBSB), NIST, Gaithersburg, MD, and at the Marine Environmental Specimen Bank (Marine ESB), at the Hollings Marine Laboratory, in Charleston, SC.

High-flyers vs. Low-riders: a performance analysis of radio tag attachments on bottlenose dolphins

Steve Shippee[1], Eric Zolman[2], Forrest Townsend[3], Greg Bossart[4,] and Wendy Noke Durden[5]

[1] Biology Dept., University of Central Florida, Orlando, FL
[2] Center for Coastal Environmental Health, National Ocean Service, Charleston, SC
[3] Trac Pac Inc, Fort Walton Beach, FL
[4] Marine Mammal Research and Conservation Program, Harbor Branch Oceanographic Institute at Florida Atlantic University, Ft. Pierce, FL
[5] Hubbs-Sea World Research Institute, Orlando FL

Studies on dolphin habitat use often depend on tracking a roto-radio VHF transmitter pinned through a piercing in the animal's dorsal fin. We evaluated the performance of attachments used in 2003-07 during radio-tracking studies in Charleston, SC and the Indian River Lagoon, FL. Identical transmitters were used, each housed in a thermoplastic sleeve held in place with a single pin. A total of 26 tags were deployed with three variations: 1) location on the fin (high, middle, low); 2) distance of piercing from the fin edge (between 14-26 mm); and 3) type of pin (Delrin® or VDPF). We used minimum days of attachment based on last tag sighting or radio signal for our comparison. Durations ranged from 2 to 97 days (mean 36.2*d* ±22.43 SD) and were shortest for high placed tags (mean 25.8*d*, n = 8); medium for tags in the center of the fin (mean 31.3*d*, n = 9); and longest for tags placed low on the fin (mean 50.2*d*, n = 9). Single-factor ANOVA shows significance for location ($F = 3.554$, $df = 2, 23$, $p = 0.0452$) but no significance for distance from fin edge ($F = 0.439$, $df = 2, 20$, $p = 0.65$). Strong significance was found for pin type ($p < 0.02$, t-test) with Delrin typically lasting twice as long as VDPF. These findings suggest that radio-tags placed lower on the fin with Delrin pins have enhanced attachment durations, possibly because the forces acting on the sleeve and pin are reduced. We also propose an improved tag design for better performance.

Migration Patterns Of The Inner Coastal Stock Of Atlantic Bottlenose Dolphins (*Tursiops truncatus truncatus*) In The Southern Hampton Roads And Elizabeth River, Virginia

Dana M. Spontak[1], Dr. Clay Green[1], Dr. James R. Reed[2]

[1] Texas State University in San Marcos, TX
[2] Christopher Newport University

Bottlenose dolphin ecology is widely studied, but ultimately unknown. The geographic ranges and migratory trends are among these studied areas. The occurrences of *Tursiops truncatus truncatus* in the waters of Virginia during the summer months have been reported since the late 1990's by the Virginia Aquarium and Marine Science Center and Christopher Newport University. Data were collected by means of boat-based surveys following a four way transect. GPS-based locations, numbers of young of years and adults, and the type of behaviors were among the reported and analyzed data. The majority of the individuals encountered were situated around the Craney Island transect, a hot spot for human activity. The relationship between numbers of individuals and locations may provide some insight into the habits and distribution of these migratory creatures.

Circulating retinol and □-tocopherol levels based on artificial formula consumed in rescued neonatal harbor seals (*Phoca vitulina*)

Noel Y. Takeuchi[1, 2], Kathryn A. Ono[1], and Lisa M. Mazzaro[3]

[1] Marine Science Research and Education Center, University of New England, Biddeford, Maine
[2] University of Florida, College of Veterinary Medicine, Marine Mammal Health Program, Gainesville, Florida
[3] Research and Veterinary Services, Mystic Aquarium and Institute for Exploration, Mystic, Connecticut

Vitamin A is a source for growth, development and maintenance of reproductive, endocrine, and immunological function, while vitamin E maintains cellular integrity and aids in developing the immune system. These vitamins are of great importance when creating artificial formulas for neonatal harbor seals in rehabilitation that may have experienced dietary deficiencies at a critical stage. This study is the first for rehabilitated Western Atlantic harbor seal (*Phoca vitulina concolor*) pups focusing on circulating levels of retinol (vitamin A) and □-tocopherol (vitamin E) via serum analysis admitted to the Marine Animal Rehabilitation Center (MARC) in Biddeford, Maine. Data from five harbor seal neonates was analyzed using reverse-phase high-performance liquid chromatography (HPLC) in 2006. The objectives of this study were to: 1. Determine the circulating levels of retinol and □-tocopherol in harbor seal pups upon admittance, on milk matrix formula, and on fish gruel formula prior to weaning 2. Compare levels of retinol and □-tocopherol in rehabilitated versus wild phocid pups. Retinol levels ranged from 0.16 to 0.20□g/mL, as newborn pups contained 0□g/mL of □-tocopherol on admittance. Retinol and □-tocopherol levels increased from admittance when given milk matrix and fish gruel formulas. Thus, artificial formulas were efficient enough in Vitamin A and E to show an increase in serum levels which reflected similarly to wild phocid pups. Feeding an adequate artificial diet with essential vitamins early in life will maximize proper growth and development in orphaned pups and will increase their chances of survival once released back into the wild.

Vessel-based monitoring of the proposed Undersea Warfare Training Range in Onslow Bay, NC USA

Kim, Urian, Andrew Read, Danielle Waples, Lynne Williams and Lucie Hazen

Duke University Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, NC 28516 USA

The U.S. Navy has proposed constructing an Undersea Warfare Training Range (USWTR) along the Atlantic coast of the United States. Proposed training activities on the range will involve surface vessels, submarines, aircraft and mid-frequency sonar. The preferred site for the range is an area of 1,713-km^2 in Onslow Bay, 87 km from the coast of North Carolina. In collaboration with the University of North Carolina Wilmington and the University of St. Andrews Scotland, we have implemented a monitoring program designed to estimate density and document patterns of distribution and seasonal residency of marine mammals in the proposed USWTR. We employ a traditional single visual line transect survey team on a 16.2m vessel operating at a speed of 10 knots. On 23 survey days from June to November 2007, we surveyed ten 74-km long tracklines on multiple occasions (up to three surveys per transect line). During these surveys we observed bottlenose dolphins, spotted dolphins, pilot whales and loggerhead turtles. We also deployed a towed, four-element hydrophone array to detect vocalizing marine mammals; from our preliminary observations, we appear to detect more groups of dolphins acoustically than visually. We have also collected photo-identification images and biopsy samples from bottlenose and spotted dolphins. In October 2007, we placed a High-frequency Acoustic Recording Package (HARP) in the USWTR to provide detailed information on the seasonal occurrence and relative density of vocalizing marine mammals. By combining multiple methodologies we hope to ensure the most complete and effective monitoring program of the proposed USWTR.

Real-Time Acoustic Monitoring of Bottlenose Dolphins in and around the Brant Island Shoal Bombing Target (BT-9) and the Piney Island Bombing Range (BT-11)

Lynne Williams[1], Andrew Read[1], Douglas Nowacek[2], and Peter Dobbins[3]

[1] Duke University Marine Laboratory, Beaufort, NC
[2] Florida State University, Department of Oceanography, Tallahassee, FL
[3] Systems Engineering & Assessment Ltd, Beckington, Somerset, UK

Traditional marine mammal monitoring techniques, such as visual surveys, are not feasible in periods of poor weather, darkness, and when surveys conflict with other human activities. In such cases, alternative monitoring tools are required. We have used autonomous acoustic recorders to determine patterns of bottlenose dolphin occurrence in two ranges in Pamlico Sound, NC, in which the U.S. Marine Corps conducts military training exercises. Unfortunately, however, the utility of this approach is limited by the need to retrieve and download data from the recorders. To overcome this limitation, we are building a real-time monitoring system for one of the ranges to allow automated detection of bottlenose dolphin whistles. The system will: (1) read in real-time acoustic data from a hydrophone, (2) compute power spectra, (3) subtract long-term averaged background noise levels from the spectra, (4) integrate the resulting spectra over multiple frequency bands in parallel, and (5) determine when the signal-to-noise ratio exceeds a threshold level across a frequency range and over a time period characteristic of bottlenose dolphin whistles. When whistles are detected, a mobile module will send a text message to a cell phone providing the detection date and time. We believe that such real-time acoustic monitoring systems hold great promise for the management and mitigation of potentially adverse human activities on marine mammals.