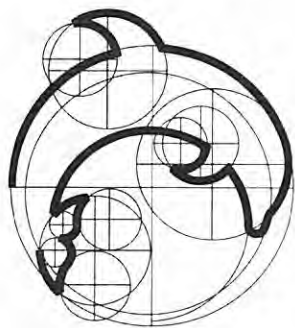


SARASOTA DOLPHIN RESEARCH PROGRAM



NICKS 'N' NOTCHES

**Annual Summary of the Collaborative Dolphin Research and Conservation
Efforts of the Chicago Zoological Society and Mote Marine Laboratory**

January 2006

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**Continuing our commitment to conservation, research, education, and animal care
across the generations and around the world**

By Randall Wells, PhD, Program Manager



*"Emily," an adult female Franciscana dolphin,
during the first radio tagging of this species.*

Among the milestones for 2005 was the birth of a calf defining a span of five generations of resident dolphins living in Sarasota Bay. The "world's longest-running dolphin research program" is now in its 36th year. It continues as a full-time, year-round operation involving 8 full-time staff members, 4 part-time staff, 4 off-site contract staff, 15 graduate students, and 22 volunteers and student interns, joined each month by up to five Earthwatch Institute volunteers. The scientific staff now spans three academic generations of researchers. Some field projects involve more than 100 participants, including visiting scientists, animal care professionals, and trained volunteers. Since its inception in 1970 the program has gained an international reputation for providing high quality information of importance to dolphin conservation.

In recent years, our scope of international work has expanded from simply providing training opportunities for foreign colleagues at our base of operations in Sarasota, Florida, to working with these colleagues in their countries, and providing what assistance we can as they develop their research and conservation programs. During 2005, we responded to requests to provide guidance to Chinese researchers on the conservation

of the baiji, the most endangered cetacean in the world. We participated in a pilot study of the population structure of Franciscana dolphins in Argentina, probably the most endangered cetaceans in South American waters. We worked with Brazilian colleagues on a study of population structure of the marine tucuxi dolphin in southern Brazil, using genetic analyses. Building on a planning workshop in Cuba early in 2005, we received funding through Mote Marine Laboratory to develop a program for training Cuban scientists in marine mammal research techniques during 2006. In July, we were invited to Barbados by UNEP to participate in a regional workshop of experts on the development of the marine mammal action plan for the wider Caribbean region.

Our desire with each research or conservation project in Florida or elsewhere is to contribute to a better understanding of the structure and dynamics of populations of small cetaceans (dolphins, whales, and porpoises), as well as the natural and anthropogenic factors (factors of human origin) that impact them. We use an interdisciplinary and collaborative approach in conducting studies of bottlenose dolphins within a unique long-term natural laboratory. The primary goals of this program include (1) collecting biological, behavioral, ecological, and health data of importance to the conservation of small cetaceans, especially bottlenose dolphins, (2) providing requisite information for bottlenose dolphin conservation to wildlife management agencies, (3) disseminating the information generated by our program to scientific and general audiences in order to aid dolphin conservation efforts, (4) using our model program to develop and refine hypotheses regarding bottlenose dolphins in other parts of the species' range as well as other species of small cetaceans, (5) using the established natural laboratory to develop and test new research tools and methodologies of potential benefit to conservation efforts, (6) training cetacean conservation workers and students from around the world in the use of these techniques, (7) applying our unique program expertise to dolphin rescue operations and post-release follow-up monitoring, and (8) applying the information we gather from free-ranging dolphins to improve the quality of care for dolphins in zoological park settings.

The work toward achieving these goals is conducted under the umbrella of the "Sarasota Dolphin Research Program" (SDRP). This name links the efforts of several organizations that work together to ensure the continuity of the long-term dolphin research in Sarasota. The Conservation Sciences Department of the Chicago Zoological Society (CZS) has provided core staff salaries and administrative and operational support for the program since 1989. Dolphin Biology Research Institute, a Sarasota-based 501(c)(3) non-profit corporation established in 1982, provides logistical support with its fleet of five small research vessels, two towing vehicles, computers, cameras, field equipment, etc. Since 1992, Mote Marine Laboratory has provided a convenient base on City Island in Sarasota Bay, with office, storage and dock space, and easy access to good boat launching ramps. The SDRP maintains academic connections including graduate student sponsorships primarily through the University of California at Santa Cruz, the University of North Carolina at Wilmington, the University of South Florida, Western Illinois University, and the University of Guelph.

Support for our program derives from a variety of sources, including grants and donations. Major funding sources include Earthwatch Institute, Dolphin Quest, Disney Wildlife Conservation Fund, and the Harbor Branch Oceanographic Institution's Protect Wild Dolphins Program. As a result of initial collaborative efforts by Congressmen Henry Hyde (R-IL), William Lipinski (D-IL), and Porter Goss (R-FL) in 2001, and more recently through the assistance of Katherine Harris (R-FL), the Chicago Zoological Society and Mote Marine Laboratory have been the recipients of congressionally-directed funds that have provided crucial sustaining support for dolphin research and conservation activities, through the National Marine Fisheries Service.

In this issue

In the articles that follow, the staff, students, collaborating scientists, and volunteers of the SDRP provide updates on the many activities of our program during 2005. The topic areas include (1) "Human Interactions and Impacts," describing our research on how human activities directly affect wild dolphins, (2) "Social Structure, Behavior, and Communication," exploring the details of the behavioral lives of the animals, (3) "Health and Physiology," where we describe the wide-range of studies examining how the animals respond to environmental challenges of human and natural origin, especially the impacts of environmental contaminants, (4) "Ecology, Population Structure, and Dynamics," which explores how to identify and define dolphin population units and measure their vital rates, (5) "Dolphin Rescues, Releases, and Follow-up Monitoring," describing efforts, in conjunction with Mote Marine Lab, to aid sick or injured individual dolphins and monitor them when they are returned to the wild, (6) our involvement with other dolphin conservation and research efforts around the world through partnerships, sponsorships, or training, and (7) our involvement in education and training programs that reach audiences ranging from elementary school students through research professionals from around the world. Once you've had a chance to read the material, we hope that you will agree that the interest and dedication demonstrated by these folks are making a positive difference for the dolphins of Sarasota Bay and elsewhere.

HUMAN INTERACTIONS AND IMPACTS

Consortium for mitigating adverse human interactions with bottlenose dolphins

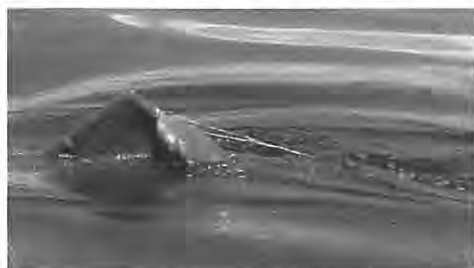
By Randall Wells, PhD, and Kim Bassos-Hull, MSc

Bottlenose dolphins in the waters of the southeastern United States are facing growing threats from human activities. Our program's efforts to understand and mitigate some of these are described below. Among the more insidious threats are direct human interactions, including such activities as feeding or swimming with wild dolphins, and related problems such as entanglement in, or ingestion of, recreational fishing gear. Solutions to these problems will require the combined efforts and diverse talents of a variety of stakeholders, and will involve education and require increased law enforcement action. The National Marine Fisheries Service (NMFS) has asked our program to serve as the lead in developing a consortium of interested parties in Florida to

identify the most effective solutions to these issues. As part of our current contract with NMFS, we will be conducting docent activities in several "hotspots" to evaluate the problems and provide education through direct



Begging dolphin near fishing boat in Redfish Pass



Fishing line-entangled dolphin in Pine Island Sound

contact with boaters engaged in illegal activities, through town hall meetings, through the development and distribution of educational materials such as brochures and DVDs, and through public service announcements. We have begun contacting some of the stakeholders involved in these issues, and plan to host meetings in 2006 to bring these groups together and begin the process. Given that some of these problems affect multiple species, we hope to involve those who have dealt with these issues for manatees, seabirds, and sea turtles, as well.

Does boat traffic affect the way dolphins use Sarasota Bay?

By Christine Shepard, PhD Student, University of California at Santa Cruz

Increases in Sarasota Bay boat traffic reflect the swelling coastal populations in both Sarasota and Manatee Counties. High levels of boat traffic can lead to injuries or disturbance to wildlife, as manifested by changes to behavior and acoustic signaling. While previous research conducted by SDRP has



demonstrated short-term behavioral and acoustical responses of individual bottlenose dolphins to vessel traffic, this study aims to examine the relationship between boat use and dolphin

use of Sarasota Bay. Additionally, yearly increases in Sarasota Bay vessel activity have created an underwater acoustic environment that is significantly different from even thirty years ago. This project seeks to examine how increases in vessel activity alter the acoustic environment of Sarasota Bay and what effects these changes might have on resident dolphins.

In June 2005, I began field work in Sarasota Bay with the assistance of three college interns. We conducted line-transect surveys to document both boat and dolphin sighting location and attribute information. The data collected for this portion of the project are currently being compiled into a Geographic Information System (GIS) to allow for spatial analysis of the sighting distributions. In addition to surveys, we used focal animal behavioral follows (an approach pioneered by Jeanne Altmann, of the Chicago Zoological Society) to collect behavioral data from individual dolphins relative to local boat densities. The behaviors and GPS recorded track lines of the focal follows are also being entered into the GIS to allow for formal analysis of habitat selection and behavioral state relative to boat densities. Comparisons will also be made using a five year historical dataset of dolphin sightings and boat use within Sarasota Bay collected by Sue Hofmann and her Earthwatch Institute volunteer teams. Underwater boat noise was recorded in a variety of habitat types throughout the bay using autonomous recorders and the recordings are being analyzed to plan for more detailed acoustic sampling of the bay next summer.

Data entry and analysis will continue this year and my preliminary results will allow me to refine my questions for the second field season, which begins in June of 2006. It is my hope that results from this project will aid conservation efforts directed towards coastal cetaceans in other regions of increased anthropogenic disturbance due to vessel activities. This work will form the basis of my graduate research as a Ph.D. student at the University of California, Santa Cruz. Support for this project has come from NOAA Fisheries, Earthwatch Institute, a GAANN Fellowship, and the UCSC Ocean Sciences Department.

Hearing abilities of bottlenose dolphins in Sarasota Bay

By Mandy Cook, PhD candidate, and David Mann, PhD, University of South Florida

Bottlenose dolphins are exposed to a wide variety of natural and anthropogenic noises in their environment, and there is increasing concern that these noises may have negative effects on their hearing. Hearing losses in these animals can be especially damaging because dolphins rely primarily on acoustics to navigate, forage, and communicate with each other. We have been investigating the hearing abilities of free-ranging bottlenose dolphins in Sarasota Bay. Dolphins can hear from about 75 Hertz to over 150 kiloHertz, which is a much larger hearing range than most other mammals (most humans can hear from 20 Hertz to 20 kiloHertz). Hearing abilities vary between and among individuals, and a few studies on captive dolphins have shown that hearing losses increase as animal age increases (similar to humans). No study has examined the hearing abilities of free-ranging bottlenose dolphins; therefore, variations in hearing thresholds among individuals and variations with respect to age have not been examined.

We are measuring the hearing thresholds of bottlenose dolphins in Sarasota Bay during temporary capture-release sessions using an auditory evoked potential (AEP) protocol based on non-invasive techniques used to measure hearing in human infants. Short duration tones of varying frequencies and sound levels are played to the dolphins using a jawphone while each animal is on the veterinary examination boat. Sensors on the surface of the dolphin's head measure microvolt potentials produced by the brainstem in response to the tones. The brain's responses to the sounds are analyzed to determine each dolphin's hearing abilities.

Data have been collected from 48 bottlenose dolphins (23 females and 25 males) ages 2-31 during capture-release sessions since June 2003. Our findings to date suggest that bottlenose dolphins exhibit a large degree of variability in their hearing abilities. Data will continue to be collected during capture-release sessions. This full dataset will be used to determine if bottlenose dolphins in Sarasota Bay exhibit hearing losses with increasing age or if they exhibit hearing losses due to daily exposure to high levels of environmental noise, including anthropogenic sources of noise, such as boats. Support for this research has been provided by: Harbor Branch Oceanographic Institution, Inc. Protect Wild Dolphin Program, NOAA Fisheries, Disney's Animal Programs, Dolphin Quest, the P.E.O. Scholar Award, the Jack Lake Endowed Fellowship, the Paul L. Getting Memorial Endowed Fellowship, the Von Rosenstiel Endowed Fellowship, and USF College of Marine Science Graduate Assistantships.



SOCIAL STRUCTURE, BEHAVIOR, AND COMMUNICATION

Bottlenose dolphin signature whistles

By Laela S. Sayigh, PhD, University of North Carolina, Wilmington and Vincent M. Janik, PhD, University of St. Andrews, Scotland

We are currently working on several avenues of research relating to individually distinctive signature whistles of the Sarasota dolphins. First, we are beginning a large scale effort to create a digital library of all recordings ever made of the Sarasota dolphins. This library is completely unique, in that it contains high quality recordings of known individuals, recorded during brief capture-release events. Many individuals have been recorded on numerous occasions, thus enabling researchers to examine issues such as long-term whistle stability. A digital library will make these data much more widely accessible to other researchers.

UNCW undergraduate student Charles White continues to work on an automated classifier for bottlenose dolphin signature whistles. Currently, his study is focusing on whistle detection, by comparing the performance of a k-means clustering approach to that of a feed forward neural network. While both approaches successfully detected dolphin signature whistles among noise, the neural network was more robust in handling irregularities such as whistle tail-offs and recording dropouts. Results so far provide a reliable method for autonomously detecting bottlenose dolphin signature whistles and lay the groundwork for automated extraction and classification of whistles.

We also use the Sarasota whistle catalogue to develop technologies for signature whistle identification in the field. Currently, the only way to identify a signature whistle is to record an isolated individual. However, animals usually travel in groups. It would be very useful to be able to recognize a signature whistle during a boat follow without any previous information on the animals in the group. For this, we developed a computer method that can categorize dolphin whistles automatically. It consists of an adaptive resonance theory neural network that is unsupervised in its learning phase. This program has been demonstrated to be successful with small sample sizes. We are now testing its performance with larger data sets from the Sarasota dolphins to adapt it for field work use.

We also are continuing our playback studies, which are designed to determine the cues that dolphins use in recognizing signature whistles of other individuals. As described in last year's newsletter, experiments conducted in 2003-2004 showed that dolphins are capable of recognizing synthetic signature whistle contours, suggesting that contour is the most important feature of the whistle for individual recognition (Janik et al. in prep). However, these experiments did not rule out the possibility that dolphins use both contour and voice cues to recognize individuals. Thus, our current experiments are looking at whether dolphins are capable of discriminating among natural non-signature whistles. If they are capable of discriminating among these whistles, which are highly variable in contour, then they must be using voice

cues for this recognition. Preliminary analysis of ten playbacks showed no difference in responses to non-signature whistles of kin vs. non-kin. These preliminary results suggest that voice cues are not used by dolphins to identify whistles of other individuals. This work is currently being funded by a Protect Wild Dolphins Grant to L. Sayigh and R. Wells from the Harbor Branch Oceanographic Institute, and a Royal Society University Research Fellowship from the UK to V. M. Janik, with additional support from Dolphin Quest and Disney's Animal Programs.

Whistles as potential indicators of stress in bottlenose dolphins

By H. Carter Esch, MSc student and Laela S. Sayigh, PhD, University of North Carolina, Wilmington

The welfare of an organism, or the state of an animal in relation to how it attempts to cope with its environment, is often related to the stress that it experiences (Broom and Johnson 1993). The diversity and limited observation of stress responses among marine mammals makes it difficult to develop a comprehensive diagnostic protocol. Typically, stress hormone profiles are produced from blood samples drawn from restrained animals (stranded, temporary capture-release). Behavioral measures are becoming an increasingly valuable component in the evaluation of mental and physical state, particularly when used in combination with quantitative physiological measurements (Frohoff et al. 2004). A systematic methodology for identifying and interpreting behavioral symptoms of stress does not exist for marine mammals. One potential approach might include acoustic monitoring of vocalization rates. Marler et al. (1992) found that the intensity and structure of vocalizations may vary throughout a period of separation, and that these changes may reflect an altered motivational state. The current project is designed to quantify vocal rates and whistle parameters (maximum and minimum frequency, number of loops, and loop duration) of bottlenose dolphins in a variety of contexts. We predict that (a) whistle rates and number of loops will be greater at the beginning of a capture-release session than at the end; (b) whistle rates and number of loops will be greater during an individual's first capture-release session than during later capture-release sessions; (c) whistle rates and number of loops will be greater when a mother is caught with a dependent calf than without a dependent calf; and (d) whistle rate and number of loops will be greater during capture-release than in normal, free-ranging conditions. Selected recordings made during brief capture-release events near Sarasota, FL (from 1975-2005) were analyzed using Avisoft sound analysis software. Vocal rates were calculated and whistle parameter measurements were measured for at least 20 whistles from each dolphin; sample size was hypothesis dependent.

Preliminary results indicate that, within a single capture-release session, vocal rates appear to be correlated

with location (in water versus on the veterinary examination boat). There does not appear to be a significant decrease in vocal rate that can be associated with habituation during a single capture-release event. No clear patterns have emerged indicating that vocal rates are depressed in dolphins that have prior capture-release experience. Females vocalize significantly more when captured with a calf than without a calf. Finally, vocal rates are significantly higher during capture-release events than in undisturbed conditions. Whistle parameter analyses are ongoing.

Evaluating stress responses in bottlenose dolphins is useful in a variety of contexts including live stranded, temporarily captured, captive, and free-swimming animals. The development of an effective tool with which to evaluate stress in bottlenose dolphins, that did not require capture-release, would allow for quicker, more efficient assessments of animals that may be at risk. Reliable indicators of stress could be used to monitor dolphins exposed to stressors such as anthropogenic noise. This project was funded by Harbor Branch Oceanographic Institute, with additional support from Dolphin Quest, NOAA Fisheries, and Disney's Animal Programs.

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Recording dolphin whistles using a suction cup hydrophone

Group dynamics and estimated communication range of social sounds used by wild bottlenose dolphins during fission-fusion events

By Ester Quintana-Rizzo, PhD candidate, University of South Florida

Two of the objectives of my dissertation project are to evaluate the definition of "group" for bottlenose dolphins, and to estimate the communication range of social sounds used by dolphins during the formation and division of groups. Bottlenose dolphins exhibit flexible associations in which the composition of temporary groups changes frequently as partners join and leave in a fluid manner. The definition of a group was evaluated using parameters such as distance. This is important because some definitions consider some Delphinid species to be members of a group if they are within 10 m of each other. However, my analysis shows that the mean distance of separation of associates from focal females is significantly greater than 10 m. The mean distance of separation of dependent calves relative to their mothers was 82 m whereas the mean distance of separation of other associates was 61 m. Other definitions consider dolphins to be members of a group if they are in a radius of approximately 100 m. However, in this study dolphins that did not join a focal female were also observed in this radius. Those individuals are called satellites. Thus, if only a criterion of distance is used to define a group the presence of satellites would make it difficult to distinguish associates from satellites.

To find distant partners, dolphins use whistles when separated. I quantified the communication range of whistles to determine if they can be heard by dolphins at the distances of natural separations of mothers and their dependent calves in Sarasota Bay, Florida. This information is important to understand the role that acoustic communication may play during the formation and division of group. We conducted sound transmission experiments in two habitats (shallow water areas and channels). Results showed that sound propagation varied with habitat type, bottom type, depth, and sound source level. Sounds were more attenuated in areas with seagrass bottom than any other bottom type. Using data from propagation measurements and background noise measurements, we estimated the distance a hypothetical dolphin whistle could be detected in different habitats. In a seagrass shallow water area with mean water depth equal to 1.57 m, a loud whistle (source level = 165 dB) ranging in frequency from 5-19 kHz can travel and still be heard by a dolphin at 150 m. In a shallow area with mud bottom and mean depth equal to 1.4 m, all whistle frequency components of the same whistle can travel up to 2 km and still be heard by a dolphin. In channels, whistles could be detectable over a much larger range (>10 km). Our findings suggest that in Sarasota Bay, the communication range of social sounds is much greater than the distance of mean separations of mothers and calves. Ecological pressures might play an important role in determining the distance of separation between mothers and calves. This research is part of my doctoral dissertation project at the College of Marine Science, University of South Florida. Field work and my studies at USF have been supported by a several funding agencies: NOAA Fisheries, the USF Acoustic Laboratory, the USF Physiology Laboratory, the USF Jack Lake Fellowship, and the USF Garrels Fellowship.

Juvenile dolphin behavioral development and survival strategies

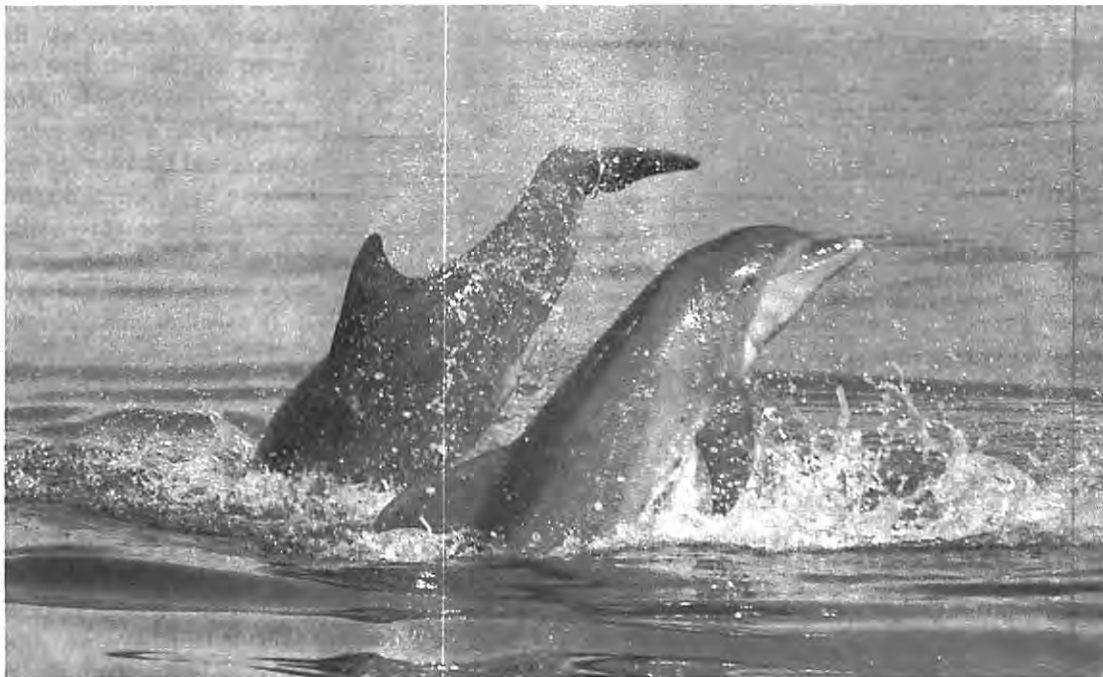
By Katherine McHugh, PhD Student - University of California, Davis

The juvenile life stage is an extremely vulnerable and formative time for developing marine mammals, who must learn to find food and avoid predators in a complex underwater environment while forging social relationships and practicing skills critical for survival and reproductive success as adults. While bottlenose dolphins are among the best studied of all cetaceans, virtually no work has focused on understanding behavioral development between weaning and sexual maturity or determining the selection pressures acting on the juvenile life stage. Many factors remain poorly understood - for example, what are the major differences between the behavior of juvenile and adult animals? How do skills and relationships critical for adult survival and reproductive success develop through the juvenile period? What social, ecological, and behavioral factors influence survivorship of juvenile dolphins? Because of SDRP's 36 year history of work on the bottlenose dolphin communities in the area, the "natural laboratory" of Sarasota Bay provides a unique opportunity to begin addressing such questions.

To this end, the main objectives of my dissertation project are to develop a better understanding of the social and behavioral development of bottlenose dolphins and to determine the major ecological and behavioral influences on survival strategies of free-ranging juvenile dolphins. I am starting to address these questions by combining long-term data from the dolphin population in Sarasota Bay with new information collected via boat-based surveys and focal animal

behavioral observations on current juveniles. Preliminary fieldwork on this project began in Summer 2005, with the help of four college interns. In this first season, I was able to conduct 47 focal follows on 23 individuals (12 females and 11 males) in the Sarasota community ranging in age from two to ten years. I plan to continue observing these individuals over the next few years, which will allow for both a longitudinal and cross-sectional perspective on the social and behavioral development of juvenile dolphins in Sarasota Bay.

I am currently finishing data entry and working on preliminary analysis of both long-term and focal follow data. Initially, I plan to examine how dolphin association patterns, habitat use, ranging patterns, and activity budgets change from weaning to sexual maturity, looking for both between and within-sex differences in developmental trajectories as well as ways in which these behavioral patterns differ from adults. In addition, I will explore how juvenile dolphin behavior influences survival to adulthood by using long-term data to compare the ranging and association patterns of individuals who died before reproducing with those known to produce at least one offspring successfully. Such information will provide a more comprehensive understanding of dolphin life history, which may have implications for conservation and management of long-lived coastal cetaceans. Support for this project has come from NOAA Fisheries, the UC Davis Graduate Scholars Fellowship in Animal Behavior, and an NSF Graduate Research Fellowship.



Socializing subadult dolphins in Sarasota Bay

Health assessment projects in Sarasota Bay and St. Joseph Bay, Florida

Randall S. Wells, PhD

Starting in 1987, the SDRP pioneered a program of health assessment of free-ranging bottlenose dolphins in an effort to be pro-active in understanding health threats to dolphins, providing an alternative to the previous approach of recovery and examination of beach-cast carcasses. This approach continues to evolve, and subsequent programs in Texas, along the mid-Atlantic coast, and in the Indian and Banana River system of Florida have built upon the model we developed. Our capture-release health assessment program in Sarasota Bay now involves more than 25 different concurrent projects (many of them summarized below), and collaborating scientists and veterinarians from around the world. In our attempt to understand the seasonal variations in distribution and effects of environmental contaminants in dolphins (related to seasonal blubber dynamics), we conducted winter and summer sessions in 2005. During February we captured, sampled, and released nine dolphins, and then ten more during June. Of these 19 dolphins, 10 were first-time samplings, including two young orphans.

Another health assessment project was conducted during April 2005, in the Florida panhandle near St. Joseph Bay. NOAA Fisheries contracted with us to help evaluate dolphins in a region that has been subject to several unusual mortality events in recent years, involving the deaths of more than 200 dolphins. The purpose was to see if these panhandle dolphins were in some way predisposed to mortality from such things as red tide. High concentrations of red tide toxin had been found in stomach contents of stranded dolphins. Dolphins along the central west coast of Florida are exposed to red tides much more frequently than are panhandle dolphins, but they do not suffer the same level of mortality from the blooms. We sampled 12 dolphins during the project. Preliminary findings suggest the existence of health conditions that might contribute to the situation, but further analyses are necessary.

Health assessment modelling

By Ailsa J. Hall, PhD, Sea Mammal Research Unit, St. Andrews, Scotland

Over the past year we have made good progress in analyzing the huge amount of data collected since 1987 on the health of the Sarasota Bay bottlenose dolphins. Since the inception of the capture release studies blood samples have been collected and analyzed for a wide range of hematology and clinical chemistry parameters. Over the years the number of parameters determined has increased, giving us an ever more detailed and comprehensive picture of the health of the study animals.

In a preliminary analysis we have endeavored to investigate how these parameters have changed over time, with season and accounting for differences between the individuals sampled. Clearly sex, age, and reproductive status are important things for which to control when looking for patterns that might suggest changes in the health status of the population as a whole. However, once we had accounted for this variation (and indeed

differences between the results obtained from the different laboratories used) some intriguing patterns seem to be emerging. For example, we found that after accounting for all the individual differences, overall the population showed lower concentrations of monocytes (a type of white blood cell particularly important in immunity) in the summer than the winter. We know that stress can affect the numbers of monocytes in the blood, possibly through a link with heat shock proteins. So perhaps increased heat stress during the summer in Sarasota Bay could account for the differences seen. In addition levels of globulin proteins (which include the immunoglobulins or antibodies) were higher in the summer than the winter. This may indicate more pathogenic organisms circulating in the population during this season, again something that conceivably may be influenced by a rise in ambient temperatures. Over the last century the average temperature in Florida has increased by almost 2°F and precipitation has decreased. Climate change models for Florida indicate that by 2100 temperatures could increase by a further 3-4°F in spring, summer and fall. It is interesting to speculate whether this could be affecting long-term trends in the health of the bottlenose dolphins in Sarasota Bay.

Microorganisms in bottlenose dolphins

By John Buck, PhD, Mote Marine Laboratory

Over the past 12 years, we have been collecting a variety of samples during health assessment sessions in order to characterize the microbiology of free-ranging bottlenose dolphins. During 1990-2002 we sampled free-ranging bottlenose dolphins off Florida, Texas, and North Carolina. Blowhole and anal/fecal samples yielded 1,871 bacteria and yeast isolates including 85 different species or groups of organisms. The following represented >50% of organisms recovered: vibrios, unidentified pseudomonads, *Escherichia coli*, *Staphylococcus* spp., and a large group of nonfermenting Gram negative bacteria. *Vibrio alginolyticus* and *Vibrio damsela* were the most commonly recovered bacteria and were dominant in both anal/fecal and blowhole samples. Many organisms occurred sporadically in dolphins sampled repeatedly, but some were regularly associated with a given individual and may indicate a carrier state. Vibrios were common, but some geographic variability in the presence of these and other organisms was noted. Potential pathogens of humans and other animals were recovered. These could be transmitted from animal to animal and thus distributed in different environments by transient dolphins, with subsequent health implications. Progress has continued on the establishment of the normal microbiological flora of wild dolphins. Eight animals from Sarasota Bay were examined in Feb. 2005 and, in a comparative study, 11 dolphins from St. Joseph Bay in the Florida panhandle were studied. These on-going studies are providing us with an emerging and, we believe, important inventory of the microflora of normal healthy animals. Comparisons can then be made with microorganisms recovered from stranded dead and alive animals. Appropriate treatment can then be applied to the latter for improved conservation practices.

Humoral immune function of bottlenose dolphins: establishing baseline parameters

By Hendrik Nollens DVM, MSc, Carolina Ruiz, BSc, Elliott Jacobson, DVM, PhD, Marine Mammal Health Program, College of Veterinary Medicine, University of Florida

Much information has been collected on health problems of the bottlenose dolphin. Nevertheless, cetacean medicine is a relatively new science. The study of the cetacean immune system and the development of sero-diagnostic tests are lagging behind those animals more commonly assessed in traditional veterinary medicine. For example, the measurement of total antibody levels has been suggested as markers of immune health and as a tool for triage during strandings and rehabilitation. Additionally, the measurement of total antibody concentrations in the serum of bottlenose dolphins would allow veterinarians to identify weaker humoral immune function in dolphins in rehabilitation centers and treat those individuals accordingly. However, normal ranges of total antibody concentrations, as present in healthy, wild bottlenose dolphins, have not yet been determined.

Over the past three years, a set of serum samples has been collected from the free-ranging Sarasota dolphin community and additional serum samples have been collected from two captive populations. As serum samples become available, the total antibody concentration is measured in each sample, using a newly developed ELISA assay for the measurement of total antibody concentration in dolphin serum. Using these data, the required amount of total serum antibodies has been established for each age category of bottlenose dolphins. Our findings also showed that distinct normal reference intervals need to be established for captive and free-ranging bottlenose dolphins.

Immune system function of bottlenose dolphins

By Jeff Stott, PhD, and Myra Blanchard, MSc, University of California, Davis

Peripheral blood samples have been analyzed on a yearly basis beginning in earnest in 1999. An extensive array of classical and advanced approaches are being used in the analysis. These studies are not only establishing important immunologic baseline values for free-ranging bottlenose dolphins in Sarasota Bay, but are providing a sensitive tool for assessing the biological effects of environmental perturbations on animal health. White blood cell (leukocyte) subpopulations are being enumerated by flow cytometry and functional capacity determined by cell proliferation and gene expression assays. Measuring differential gene expression, specifically cytokine genes, in leukocytes with molecular biology is just beginning. Expression of cytokine genes is induced upon leukocyte activation and dictate the type of immune response that is elicited. Data generated on these

potent modulators of the immune system are providing an additional level of analysis of the immune system that has previously not been possible.

To date, a tremendous amount of baseline data has been generated on free-ranging dolphins. Such baseline values have been determined to be influenced by animal age and sex. Though sample numbers are low, preliminary data suggest that baseline values may also be influenced by season (time of collection). As would be expected, outliers in immunologic phenotype and function have been identified. The implication of these findings, relative to animal health and survival, will become evident as the study proceeds.

Organic environmental contaminants in bottlenose dolphins

Jennifer Yordy, PhD student, Medical University of South Carolina, and John Kucklick, PhD, National Institute of Standards and Technology

Organohalogen compounds, such as polychlorinated biphenyls (PCBs) and chlorinated pesticides were manufactured by man to provide materials such as electrical transformers, flame retardants and insecticides. These compounds were released into the environment before their toxicities and environmental consequences were fully understood. Although currently banned from production, these compounds which were synthesized for their stability, have proven remarkably persistent and have been shown to accumulate to potentially toxic levels within the lipid rich blubber layers of marine mammals. While compounds such as PCBs have been banned, other compounds with similar toxicological and bioaccumulation properties are still in active use. Probably the most important of these "new" pollutants are the brominated flame retardants which include another group of organohalogen compounds, the polybrominated diphenyl ethers or PBDEs. To assess the concentrations, patterns and toxic potential of organohalogen contaminants found within the Sarasota Bay bottlenose dolphin population, over 195 blubber, blood and milk samples were collected for contaminant analysis during live capture and release programs since June 2000. To date, 81 organohalogen compounds have been detected in Sarasota bottlenose dolphin blubber, with PCBs (0.5- 52 ppm) and 4'4'-DDE (0.1-24 ppm), a toxic metabolite of the pesticide 4,4'-DDT, being the predominant contaminants detected. Although at lower concentrations, PBDEs were also detected at significant levels (.01-9.7 ppm).

Organohalogen contaminants are primarily absorbed through the diet and may be accumulated, excreted, offloaded through milk or transformed by the body to form potentially toxic metabolites. These processes result in a complex mixture of contaminants with toxicities that may differ significantly from those known for single compounds. Understanding of the different patterns and distribution of contaminants between body compartments such as blubber, blood, milk and tissue is important to understanding the link between

contaminant burden and adverse health effects. The collection of biological samples from the Sarasota Bay bottlenose dolphin population spanning various years and seasons will allow for an in-depth examination of contaminant distribution between body compartments. In addition, tissues collected from stranded dolphins will be used to determine contaminant distribution throughout the body and help identify target organ exposure.

Many of the organohalogen compounds detected in Sarasota dolphins have been proven to interact and disrupt endocrine functions in cellular and animal models. However, there is little evidence of endocrine disruption in free-ranging marine mammals despite the extremely high levels of organohalogens found within their tissues. Many of the known contaminant interactions with the endocrine system do not result in physiological changes that could be easily measured in free-ranging dolphins. Consequently, we plan to use validated human and mouse cellular functional assays to assess whether the biologically relevant contaminant mixtures found in bottlenose blubber, blood and milk disrupt development and reproductive physiology. By determining the concentrations, patterns and distribution of contaminants throughout the bottlenose dolphin body we can accurately assess whether Sarasota Bay dolphins are at risk for the adverse health effects and endocrine disruption associated with organohalogen exposure. Funding has been provided by NOAA Fisheries and the National Institute of Standards and Technology.

Emerging organic contaminants in bottlenose dolphins from Sarasota Bay

By Magali Houde, PhD candidate, University of Guelph, Canada

Thousands of man-made chemicals are produced and used to fulfill the needs of every aspect of our society. Perfluorinated chemicals are used in paints, adhesives, and aqueous fire-fighting foams as well as stain repellent for clothes, furniture and carpets. These chemicals have been detected in human blood and wildlife worldwide including remote regions such as the Arctic. Perfluorinated compounds are known to be toxic in laboratory mammals but their effects on marine mammals are still unknown. Capture, sampling and release of dolphins in the Sarasota Bay provided a unique opportunity to study the exposure of dolphins and their prey to these pollutants. A suite of perfluorinated compounds (totaling 11 substances) was measured in plasma of 50 dolphins live-captured and released between 2002 and 2005. Milk samples from 9 females were also analyzed.

Results demonstrated high concentrations of total perfluorinated compounds in plasma of dolphins (mean concentration of 749 ng/g wet weight). Concentrations detected are, in fact, among the highest reported in wildlife to date. Age, gender and reproductive history of dolphins are known in Sarasota Bay due to the long-term biomonitoring of this community. No correlations could be found between gender and contaminants but concentrations seemed to decrease with age in both males and females. Moreover, higher concentrations were detected in calves compared to their mothers. In order to understand such elevated levels in calves, milk samples were analyzed and perfluorinated compounds were detected suggesting lactational transfer from mothers to offspring.

A second objective was to investigate the distribution and the potential route of entry of these chemicals into dolphins by measuring concentrations of perfluorinated compounds in water, sediment, zooplankton and fish composing the dolphin's diet. Perfluorinated compounds were detected in all compartments analyzed from Sarasota Bay. It was observed that concentrations detected in wildlife generally increased with trophic level (Figure 1). These results indicate that perfluorinated compound can accumulate through the food chain reaching elevated concentrations in dolphins.

Results from this study illustrate that commonly used chemicals are accumulating in the marine ecosystem. With continued use, concentrations are likely to increase and possibly threaten the integrity of the marine ecosystem. Biomonitoring of emerging contaminants is an essential aspect for chemical regulatory assessments and for the conservation and management of wild populations such as marine mammals. This study was funded by the NOAA Fisheries, Dolphin Quest, Disney's Animal Programs, the National Sciences and Engineering Research Council of Canada and les Fonds de la Recherche sur la Nature et les Technologies (Québec).

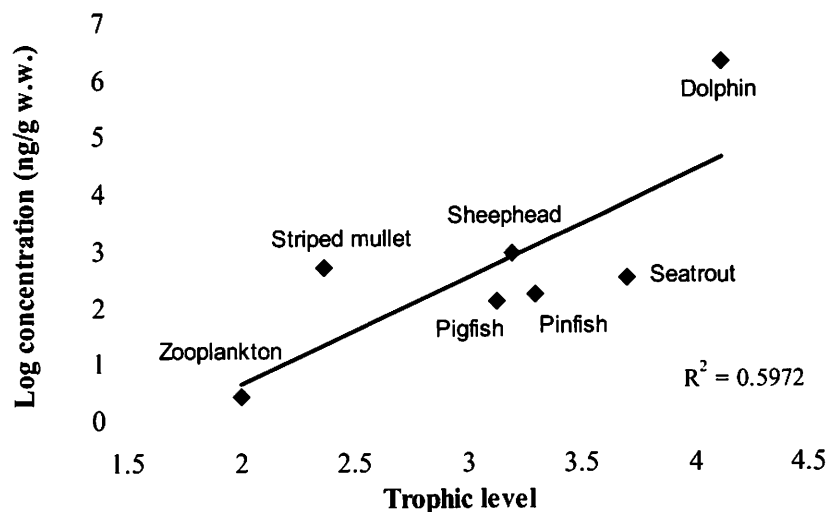


Figure 1. Concentration of the sum of all perfluorinated compounds analyzed in relationship with trophic levels in a food web from Sarasota Bay.

Non-lethal monitoring of trace elements in Sarasota Bay bottlenose dolphins

By Colleen Bryan, MSc Candidate, College of Charleston, Steven Christopher, PhD, and W. Clay Davis, PhD, National Institute of Standards and Technology

The main focus of this project was to establish trace element baseline levels in the non-lethal sampling compartments of blood and skin for the Sarasota Bay population of bottlenose dolphins. Trace elements enter the environment naturally and as a result of man's expanding anthropogenic activities. Essential trace elements such as copper, selenium and zinc are being measured along with known toxic trace elements such as mercury, lead, and cadmium. Whether essential or non-essential, excessive trace element exposure levels can potentially have toxic effects. Toxicity depends on both concentration and chemical form (speciation), which controls bioavailability. Increased human activity in recent decades has accelerated the input of many heavy metals into the marine environment and these potential stressors can disproportionately impact waterways and wildlife in the coastal zone. The impact of trace elements on living bottlenose dolphins is relatively unknown. This lack of fundamental information warrants the collection of accurate baseline information on the type and level of various trace metals in tissue to establish nutritive and toxicological benchmarks for bottlenose dolphins. This will allow concentration levels to be compared across regional populations and mortality cases to be referenced to a living population. Excepting mercury, measurement of trace elements in clinical samples such as blood has been unexplored in bottlenose dolphins. The resident community of bottlenose dolphins in Sarasota Bay has been studied for more than 36 years and presents a unique opportunity to investigate relationships between life history, health, and trace element concentration data. Whole blood and skin samples were collected from November 2002-June 2004 during health assessment live capture/release events in Sarasota Bay using collection protocols developed by the National Institute of Standards and Technology (NIST) specifically for dolphin health assessments. Samples were analyzed for aluminum, vanadium, chromium, manganese, copper, zinc, arsenic, selenium, rubidium, strontium, molybdenum, cadmium, lead, total mercury, and methylmercury. Statistically significant blood-skin correlations were found for several trace elements indicating that these are valid non-lethal monitoring tissues. The strongest correlation was established for total mercury and levels in blood and skin. These levels were above the threshold at which detrimental effects are observed in other vertebrate species.

There are several anthropogenic inputs of mercury to the environment, including mining, fossil fuel combustion (e.g., coal-fired power plants), byproducts from paper manufacturing, chlor-alkali production, and medical waste incineration. Once deposited in the coastal zone, mercury is methylated by microorganisms in sediment and soil into its more bioavailable and toxic form (methylmercury) allowing it to propagate through the marine food chain to apex predators such as dolphins. This process occurs very efficiently along Florida's coastal regions that are rich in marshes and

mangroves. Bottlenose dolphins obtain mercury primarily from fish prey. Mercury is known to have neurological and immunological toxic effects at low concentrations. U.S. Environmental Protection Agency (US EPA) reference doses for total mercury and methyl mercury in edible fish tissue are 300 ng/g and 100 ng/g (units of parts-per-billion), respectively. Consumption of fish is the main route of human exposure to mercury and this element is often the reason for issuance of most of the fish consumption advisories in the U.S. These action levels are used as benchmarks for human risk, especially for pregnant females or children. It is interesting to note that blood total mercury concentrations for most of the older animals exceed 300 ng/g, the EPA action limit for total mercury in edible fish tissue. Total mercury levels in dolphin blood were related to age class and sex, as shown in Figure 1. Males and females accumulate mercury through the calf and juvenile stages. It seems that fish consumption plays a stronger role in mercury bioaccumulation relative to gestational or milk transfer to young. Total mercury concentrations in reproductive-age females are significantly higher than adult males and higher than the younger age classes of both sexes. This increased mercury bioaccumulation may be due to higher female feeding rates needed to keep up with the energy demands of lactation. Methylmercury was measured in a subset of samples. The chemical form of mercury in blood is predominantly toxic methylmercury (90% of total mercury signature) and in milk comprises greater than 50% of the total mercury signature.

The trace element concentrations established in this study can serve as a baseline index for future monitoring of this population and as a benchmark for comparisons to other coastal bottlenose dolphin populations currently under study. The methods developed at NIST are universal and will be transferred to all dolphin live capture health assessment

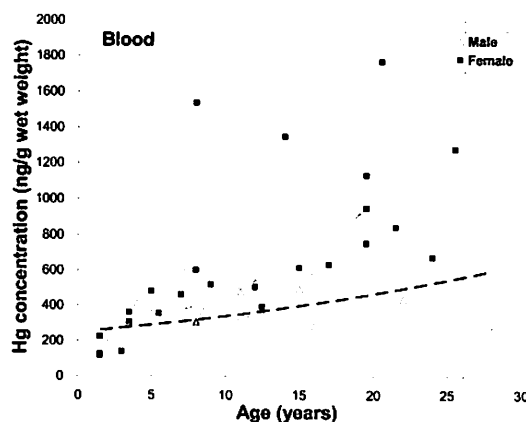


Figure 1. Comparison of age and sex versus total mercury concentration (ng/g wet weight, ppb) in Sarasota Bay, Florida bottlenose dolphins. Data were fit using an exponential function for females (solid line) and males (dashed line).

projects performed in the U.S. Several manuscripts addressing the analytical methods developed for the project and the utility of employing blood and skin as non-lethal indicators for trace element status are currently in preparation. Future research will be incorporated into Ms. Bryan's PhD project at the Medical University of South Carolina. One of the goals will be to put concentration data in a physiological context in order to qualify sublethal health impacts, using a combination of biological and physiological endpoints to aid in evaluating the effects of specific trace element contaminants. Other future goals are to conduct more trace element speciation experiments, examine trace element protein coupling and mechanisms, develop biomarkers for bottlenose dolphins and apply these methods to urine diagnostics. Support for this project has been provided by NOAA Fisheries, Dolphin Quest, and Disney's Animal Programs.

Mercury and Selenium: A contaminant and nutrient interaction assessment

*By Carla Willetto, DVM, MSc, VETS, Inc.,
Victoria Woshner, DVM, PhD, Katrina Knott,
MSc, and Todd O'Hara, DVM, PhD, University of
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Veterinary Environmental Toxicology Services (VETS) and the new Wildlife Toxicology Laboratory at the Institute of Arctic Biology (IAB) at the University of Alaska Fairbanks (UAF) have teamed up with Dr. Victoria Woshner to address selenium (Se) and mercury (Hg) from a "functional" perspective in bottlenose dolphins sampled in the Sarasota Bay area. Selenium and Hg interact in a yet unknown way that likely alters the toxicity of Hg and alters the nutritional and toxic properties of Se in cetaceans. For this reason we conduct functional assays in the suite of indicators to address Hg and Se status in *Tursiops* in concert with the current sampling for Hg and Se concentrations in blood compartments and epidermis. These functional assays include glutathione (GSH) peroxidase (Px) measurements, or GSH-Px assays. Field sampling protocols for this project were developed to fit in with overall capture operations and necropsy. Since Se forms an integral part of the GSH-Px enzyme the nutritional requirement of Se is important. Selenium in the form of selenocysteine is incorporated at the four active sites of the enzyme GSH-Px. This enzyme assumes a critical role in protecting against free-radical and oxidative damage associated with oxidative stress. We are also evaluating tissues from capture-release and stranded dolphins using histologic (light microscopy) techniques to assess the functional state of the tissues. We will determine the presence and absence of specific tissue changes known to occur for Hg toxicosis and Se deficiency. Histological examinations are underway to detect possible indications of disease or toxicant effects such as ceroid deposits, neutrophilic infiltrate, fat cell necrosis or other associated changes. In a few animal and human studies it was observed that deficiency of Se could cause pregnancy complications (Zachera et al., 2001). Therefore, we propose to evaluate the blood and plasma levels of Hg and Se, histologic

features, and glutathione peroxidase in blood to better develop a "functional" understanding of this Hg and Se interaction and the health status of the Sarasota dolphin population.

Preliminary data (Knott et al., 2005) indicated that the circulating blood concentration of total Hg in 38 bottlenose dolphins from Sarasota Bay, Florida was 543.3 ppm (or $\mu\text{g/L}$ ww). This concentration is 100 fold higher than the recommended threshold level established for humans (5.8 ppm; US EPA), below which exposures are considered to be without adverse effects. It remains to be seen, however, whether this threshold level is meaningful to a fish-eating small cetacean. Blood and epidermal (outer skin) biopsies were collected from 38 bottlenose dolphins in Sarasota Bay, Florida, during summer (June) and winter (February) 2004-2005, as part of the Dolphin Health Assessment Project. Mean circulating levels of total Hg, whole blood total Se, serum total Se and GSH-Px activity were 543 $\mu\text{g/kg}$, 0.77 $\mu\text{g/g}$, 0.40 $\mu\text{g/g}$ and 98.8 mU/mg Hb, respectively, and did not differ by season (winter v. summer). Total Hg levels in blood increased linearly with age in both male and female dolphins (expected finding). Serum total Se made up half of the concentration of total Se in blood and both were only marginally related to the increases of total Hg with age. GSH-Px activity was linearly related to blood total Se; but neither to serum total Se, nor total Hg. This may indicate measures of blood Se are more important "functionally" for GSH-Px but further assessment of this relationship is underway.

Sarasota Bay dolphins showed the typical response of increased Hg exposure and accumulation with age. High Hg levels in the blood of bottlenose dolphins, however, seem to have a minimal effect on the Se concentrations and enzyme activity that would signify detoxification. Total Hg levels, however, provide an incomplete picture of the effect of more deleterious forms of Hg, such as methylmercury (MeHg), that can be at high levels in fish and biomagnify to the dolphin. We are examining the amount of MeHg in the circulation of dolphins and the relation to levels of Se and GSH-Px activity. Because nutritional deficiencies are not expected in these robust free ranging animals (captured), these data will be important when cases of suspected inadequate nutrition (stranded) or Hg toxicosis are reported. Data gathered from the dolphin population in Sarasota Bay will also be compared to other studies of cetacean species, especially those residing in Arctic climes (e.g., beluga whales).

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Investigating the thermal response of Sarasota Bay dolphins to changing environmental temperatures

By "Team Thermal": Ann Pabst, PhD, Bill McLellan, Andrew Westgate, PhD, Erin Meagher, MSc, Michelle Barbieri, MSc, and Ari Friedlaender, MSc, University of North Carolina, Wilmington, and Duke University

The goal of our work with the Sarasota Dolphin Research Program is to better understand reproductive and whole-body temperature regulation (thermoregulation) in bottlenose dolphins. The long-term, health-monitoring program for Sarasota Bay dolphins offers us a unique opportunity to study thermoregulation in wild cetaceans. This year, we carried out the last of our investigations aimed at understanding how Sarasota Bay dolphins thermally adapt to seasonal changes in environmental temperatures. Their year-round residency exposes these dolphins to water temperatures that can drop below 10°C (50°F) in the winter and exceed 31°C (87.8°F) in the summer.

Bottlenose dolphins in Sarasota Bay may invoke a suite of physiological modifications to cope with their changing thermal environment. We investigated thermal function in dolphins using multiple measurement techniques, which included skin surface temperatures and heat flux values, measured at multiple positions on the dolphin's body. Heat flux is the rate of energy transfer per unit area and measured in Watts/m². Deep core temperatures, measured with a specialized colonic probe, and blubber thicknesses, measured using ultrasound, were also recorded. A dorsal fin Trac Pac was deployed on a subset of dolphins, which recorded skin surface temperatures and heat flux values, as well as velocity and time-depth records. These Trac Pacs were attached to the fin's surface, using suction cups, and deployed for periods lasting up to 8 hours. Infrared thermal imaging (a form of digital photography) was used to measure skin surface temperatures of wild dolphins while they are free-swimming.

Our research team has collected this suite of physiological data on Sarasota dolphins during multiple health-monitoring studies, and this year, much of our thermal research has reached completion. For example, Michelle Barbieri completed her Master's thesis research on surface temperatures of free-swimming dolphins. Her work demonstrated that dolphins maintain their surface temperature within about 1°C (33.8°F) of water temperature across all seasons. Changes in integumentary and vascular insulation likely account for the stability of this temperature differential, and, thus, the protection of core temperature across a large annual range in environmental temperature.

This year also represented the culmination of six years of thermal tracking work. We deployed our first Trac Pac thermal data logger in the summer of 1999 and our last during the summer of 2005. We have been fortunate enough to collect about 130 hours of data from 55 individual deployments in both winter and summer seasons. This effort represents one

of the most comprehensive thermal data sets yet collected from free-ranging dolphins and we are looking forward to spending the next year analyzing and interpreting these results. We hope to be able to address a number of important thermal questions including (1) how do bottlenose dolphins respond thermally to seasonal changes in water temperatures that can vary by as much as 22 °C (71.6°F), (2) what are the "typical" thermal characteristics of free-ranging bottlenose dolphins and what sort of variability do we see across ages and sexes, and (3) do bottlenose dolphins respond thermally to changes in activity and what is the relationship between diving and heat loss? Andrew Westgate will begin a Post-Doctoral Fellowship with SDRP starting January 2006 and is looking forward to devoting considerable time to this unique data set.

Erin Meagher collected the final heat flux measurements for her PhD research this year as well. Cetaceans use their appendages (dorsal fin, pectoral flippers and flukes) to either conserve or dissipate body heat, thus, these body sites are considered thermal windows. Erin's study re-examines the roles of the thermal windows and other body surfaces in regulating the body temperature of dolphins. Thus, we are mapping heat flux patterns over multiple body surfaces, including the appendages, tailstock and lateral body wall, in wild bottlenose dolphins. Assessing heat flux at multiple body sites simultaneously will elucidate whether dolphins prioritize one body surface or thermal window over another when dissipating excess body heat. In January 2005, experiments were conducted on six wild bottlenose dolphins (3 males, 3 females). These data were added to those collected in February 2003 and 2004 and June 2002, 2003 and 2004 for a total of 57 bottlenose dolphins sampled in winter and summer. Preliminary results suggest that mean heat flux from all body sites pooled in the winter was generally, although not significantly, higher than mean heat flux in the summer. Thus, the initial hypothesis that heat flux across a dolphin's body surface would decrease in the winter in response to increased blubber thickness and decreased ambient water temperatures was not supported. These winter increases in heat flux occurred despite significantly thicker blubber layers at these sites in the winter. These results suggest that bottlenose dolphins resident to Sarasota Bay may be using alternative mechanisms to dissipate excess body heat in the summer, such as respiratory evaporative heat loss or spending more time in cooler microclimates. These alternative mechanisms are currently under investigation.

Our team has also completed a 10 year study on the ontogeny of the dolphin reproductive countercurrent heat exchanger. Male bottlenose dolphins possess a countercurrent heat exchanger (CCHE) that functions to regulate the temperature of their intra-abdominal testes, and we investigated the development of CCHE function by measuring deep body temperatures of wild Sarasota dolphins. During 14 field sessions (June 1993-February 2005), we collected deep body temperatures of 49 known-age males. Nineteen dolphins were sampled multiple times, over a span of 2-10 years. The CCHE flanks a region of the colon and in captive dolphins colonic temperatures measured within this region are cooler than those

measured either cranially or caudally. Thus, we used a specially-constructed probe, housing a linear array of thermocouples, to measure colonic temperature simultaneously at multiple positions. For most individuals, testis size (measured *via* ultrasound) and serum testosterone levels were also measured. Young males (2-9 years) displayed uniformly high temperatures along the length of their colons - there was no measurable influence of the reproductive CCHE on colonic temperatures. In older males (10-43 years) colonic temperatures were dependent upon position; temperatures measured at the CCHE were on average 0.5°C (32.9°F), and maximally 1.7°C (35°F), cooler than those measured outside this region. Longitudinal records from individuals that became sexually mature during the course of the study also showed that temperatures at the CCHE decreased as testis size and testosterone levels increased. These results, the first to demonstrate that CCHE function changes with age and reproductive maturity, also illustrate the importance of long-term field studies to enhance our understanding of marine mammal biology.



"Team Thermal" radiotracking a tagged dolphin.



Evaluating bottlenose dolphin health from breath samples

By Bets Rasmussen, PhD, OGI School of Science & Engineering, OHSU

We continued our collection of dolphin breath samples during the 2005 health assessment sessions. Volatile organic compounds in exhaled dolphin breath are a reflection of biochemical constituents circulating in the blood. Non-invasive monitoring of such compounds is beginning to yield health, reproductive, physiological and seasonal information about wild dolphins. From a conservation aspect, information from breath of wild dolphins may reveal (1) areas of localized, specific pollution if particular dolphins are known to frequent such regions, (2) incidence of respiratory diseases, (3) basic metabolic requirements, especially seasonal, and (4) possibly reproductive status information.

During 2005 our data base was extended from 47 dolphins to an additional 7 in February 2005 and 9 in June 2005 making a total of 63 dolphins from whom we have analyzed exhalant breath samples. We continued to identify and now semi-quantitate more than 60 compounds. Several groups of compounds continued to be of particular interest: pentane (indicative of strenuous exercise); several sulfur compounds, presumably of bacterial origin; acids, again perhaps indicative of bacterial infections; aldehydes and isocyanato compounds may also prove to be diagnostic. Our monitoring of concentration changes should increasingly: (1) be indicative of bacterial respiratory problems, or by the inclusion of hydrogen measurements other serious lung problems, (2) reveal seasonal changes related to fat metabolism, as indicated primarily by changes in ketones, and (3) demonstrate chemical clues about reproductive condition. We are occasionally detecting hormone metabolites. We plan a publication on at least one of these aspects in 2006.



Elizabeth Berens collects breath samples

ECOLOGY, POPULATION STRUCTURE, AND DYNAMICS

Earthwatch Dolphin Monitoring Program 2004-2005

By Jason Allen, BS, Field Coordinator, SDRP

The Sarasota bottlenose dolphin community remains the most thoroughly studied free-ranging dolphin population in the world. We have been able to continue our year-round monthly monitoring of the Sarasota dolphin community during 2005 thanks largely to continuing support from Earthwatch Institute volunteers and NOAA Fisheries. We continue to address increasingly refined questions about the lives of these animals with the benefit of information gained through our intensive year-round studies of their distribution, social and reproductive patterns.

Photo-identification surveys were conducted on 101 days from November 2004 through October 2005 with the assistance of 33 Earthwatch volunteers from 16 states and five countries. These volunteers contributed over 2,000 hours to our project.

During this period, we had 481 group sightings that totaled 1,791 dolphins (including resighted animals). Monthly values were variable, but overall we averaged about five sightings and almost 18 dolphins per day (Figure 1). We had a high of 13 sightings in one day during a February 2005 survey and a high of 73 dolphins during a June 2005 survey. Our single largest dolphin group occurred on the 23rd of September and was composed of 30 known community members. These values have remained fairly consistent over the past several years (Figure 2). However, monthly averages of group size show that there were many more dolphins per sighting in the summer of 2005 than in the previous year (Figure 3). In addition, the proportion of sightings with 15 or more animals was much larger this summer compared to the previous ten years (Figure 4). This increase in group size seems to be correlated with the extensive red tide event that affected Sarasota Bay for 10 months starting in January, and becoming exceptionally severe this summer.

We documented the births of ten calves during the spring/summer of 2005 while monitoring the Sarasota dolphin

community. Lightning had her sixth calf, while Pumpkin had her fifth. Other moms included Merrily (pictured below), Moonfin look-a-like, Square Notch, FB 127, FB 149, FB 167, and FB 175. Finally, the most significant addition to the Sarasota population this summer was the birth of Annie's first calf. This represented the first known fifth-generation dolphin born into the Sarasota community. Though this calf's grandmother and great-grandmother are dead, its 39 year-old great-great-grandmother is still seen in Sarasota Bay. Unfortunately, this newborn suffered the fate of most first-born calves in the Sarasota Bay area, and was lost shortly after birth.

Last year we reported that Rose and RP 27 had died, leaving behind one- and two-year-old orphans, respectively. During our capture-release efforts this year we performed a health assessment with both of these individuals and found that they are well and healthy. First time health assessments with Pup and Wanda's 2002 calves, Murphy Brown's 2003 calf, FB 234 and FB 189 (recent arrivals to Sarasota Bay), Yorik (observed since 1999), FB 193 (observed since 1990), and FB 195 (observed since 2002) also occurred this year.

During the past year, we lost two Sarasota Bay community members. FB 99 died from a stingray barb that punctured her body and then traveled through her aorta. Pumpkin's 2002 calf, Seed, was also found dead on the 12th of September. Sadly, the necropsy showed that her spine was broken, most likely from a motor boat collision. Through our Earthwatch-sponsored surveys, we have accounted for over 90% of the Sarasota Bay community members during 2005. As of October 2005, the number of dolphins regularly using the waters surrounding Sarasota Bay stands at approximately 160 animals.

Once again, we would like to thank all of our Earthwatch Institute volunteers for their interest in, and support of, the Sarasota Dolphin Research Program.



Merrily with her third known calf, born this summer, during a September survey. FB 179 (her second, now three years old) is pictured in the background.

Table 1. Births, additions, deaths, and losses to the Sarasota Bay population over the past year: Ten new calves were born and two well-known animals were confirmed dead.

Sarasota Population's Gains and Losses in 2005

Births

Number	Name	EVENT
FB07	Lightning	6th known calf
FB09	Pumpkin	5th known calf
FB11	Merrily	3rd known calf
FB27	Moonfin Look-alike	5th known calf
FB87	Squarenotch	2nd known calf
F125	Annie	1st known calf
F127	FB 127	1st known calf
F149	FB 149	4th known calf
F167	FB 167	2nd known calf
F175	FB 175	2nd known calf

Additions

Number	Name	EVENT
F189	Venice Di Milo	Sampled February 2005
F193	Fishmouth	Sampled June 2005
F195	Beaker	Sampled June 2005

Missing

Number	Name	EVENT
FB03	FB 03	Not ID-ed in 2004 or 2005
FB46	FB 46	Not ID-ed in 2004 or 2005
F180	HSM2	Not ID-ed in 2004 or 2005
F184	FB 184	Not ID-ed in 2003, 2004, or 2005
F214	Squash	Not ID-ed in 2004 or 2005
F163	LA94	Not ID-ed in 2004 or 2005

Deaths

Number	Name	EVENT
FB99	FB 99	Died 9 October 2005
F177	Seed	Died 12 September 2005

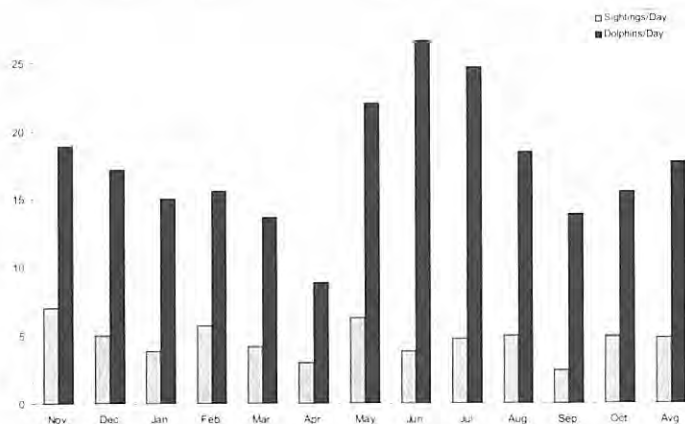


Figure 1. Average number of dolphin sightings and total dolphins per day from November 2004 through October 2005.

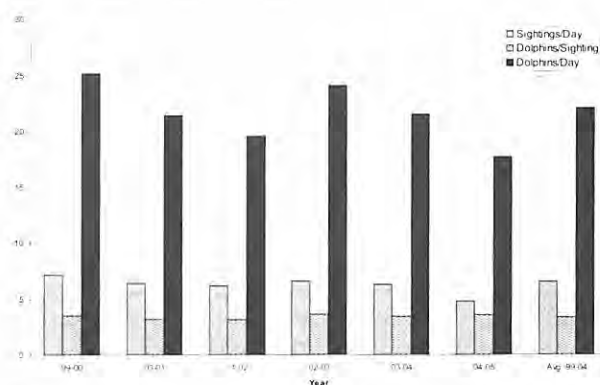


Figure 2. Average number of dolphin sightings per day, dolphins per sighting, and dolphins per day from 1999 through 2005. Averages from data collected between November 1999 though October 2004 are also provided. Though these values vary slightly, they remain fairly consistent from year to year.

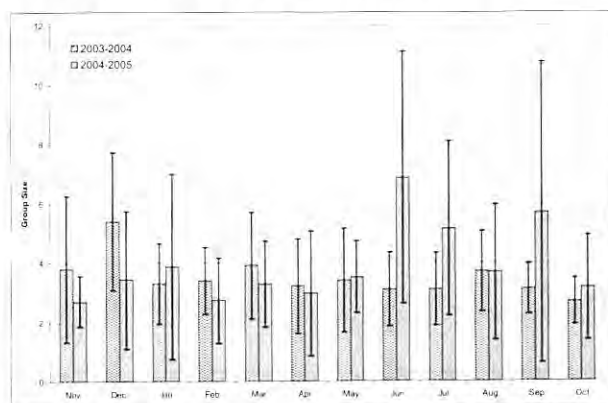


Figure 3. Average number of dolphins per sighting (i.e., group size) with associated standard deviation (error bars). Group size tended to be larger during the summer of 2005 compared to the previous year. This correlates with the red tide that affected Sarasota Bay this year.

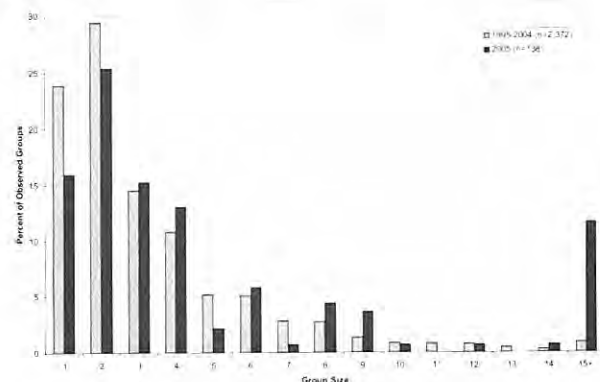


Figure 4: Group size (number of dolphins per sighting) on the x axis and the proportion that each group size was recorded on the y axis. Large groups (15 or more dolphins) represented a much greater proportion of sightings in 2005 ($n=138$) than during the previous ten years ($n=2,372$).

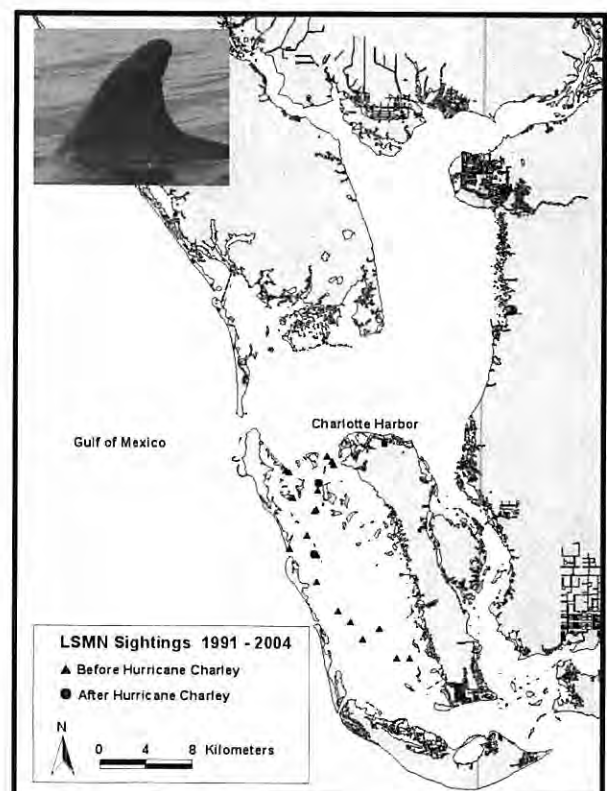
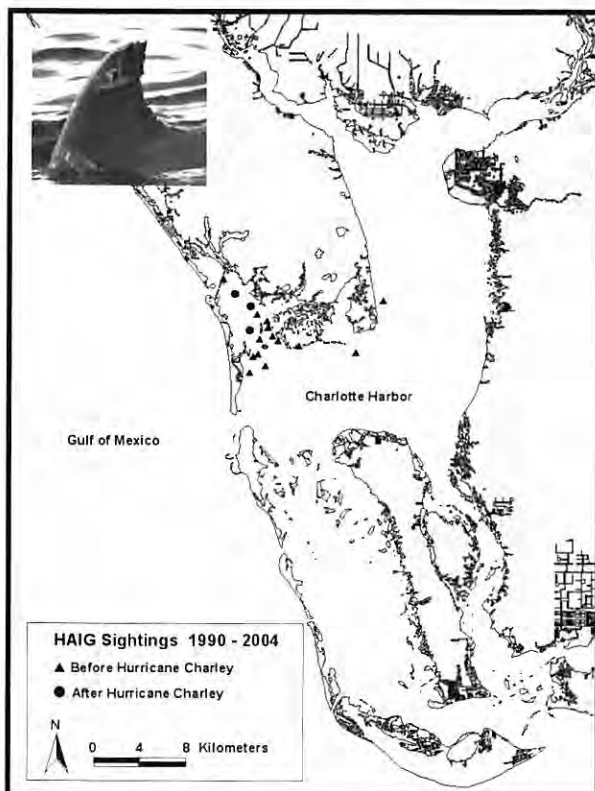
Bottlenose dolphin abundance, distribution, seasonal and long-term site fidelity in the Charlotte Harbor Ecosystem

By Kim Bassos-Hull, MSc, SDRP Research Associate

Long-term studies documenting abundance trends and site fidelity of bottlenose dolphins in coastal estuaries can provide clues to the health of the ecosystem and stocks for management decisions. Dolphin distribution within these estuaries can be indicative of environmental features and prey distribution. We completed multi-week photographic identification surveys during September 2001, 2002, and 2003 and February 2002, 2003, and 2004 to determine dolphin abundance and distribution within Charlotte Harbor, as a continuation of National Marine Fisheries Service sponsored surveys conducted from 1990-1994 and in 1996. Smaller scale opportunistic surveys were done on occasion in some spring and summer months, for example, after Hurricane Charley passed through the study area in August 2004. Since 2001 we have spent 255 days on the water and collected 1,710 group sighting records. Two types of search effort were used: (1) a 1 km randomized grid transect which included cross-harbor, edge, and contour transects and (2) opportunistic transects both within the defined study area and in surrounding waters. We attempted to collect dorsal fin identification photographs of all dolphins in each sighting along with information on location, group size, numbers of calves, activities, and environmental parameters.

With photographic identification analyses mostly complete we have identified 851 different dolphins that use

the Charlotte Harbor estuary and/or Gulf of Mexico surrounding waters. Repeated sightings of at least 471 marked individuals show they are present year-round and at least 390 dolphins show long-term site fidelity of five years or longer. Preliminary mark-recapture analyses indicate comparable numbers of dolphins in the region during the 1990's summer surveys and the more recent 2001-2003 summer surveys (ie. N=423 with 95% confidence interval 369-499 in September 2001), with a potential increase in numbers in winter (ie. N=548 with 95% confidence interval 435-722 in February 2002). Preliminary examination of the distribution of sightings show relatively low numbers of dolphins near the river mouths during the summer rainy season when hypoxia (very low dissolved oxygen concentration) was recorded and larger numbers in these areas during the drier winter months when waters had higher salinities and were well mixed, with higher oxygen levels. Though most of the identified dolphins demonstrated strong site fidelity as reported for other Gulf of Mexico estuaries, a few individuals were documented traveling between estuaries. At least 32 dolphins with 10 or more sightings have been observed before and after Hurricane Charley and there was no obvious change in the distribution of their sightings. Funding for this project has been provided by the Mote Scientific Foundation and NOAA Fisheries (NMFS).



Both HAIG and LSMN are long-term residents that have been seen before and after Hurricane Charley in the same general location.

Genetic analyses of stock structure in Tampa Bay: Examining community structure of bottlenose dolphins in Tampa Bay using a genetic approach

By Kim Urian, MSc, University of North Carolina, Wilmington



In my Master's thesis work I described five separate communities of dolphins in Tampa Bay, defined by their patterns of association and home ranges. We are now estimating gene flow among these communities and determining how well our

observations fit the "Boundary Rank" model described by Karen Martien and associates. To address these questions, we conducted photographic identification surveys and biopsy darting for genetic sampling in Tampa Bay during August 2003, and July-August 2004. Unfortunately, we were unable to conduct surveys and biopsy sampling during our field season this year, due to the frequency of hurricanes!

To ensure representative coverage, our goal is to collect at least 30 genetic samples from each of the five putative communities in Tampa Bay. We focused on dolphins identified in previous surveys and, in particular, we targeted known members of each of these communities. Our field program supplemented genetic samples collected from dolphins in Tampa Bay during 2000 and 2002; we are now close to our goal of 30 samples from each community. We now hold 29 samples from mid-Tampa Bay, 13 from eastern Tampa Bay, 25 from Old Tampa Bay and more than 30 samples from each of the remaining two communities. The biopsy samples have been provided to NOAA Fisheries for genetic analyses.

From photo-identification images taken during 2003 and 2004, we have identified 227 individual dolphins. Of these, we matched 82 dolphins to our long-term Tampa Bay Photo-identification Catalog; 26 dolphins were photographed in both years. Nearly all the dolphins that we matched to the Tampa Bay Catalog were first identified during surveys we conducted between 1988-1993, indicating that a large proportion of these dolphins are still found in these waters.

We have now completed our photo-ID analysis to determine the identities of the 99 dolphins sampled from biopsy efforts in Tampa Bay from 2000-2004. Approximately half of the dolphins we sampled were matched to the Tampa Bay Catalog (the remaining dolphins will be new additions to the Tampa Bay Catalog, or the dorsal fin images did not meet our criteria for quality or distinctiveness). Our success in targeting individuals with longitudinal sighting histories was due to the skill of Brian Balmer and Anna Sellas, who conducted the biopsy sampling. The high number of sampled dolphins with previous sighting records is critical to our evaluation of community structure in Tampa Bay.

Once the genetic analyses are conducted, we will be able to determine how much gene flow occurs among the five communities in Tampa Bay. This will help us to better understand

the fine-scale population structure of bottlenose dolphins in this region. In addition, the samples collected during these surveys will supplement the growing genetic catalog of dolphins along the west coast of Florida and provide information on population structure over a broad geographic area. This research was supported by NOAA Fisheries.

Echo and Misha Update: Fifteen years back in the wild

By Kim Bassos-Hull, MSc, SDRP Research Associate

It has been 15 years since Echo and Misha were returned to the wild in their native Tampa Bay waters after spending two years at a research laboratory in California. Both dolphins were the subjects of a unique two-part scientific experiment. Echo and Misha were initially collected in Tampa Bay in July 1988 and spent two years at the University of California at Santa Cruz's Long Marine Laboratory where researchers studied their echolocation processing abilities and behavior patterns. Then, as planned prior to collection, on 6 October 1990 they were released back into Tampa Bay after a transition process in a seapen at Mote Marine Laboratory. During intensive monitoring during the first year following their release, both Echo and Misha were observed feeding, interacting with other local dolphins, and in general displaying typical behavioral, ranging, and social association patterns, as well as having excellent body condition.

Echo and Misha split up after the first few months back in the wild but researchers have continued to observe both dolphins through opportunistic sightings. Misha has been sighted on 70 occasions since release along the southeast coastline of Tampa Bay. During Misha's most recent sighting on 16 August 2005 in the Manatee River (southeastern Tampa Bay), he was observed with longtime associate, KATT, and a smaller individual, BOXR, that is sometimes seen in Sarasota Bay. Misha and KATT have been sighted together 14 times since 1991 and they have been together in every sighting since 1999, so perhaps we are documenting the formation of a male pair. Echo has been sighted 55 times since release, with many of the more recent sightings contributed by the Eckerd College Dolphin Research Program from the Boca Ciega region (western part) of Tampa Bay. Echo's most recent sighting, by the SDRP Tampa Bay biopsy sampling team, was on 20 August 2003, to the east of Boca Ciega Bay. With plans to conduct more survey effort in Tampa Bay over the next few years we hope to keep tabs on these two special dolphins.



Misha on 16 August 2005

Understanding bottlenose dolphin feeding ecology through combined analyses of stomach contents and stable isotopes

By Nélío Barros, PhD, Mote Marine Laboratory

We are studying the feeding ecology of bottlenose dolphins in Sarasota Bay by combining traditional analyses of stomach contents of stranded animals with assessments of stable isotopes in tissues of both dolphins and their preferred prey. The advantage of this approach is that it incorporates short-term evidence of prey consumption (stomach contents) with data derived from long-term assimilation of elements through the food chain (stable isotopes), thus encompassing a wide temporal spectrum of feeding data. To date, stomach content data from 30 well-known dolphins from Sarasota Bay indicate that this resident population preys on 34 species (within 21 families) of teleosts, cephalopods and elasmobranchs. Most prey are bottom-dwelling and associated with seagrass beds, suggesting that seagrass beds are important foraging areas for dolphins and the other resident marine mammal in the bay, the Florida manatee.

Analyses of carbon and stable isotopes in dolphin tissues, a long-term indicator of diet, have demonstrated that older Sarasota Bay dolphins have higher levels of carbon isotopes and lower levels of nitrogen isotopes in their tissues. This ontogenetic variability may reflect shifts in prey base and/or habitat use. To further enhance our ability to distinguish between animals living in the Bay versus Gulf waters or other areas, we're including an additional tracer (sulfur) in our stable isotope analyses. This element should provide better discrimination of resident dolphins as it distinguishes marine versus freshwater food sources in estuarine systems. Preliminary results of sulfur isotopic analyses in teeth of dolphins from different west central Florida populations have shown a trend for lower isotopic values in estuarine to offshore waters. These encouraging results suggest that stable isotopes (and stomach content analyses) will not only provide insights into dolphin feeding ecology but may also serve as diagnostic tools in separating different dolphin populations inhabiting coastal and offshore waters of west central Florida.

Dolphins feed on a variety of fish species including...



pinfish



trout



catfish



snook



jack



Figure 1. Stable Isotope Laboratory at the U.S. Geological Survey facilities in Denver, CO, where the sulfur isotope analyses are being conducted.

Monitoring swimming, diving, and forestomach temperature changes on instrumented wild dolphins to determine post-release foraging effort and success

By Steve Shippee, Frank Deckert, Forrest Townsend, DVM, and Kristin Knowles, Trac Pac Inc.

We conducted a tagging and tracking study with bottlenose dolphins in the Sarasota Bay region during June 2004 and February 2005. Our project involved attachment of suction-cup attached dorsal fin packs (Trac Pacs) on five different dolphins. The Trac Pacs incorporated a Time-Depth-Recorder (TDR) and radio transmitter that allowed continuous post-release monitoring of the tagged animal. A dissolvable link was used to cause the pack to jettison after a predetermined time period. In addition to the dorsal tag, a temperature telemeter pill was inserted via esophageal tube into the dolphin's forestomach during the health examination. The pill emitted an inaudible radio signal to a data recorder on the Trac Pac. From the data collection instruments on the pack, we were able to record direct measurements of diving, swimming speeds, respiration rates, water temperature exposures, relative salinity, and feeding success. The tag attachment times lasted 15 mins, 1 hour, 2 hours, 16 hours, and 41.5 hours, respectively. The two longer tag attachments included three overnight observation periods.

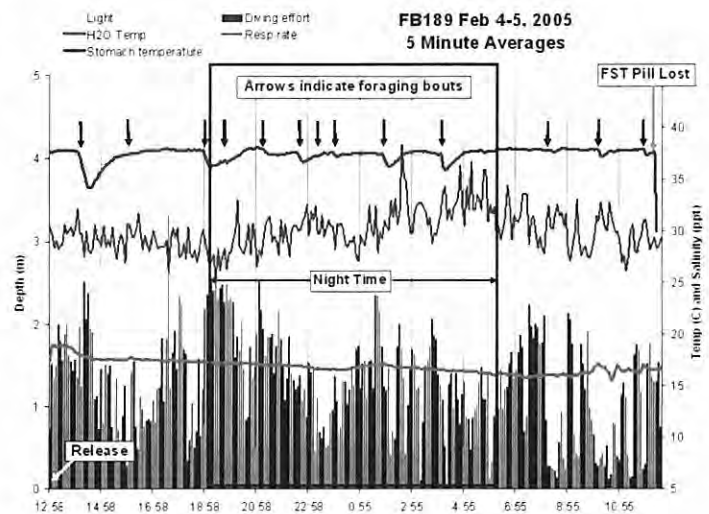
We tracked the animals from an 18' boat throughout the tag attachment periods using radio direction finding gear and recovered the instrumented tags once they were jettisoned. Location information for each animal's track was recorded using GPS equipment, and visual observations of behaviors were made. Particular attention was paid to the animal's movements through the habitat, foraging activities, interactions with cohorts and man-made sources. The TDR data recorders were programmed to collect data every two seconds. Visual observations were overlaid with the TDR and GPS records for post study analysis to yield a detailed set of data on habitat use, foraging patterns, unusual behavior patterns, and interactions with natural and anthropogenic food sources.



The suction-cup-mounted Trac Pac records data on dolphin behavior and stomach temperatures.

The measurements of stomach temperature, and our visual observations, revealed that the two animals we tracked overnight spent a considerable amount of time feeding after sunset. We also noticed that the animal's movements from place to place appeared to be strongly linked to tidal stage and water currents. Of particular note, we observed foraging activity during daytime and nocturnal periods in gulf inlets, estuarine, and riverine locations. The range of movement and activity levels of the animals during the short-term tracking periods was unexpected, and suggests a very wide range of habitat use. Foraging activity occurred in each habitat type, further pointing to the feeding generalization of these animals. Activity levels and swimming speeds suggest that periods of slower steady-transit swimming are also the times when the animals engage in "half-brain" sleep.

We will continue to use this technique in the future to further investigate the nocturnal behaviors and foraging activities of dolphins in the Sarasota community. We are hopeful that this method will tell us a great deal about the relationship of dolphin movements relative to tidal changes, habitat type, and prey fish abundance patterns. We thank the Harbor Branch Oceanographic Institution's Protect Wild Dolphins Program, Dolphin Quest, and Disney's Animal Programs for supporting this research.



Data recorded during February 2005 for Dolphin FB189 - "Venice di Milo". Arrows indicate feeding events.

Habitat quality and prey availability for bottlenose dolphins

By Damon Gannon, PhD, and Elizabeth Berens, MSc

Bottlenose dolphins of Florida inhabit one of the most urbanized coastlines in North America. Currently, the habitat requirements of dolphins are poorly known. We are addressing several important questions regarding prey availability and habitat quality, including: 1) What qualities do dolphins look for when selecting habitat? 2) To what degree do the distributions of prey, predators, and competitors influence their habitat preferences? and 3) How does the presence of humans affect the dolphins' use of coastal waters?

To answer these questions, we began studying Sarasota Bay's fish community with the use of a large purse-seine net and a passive acoustic recording system in June 2004. From June 2004 to September 2005 we made 311 seine sets and 440 passive acoustic recordings. So far, we have



caught, measured, and released 70,112 fish. In summer, the abundance of dolphin prey is at least two orders of magnitude higher in seagrass and mangrove habitats than in sandflat, open bay, and shallow Gulf of Mexico habitats. But during winter, many fish appear to leave the seagrass beds and mangrove forests and move to the deeper waters of the inlet, open bay, and dredged channel habitats. As you might expect, dolphins also tend to spend more time in these deeper habitats during winter.

As fish grow, their habitat preferences change. For many species, such as pinfish (*Lagodon rhomboides*, the most abundant bottom fish in Sarasota Bay and a common prey item in the diet of bottlenose dolphins), juveniles tend to be concentrated in the seagrass and mangrove forests, whereas adults often occupy deeper waters. The sizes of the fish are important because dolphins tend to select prey within the size range of about 4 to 16 inches (10-40 cm). Therefore, prey availability for dolphins varies substantially among habitats and the distribution of prey changes seasonally. In addition to predictable seasonal changes in prey availability, the occurrence of red tide also results in changes in prey availability for dolphins and these red tide events are not predictable (see below).

Winter and summer sampling will resume in 2006. This research project would not be possible without the help of interns and volunteers who generously donate their time and effort to this ambitious project. Funding is provided by the NOAA Fisheries and by Harbor Branch Oceanographic Institution's Protect Wild Dolphins Program.

Red tide impacts Sarasota Bay through most of 2005

By Spencer Fire, PhD candidate, University of California, Santa Cruz

Beginning in January 2005 and continuing to the time of this writing (October), a persistent bloom of the red-tide alga, *Karenia brevis*, has been present in Sarasota Bay and surrounding waters. Cell concentrations have reached levels approaching 300 million cells per liter of seawater, indicating a severe red tide event. As point of reference, concentrations of 1,000 cells per liter or less are considered background levels, and 100,000 cells per liter or more typically cause respiratory irritation in humans and fish kills. The 2004 red tide event occurring in Sarasota Bay waters lasted from January to March, and concentrations reached a maximum of 2 millions cells per liter. During the 2005 red tide bloom there have been significant increases in sea turtle and seabird strandings. Sea turtle strandings have increased 2-fold over the previous 10-year average with over 160 sea turtles stranding in the region since January. Live cormorants, brown pelicans and great blue herons with neurological signs consistent with red tide intoxication have been admitted to local wildlife rehabilitation centers in increasing numbers. Lastly, dolphin strandings have been above average for the summer months, with 19 dolphins stranding during July through October. Tissue samples tested from some of the sea turtles and dolphins have been positive for the red tide toxin. The scope of this red tide event is much greater in magnitude of severity and spatial distribution than many previous events, and several aspects of its effects on the biota of Sarasota Bay are currently under investigation.



Intern Kristen Clark collects water samples near red tide fish kill areas



Effects of red tide on bottlenose dolphins

By Spencer Fire, PhD candidate, University of California, Santa Cruz

For decades “red tide” has been a nuisance along Florida’s Gulf Coast and has had a significant impact on the economy, wildlife, and human health of many coastal regions of the U.S. It has been responsible for shellfish poisoning, fishery closures, loss of tourism and die-offs of marine animals, including marine mammals. In recent years, several large mortality events of bottlenose dolphins in the Gulf of Mexico and Atlantic Ocean have been suggested to be caused by red tide. Brevetoxin, the neurotoxin produced by the red tide alga *Karenia brevis*, has been shown to have harmful effects on a wide variety of organisms, but its effects on bottlenose dolphins are unclear. The aim of my research is to gain an understanding of the impact of red tide on the diet, health, and behavior of bottlenose dolphins in Florida’s Sarasota Bay area.

My study involves quantifying brevetoxin levels in the tissues of fish eaten by dolphins, as well as in dolphin tissues recovered from carcasses stranded during red tide events. This will give insight to what levels of brevetoxin are present in the dolphins’ diet and how the toxin is distributed throughout the animal once ingested. The behavioral response of dolphins to the presence of red tide is also being investigated. It is unknown whether dolphins are aware of (or react to) the presence of high concentrations of *Karenia brevis* during red tide events. By observing their behavioral states and recording their movements relative to concentrations of *Karenia brevis*, we may be able to determine if there is a response to the toxic event. The purpose of all these efforts is to estimate the levels of harmful toxin to which dolphins are exposed, and through which pathways the exposure presents itself. It is hoped that an increased understanding of how dolphins are affected by red tide will help conservation efforts in the future.

Preliminary findings show that the majority of dolphin carcasses recovered during active red tide events have detectable levels of brevetoxin. Samples of liver, kidney, lung, muscle and blubber tissue, as well as stomach contents, urine and fecal samples have concentrations of brevetoxin ranging from 7 to 2,900 nanograms per gram (ng/g) of tissue (as point of reference, the current regulatory limit for brevetoxin in shellfish for humans is 800 ng/g). Samples of dolphin prey fish (pinfish, spot, pigfish, mullet) taken during a red tide event also had detectable levels of brevetoxin in their tissues, with concentrations ranging from 3 to 261 ng/g. Brevetoxin has also been detected in samples from dolphin carcasses and fish recovered more than 6 months after the last red tide occurrence in the same area, which raises further questions about the residence time of the toxin in these animals. Support for lab analyses and field observations has been generously provided by Long Marine Laboratory, Disney Wildlife Conservation Fund, and Harbor Branch Oceanographic Institution’s Protect Wild Dolphins Program.



Elizabeth Berens drawing the purse-seine net closed with mechanical hydraulics while intern Kate Wells pulls the excess net into the back of the boat.

Effects of red tide on prey availability

By Damon Gannon, PhD, and Elizabeth Berens, MSc

Red tide can affect fish in several ways: by exposure to brevetoxin (the neurotoxin produced by the red tide organism, *Karenia brevis*) in the water; by consuming food that is tainted by brevetoxin; or by exposure to hypoxic water (water with unusually low concentrations of dissolved oxygen), which often accompanies severe red tides. Red tide causes an increase in the biomass of dead organisms in the water, and the process of decomposition uses up oxygen. Both brevetoxin and hypoxia can kill fish.

The 2005 severe red tide event in Sarasota Bay appears to have had a significant effect on the bay’s fish community. SDRP’s quantitative survey of fish resources in Sarasota Bay documented dramatic decreases in fish abundance coinciding with the red tide. Compared to the same period in 2004 (during which there was no red tide), overall catch rates of fish in the summer of 2005 dropped by 49.9%. Declines in abundance of the species typically eaten by dolphins were even greater than the average rate for all species. For example, combined catches of pinfish (-75.4%), pigfish (-99.7%), silver perch (-99.5%), spotted seatrout (-93.2%), mojarra (-68.9%), and hardhead catfish (-96.2%) decreased by 76.1%. We plan to continue our survey to monitor the recovery of the fish community from this ecological perturbation.

Population structure of bottlenose dolphins in and around St. Joseph Bay, Florida.

By Brian C. Balmer, MSc Student, University of North Carolina, Wilmington

During 1999 and 2004, bottlenose dolphins along the Florida panhandle experienced two unusual mortality events resulting in the deaths of more than 227 dolphins. The majority of these strandings were located near St. Joseph Bay, but it is not known which stock(s) were impacted. This project represents the first effort to identify dolphin ranging patterns in this region. We used three methods to determine these patterns: surveys that involved both photo-identification and biopsy darting for genetic samples, and radio tracking of individuals.

Photo-identification surveys were undertaken during April – May 2004 and February – July 2005. More than 250 individuals have been identified, and over one-third of these have been identified in multiple seasons. In total, 66 biopsy samples have been collected from individuals in the St. Joseph Bay area.

In April 2005, NOAA sponsored a capture-release health assessment of dolphins in the region; nine individuals were tagged with VHF radio transmitters. These dolphins were monitored daily through boat, aerial, and/or vehicle tracking for more than 50 days. Seven radio-tagged animals were

located more than 10 times with five being located more than 30 times. The tracking region covered by boat and/or truck included approximately 65 km of coastline. To ensure that tagged animals were not leaving this area, extended aerial tracking was conducted five times during May and June, ranging approximately 125 km to the east and to the west of St. Joseph Bay. Individual animal's known maximum distance from its capture-release location ranged from 15-100 km. Two animals, which were not heard for 20 or more days, reappeared within 50 km of their capture locations, suggesting that these individuals had ranged greater than 100 km. In contrast, two others had a typical daily ranging pattern of less than 10 km.

Along with this intensive radio tracking, ongoing photo-identification surveys and biopsy dart sampling for genetic analyses will help in determining the movement patterns of bottlenose dolphins in the St. Joseph Bay region of the Florida panhandle, leading to improved definitions of stock designations. This research would not be possible without funding from NOAA Fisheries and the Disney Wildlife Conservation Fund.



Radio tagged mother (X05) with roto tagged calf (X07) captured, tagged, and released on the Gulf side of St. Joseph Peninsula.

DOLPHIN RESCUES, RELEASES, AND FOLLOW-UP MONITORING

Follow-up monitoring of rehabilitated rough-toothed dolphins

Randall S. Wells, PhD, and Janet Gannon, MSNR

During 2005, program staff members were called upon to perform follow-up monitoring of 12 rough-toothed dolphins released after rehabilitation. Three of these were the survivors of a mass stranding off Ft. Pierce, Florida, in August 2004, rehabilitated by Mote Marine Laboratory's Dolphin and Whale Hospital. The other nine were rehabilitated by the Marine Mammal Conservancy (MMC), following a mass stranding in the Florida Keys in March 2005, and were released as a group of seven and a subsequent pair of animals, due to differences in recovery times.

Mote's dolphins were released off Ft. Pierce in March, 2005. They were tracked via satellite-linked radio transmitters as they made their way to the northeast in the Atlantic Ocean (see map below). Transmissions were received over periods of three to 23 days, and all available data indicate that the animals were doing well throughout the period of contact.

Two of the seven MMC dolphins released in May carried satellite-linked transmitters, and the other five carried VHF tracking transmitters only. They were released off the Keys, and were tracked for 31 to 38 days. After an initial period of apparent disorientation in the shallow waters west of Andros Island in the Bahamas, they continued to the east, cut north through Crooked Island Passage, and paralleled the West Indies. The last signal placed them northeast of the Lesser Antilles, with no indication of any health difficulties.

The two MMC dolphins remaining from the March stranding were released in September. Both received satellite-linked transmitters, and were released east of the Florida Keys. Tracking was performed over a period of two weeks, and the animals proceeded south to a deep trench close to the north coast of Cuba. The premature loss of contact was believed to be due to release of the tags from attachment pin breakage, a design feature for protecting the dolphins from entanglement. The attachment pins may not have been sufficiently strong to weather the heavy seas associated with Hurricane Rita as it passed over the dolphins.

The fact that these three groups of dolphins, along with another group from the March 2005 mass stranding released by another organization, followed different paths once released is interesting, and difficult to interpret. In all three cases described above there were no immediately obvious indications of any animal performance problems at the time of last transmission, suggesting that the rehabilitation programs had been successful.

Post-release monitoring is a service for which the SDRP is now contracted by NOAA Fisheries, and we expect to be involved in a number of release projects as programs at a variety of facilities in the southeast have become more successful in treating stranded dolphins.

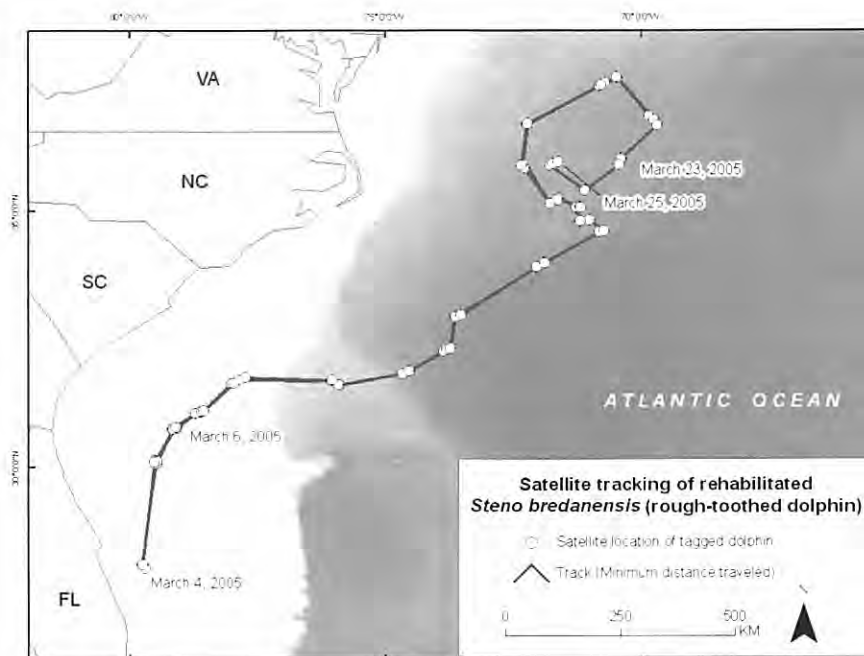


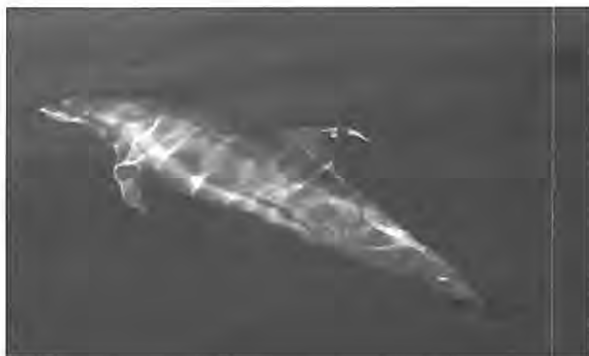
Figure 1. Movements of 3 roughtoothed dolphins released by Mote Marine Laboratory in March, 2005.

INVOLVEMENT IN OTHER MARINE MAMMAL CONSERVATION AND RESEARCH ACTIVITIES

Bermuda bottlenose dolphin tracking project update

Leigh Klatsky, MSc, *Dolphin Quest*

Beginning in 2003, the Bermuda Dolphin Tracking Project has focused on developing a better understanding of the habitat use and dive behavior of offshore bottlenose dolphins residing near Bermuda in the northwest Atlantic Ocean. A second successful field season occurred May 2005 with the capture, sampling and outfitting of three dolphins with satellite-linked and VHF transmitters before their release.



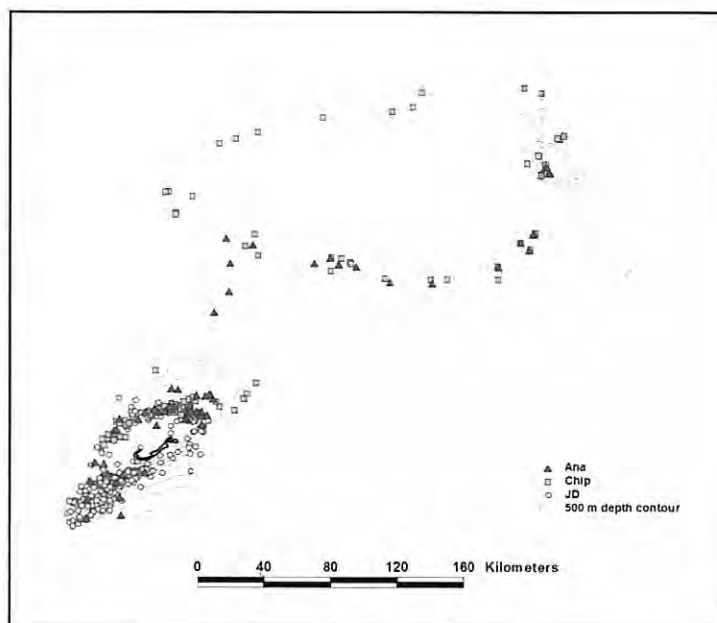
The dolphins were tracked for 12, 14 and 46 days with two of the dolphins traveling over water depths of 5,000 m to Muir Seamount, located over 200 km to the northeast of Bermuda, before their tags ceased transmitting. The third dolphin remained within 60 km of Bermuda and made similar movements to those observed for the three dolphins tracked in 2003 for 45 days. This dolphin, and the three dolphins tagged in 2003, preferred to stay in close proximity to the Bermuda Pedestal and in water depths ranging between 1,000 -1,400 m. These movement patterns, along with year-round dolphin sightings, suggest there may be a resident population of dolphins around Bermuda. Further investigation is necessary to determine if Bermuda waters may also be a stop-over site of a larger range, as recently witnessed by the longer-ranging movements by the two dolphins.

The dive data collected from the time depth recorders located on the satellite tags revealed that although a majority



of the total dives made by the three dolphins during the tracking period did not exceed five minutes in duration, several dives were recorded between 10 – 11 minutes. In addition, all three dolphins made dives beyond 600 m including the occasional dives made by the one female dolphin to depths between 800 - 900 m. These are the deepest recorded dive depths and durations for wild bottlenose dolphins to date.

This project has provided the opportunity to observe, examine and sample offshore dolphins found in the deep waters of the northwest Atlantic Ocean, as well as for comparison with the nearshore dolphins found in Sarasota Bay. Samples collected have been provided to many ongoing investigations, including blubber for contaminant analysis. Future research plans include a genetic study of these dolphins, as well as a photo-id study, to help determine if these animals should be managed as a local population and/or part of a larger oceanic population. This project has been funded by Dolphin Quest Inc. / Quest Global Management, with additional support from the Bermuda Zoological Society and the Chicago Zoological Society.



Tracking locations of three bottlenose dolphins tagged with satellite-linked transmitters during 2005 off Bermuda. The island of Bermuda is in the lower left corner; Muir Seamount in the upper right.

Radio tagging of Franciscana dolphins in Argentina

Pablo Bordino, MSc, AquaMarina

Franciscana dolphins are among the smallest of dolphins, and are the most endangered dolphin species in South America. The main goals of this study were to determine if capture-release and radio-tagging of this species is feasible, and if so, to begin to obtain information regarding movement patterns to aid in development of an effective management plan in Argentina. Three female Franciscana dolphins were radio tagged with small VHF transmitters and released in Bahia Samborombon in March 2005. The tags were attached to the dorsal fins by a single delrin plastic pin with corrosible nuts. The dolphins were tracked for 6 weeks from a lighthouse, the roof of a hotel, a boat, and from the shore. The maximum range from the highest receiving stations was about 20 km. Signals were received from at least one of the tagged dolphins daily, from two individuals on 71% of days, and from all three individuals on 40% of the tracking days. Preliminary analyses by unit effort revealed fairly localized movements by the dolphins, which were mainly recorded in the same area where they were caught. Preliminary analyses suggest a movement pattern associated with the tidal flow, with dolphins coming into the bay during high tide. Though the pilot data set is small, the consistency of findings across the animals suggests that the current designation of a single management stock in Argentina should be re-evaluated. The suggestion of small ranges in areas of heavy artisanal fishing pressure increases the urgency with which protective measures need to be implemented for this species. This study represents the first time that radio tracking has been accomplished with Franciscana dolphins; additional tagging is planned for 2006. Support for this project was provided by Wildlife Trust, Disney Wildlife Conservation Fund, Disney's Animal Programs, and the Chicago Board of Trade.



Tracking Franciscana dolphins north of San Clemente: Brian Balmer, Pablo Bordino (project leader), Randall Wells. Photo by Bill Scott.



Tagging and tracking team. Photo by Bill Scott.



Three Franciscana killed in artisanal fishing nets in one day near San Clemente. Photo by Bill Scott.

INVOLVEMENT IN OTHER MARINE MAMMAL CONSERVATION AND RESEARCH ACTIVITIES *cont.*

Distribution, habitat use and relative abundance of coastal tucuxi and bottlenose dolphins in the Gulf of Morrosquillo, Colombia

By Salomé Dussán-Duque, MSc

There are two species of coastal dolphins that share the habitats of the Gulf of Morrosquillo in Colombia: tucuxi and bottlenose. Coastal tucuxi have been designated in Colombia as a "vulnerable" species due to a moderate risk of extinction. Abundance appears to have declined by 30% or more in the last 10 years. In addition, the populations of bottlenose dolphins in Colombia are classified as "data deficient". Clarification of the status of bottlenose dolphins in coastal Colombian areas is a priority for long-term conservation. The main threats for the Gulf of Morrosquillo populations of coastal dolphins are: changes in regional prey abundance and distribution, progressive loss of habitat, and direct catch for illegal marketing and display. The main goal of this project is to evaluate the distribution, habitat use and relative abundance of coastal tucuxi and bottlenose dolphins in the Gulf of Morrosquillo to develop guidelines for the management and long-term conservation of these species and their habitats.



From November 2002 through November 2005 we collected data for a total period of seventeen months, making this project the longest ongoing research on coastal dolphins in Colombia. We collected behavioral, geo-physical, environmental, photo-ID, acoustic, and carcass data. During 2005 we started recording the vocal behavior of tucuxi through a sister project with the University of Pavia, Italy and the IMR in Norway. The data are still being analyzed, using mainly ArcGis, capture-recapture techniques and the acoustic software Raven (University of Cornell). The results are being compared to previous studies of colleagues in Colombia and Brazil. Preliminary findings for both species include: 1) sightings per unit of survey effort are less frequent now than reported in 1994, 2) use of Cispatá Bay is significantly less than that reported in 1994 and 1998, 3) some individuals seem to be permanent residents of the area over the last 10 years ($n = 3$), 4) there is a strong tendency for site fidelity to the feeding grounds through the years, 5) the presence of specific individuals fluctuates through the seasons and 6) the vocal behavior of tucuxi in the area seems to be similar to that reported in study areas of Brazil, although it reached higher frequencies.

On the 30 July 2005, I traveled to the islands in the northern part of the Gulf, where a zoo has held two tucuxi

dolphins under poor conditions for 10 years. On my visit I found another two tucuxi in a new pool that were captured toward the end of June in my study area. One of the individuals was recognizable and had been identified in the wild during October 2004. The health of the dolphins did not appear to be very good.

The category of "vulnerable" makes the capture and maintenance in captivity of this species in Colombia illegal. Permission for releasing of the dolphins was granted after a legal process that lasted for almost a month. On 26 August 2005, in a cooperative project between different organizations, we traveled to the islands to release the dolphins. The dolphin that was identified previously was not in the facility anymore, and the owners of the zoo did not provide clear information about its absence. We released the other tucuxi in one of the areas with a high number of sightings of this species. We are currently proceeding with obtaining permission from the government to release the two dolphins still remaining in the facility. We plan to work with the SDRP to radio-track and monitor the dolphins upon release.

Based on the preliminary results of this project, a designation of "Environmental Protected Area" in the Gulf of Morrosquillo was approved for both species this year. This is a major outcome for the project and the long-term conservation of both species and their habitats. The EPA will be part of a bigger management area for different species of fauna and flora. It will include the 33 National Parks of Colombia. We are currently working with different colleagues on developing management plans for each species. Our data on Gulf of Morrosquillo species and habitats are being compiled to be presented to the Colombian Environmental Ministry in support for the creation of a National Park. The year 2006 promises to be a very important and a busy year for our research. We would like to thank the support of the Chicago Zoological Society, Corporación Autónoma Regional de los Valles del Sinú y del San Jorge, Colombia and Conservación Internacional, Colombia.

Genetic population structure of coastal tucuxi dolphins in Southern Brazil

By Paulo A.C. Flores, PhD, Deborah A. Duffield, PhD, and Paulo Simões-Lopez, PhD

The marine tucuxi inhabits river and lake systems of Amazonia, the lower Orinoco River, and coastal marine waters from southern Brazil north to at least Nicaragua. For more than 10 years, Paulo Flores has been studying marine tucuxi at the southern extent of the species' range, in Baía Norte of the Florianópolis region of Brazil. His work, including his Earthwatch Institute photographic identification studies since 2001 that include Randall Wells as co-PI, has demonstrated the existence of a long-term resident population of tucuxi that appears to be isolated from other populations, based on distance from other documented populations. This population is subjected to human impacts from gill-net fishing (for which incidental dolphin take has been documented), boat traffic,

and coastal development. The degree of risk from human threats to this population remains to be evaluated, as more information is needed on population structure and the degree of isolation.

As a collaboration between Brazilian and U.S. scientists, we initiated a study of the genetic structure of the population of marine tucuxi inhabiting Baía Norte, taking advantage of existing samples from stranded tucuxi recovered



from Baía Norte. Teeth from stranded tucuxi were used as a source of genetic material to begin to evaluate the genetic variability in the population (teeth from museum specimens were provided by Dr. Simões-Lopes).

Genetic variability were assessed by two methods: 1) mitochondrial DNA haplotypes, to examine phylogeographic distinctions between the resident population and samples from other areas, and 2) DNA microsatellites, to investigate the population structure of this resident group

Total genomic DNA was extracted from 36 individuals. Mitochondrial DNA (mtDNA) was amplified with three primers of different sizes: 130 base pairs (bp), 230 and 540, with successful amplification from both the 130 and 230bp for 34 of the 36 samples (individuals). An ~ 230bp mtDNA sequence of the control region was obtained, which overlaps with *Sotalia* sequences from GenBank and Cunha *et al.* (2005) from a phylogenetic study along the Brazilian coast. The sequences obtained from 33 individuals were excellent but all identical, producing only one haplotype which is identical to the sequence reported as the only one for south-southeastern Brazil by Cunha *et al.* (2005) as found in GenBank. Therefore, at the level we analyzed, no genetic variability was found in our sample, which included 15 males, 10 females and five individuals with no gender identification (calves, juveniles and adults) from Baía Norte, as well as one male and five other individuals from Baía de Babitonga, located about 200 km to the North. Microsatellite analyses continue.

We were able to consistently extract DNA from teeth of museum/scientific collection material. These protocols will be extremely helpful for other researchers with access to such material from museums or



scientific and stranding network collections, especially in Latin America where the subject species occurs, for future molecular studies. We have banked DNA for 34 individuals, which is likely to represent the largest sampling for a discrete population of marine tucuxi to date. Support for this project was provided

by the Chicago Board of Trade, Dolphin Biology Research Institute, and the Whale and Dolphin Conservation Society.

Literature Cited:

Cunha, H.A., V.M.F. da Silva, J. Lailson-Brito Jr., M.;C.O. Santos, P.A.C. Flores, A.R. Martin, A.F. Azevedo, A.B.I. Fragoso, R.C. Zanelatto, and A.M. Solé-Cava. 2005. Riverine and marine ecotypes of *Sotalia* dolphins are different species. *Marine Biology*. (pdf)

Serving as a Scientific Representative on a NMFS Take Reduction Team

By Damon Gannon, PhD

During spring 2005, I was asked by the National Marine Fisheries Service to serve as a scientific representative to the Pelagic Longline Take Reduction Team (Bill McLellan, our colleague from University of North Carolina, Wilmington, is the other scientific representative on the team). Under the Marine Mammal Protection Act, the government is required to form Take Reduction Teams (TRTs) for commercial fisheries that accidentally kill or seriously injure marine mammals. Take Reduction Teams are composed of experts and stakeholders—representatives from the fishing industry, environmental organizations, government agencies, and the scientific community—who work collaboratively to develop strategies for reducing bycatch of marine mammals. The Pelagic Longline TRT has been convened to develop a plan for reducing the unintended catch of long-finned (*Globicephala melas*) and short-finned (*G. macrorhynchus*) pilot whales in the Atlantic pelagic longline fishery. Pelagic longlining is a commercial fishing method in which hundreds of baited hooks are deployed to catch swordfish and tuna. The team has its work cut out for it because interactions between longlines and pilot whales are relatively rare and the nature of these interactions is not well known. Although the rate of incidental catch is low, when extrapolated over all of the boats of the fishery, the total number of whales killed and seriously injured is significant. Pilot whales become ensnared in longlines by blundering into them, by eating the baited hooks, or by depredating the tuna and swordfish that have been caught. The Pelagic Longline TRT was convened in June 2005, and under the law, has until May 2006 to develop a consensus plan for reducing bycatch of pilot whales. The plan must be reviewed by the National Marine Fisheries Service and approved by the Secretary of Commerce. Once the Take Reduction Plan goes into effect, the fishery has five years to reduce pilot whale mortality and serious injury to “insignificant levels approaching zero.” The TRT will meet periodically during this five-year period to assess whether the plan is working satisfactorily and to make any changes that may become necessary.

Education continues to be a major component of SDRP activities, directed toward the general public, students, colleagues, and wildlife management agencies. We work to educate the general public regarding bottlenose dolphins and conservation issues through public presentations at Brookfield Zoo, Mote Marine Laboratory and elsewhere, articles and interviews, and through volunteering opportunities through Earthwatch Institute. We also produce books for the general public and students. One of these, "Dolphins, Whales, and Manatees of Florida: A Guide to Sharing Their Waters," by John Reynolds and Randall Wells, was published in 2003 to fill a niche for teaching people about how to better appreciate and treat marine mammals in their environment. Another, "Dolphin Man: Exploring the World of Dolphins," by Laurence Pringle and Randall Wells, was published in 2002 to provide middle school students with an opportunity to learn about Sarasota Bay's dolphins and about one pathway for becoming a marine biologist engaged in dolphin biology research and conservation.

An Immersion Cinema interactive program, "Dolphin Bay," loosely based on our long-term dolphin research and conservation program in Sarasota Bay, was previewed and tested during 2004, revised earlier this year, and is now being aired during multiple daily showings at Mote Marine Laboratory's 165-seat theater. Participants are able to investigate realistic threats to bottlenose dolphins in the imaginary bay, and attempt to resolve the threats for the animals by applying field research techniques and performing rescues. The program is designed to entertain as well as educate young people, especially, about the threats faced by coastal dolphins, and about the means available to them for making a positive difference in the dolphins' lives. It tries to present a balanced selection of realistic alternatives. The consequences of the choices made by the participants are shown through modeling of the Dolphin Bay population using the program "Vortex" (developed by the Chicago Zoological Society's Dr. Robert Lacy), indicating the population size 50 years hence.

At the college level, we are fortunate to have access through Mote Marine Laboratory to high quality, dedicated undergraduate student interns who volunteer with our program for at least 3 months at a time (for more information on participation, contact Andrea Davis at <adavis@mote.org>). As described throughout the newsletter, graduate students come to our program primarily through the University of California at Santa Cruz, the University of South Florida, and the University of North Carolina, Wilmington to conduct their thesis or dissertation research (13 doctoral dissertation and 21 master's thesis projects have been conducted in association with our program). We participate in college-level marine mammal courses, and provide supporting materials for these courses. We continue to host the annual summer MARVET marine mammal veterinary student course, and we participated again in the University of Florida's SEAVET program.

Our efforts to provide information to our colleagues and wildlife management agencies continues, through publication of numerous scientific articles, through invited presentations at various scientific conferences and through participation in national/international panels such as the Atlantic Scientific Review Group (R. Wells, member), Take Reduction Teams (D. Gannon, member), the Working Group on Marine Mammal Unusual Mortality Events (R. Wells, chair), the International Whaling Commission Pollution 2000+ Programme (R. Wells, Steering Committee member), the IUCN Cetacean Specialist Group (R. Wells, member), and the IUCN Reintroduction Specialist Group (R. Wells, member).

SDRP contributes to Mote's Research Experiences for Undergraduates Program

By Damon Gannon, PhD

Each summer, Mote Marine Laboratory hosts a 10-week program to provide research experiences in marine science to advanced undergraduate students. This highly-prestigious project is funded by the National Science Foundation's Research Experiences for Undergraduates (REU) Program. Under the supervision of a scientist from Mote, each student designs and completes an independent research project. Students present the results of their research in a manuscript-style research paper and in an oral presentation at a laboratory-wide research symposium. In addition, students get the opportunity to participate in many ongoing research projects, attend research seminars, participate in discussion groups on science careers, and go on field trips to local marine science research and education centers.

This year, I mentored REU student Leo Procise from the University of Saint Francis in Fort Wayne, Indiana. Leo was one of the core members of the purse seine survey crew and his independent research project was titled "An Investigation of the Differences Between Trimmed and Untrimmed Mangroves in Sarasota Bay: An Essential Habitat with Respect to Several Abiotic and Biotic Factors." Residents with waterfront property have the option of trimming their mangrove trees to a minimum height of six feet. Leo investigated whether trimming of the mangroves affects the average size of individual fish or the composition of the fish community living among the trees' roots. His research showed that in both 2004 and 2005, the average density of fish (number of fish caught per deployment of our purse seine net) living among trimmed mangroves was lower than that found among untrimmed

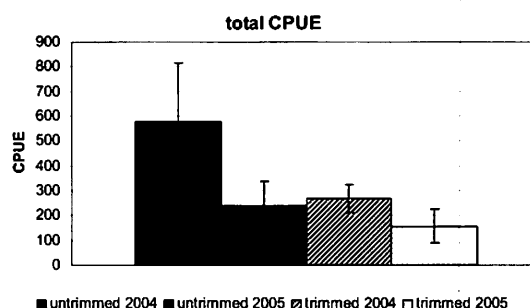


Figure 1. Total catch-per-unit-effort of fish among trimmed and untrimmed mangroves during 2004 and 2005.

mangroves (Figure 1). Unfortunately, as described above, the severe red tide event that persisted throughout most of 2005 in Sarasota Bay caused dramatic changes to the fish community. Because the red tide appeared to have a greater effect on the fish community than did trimming of the mangroves, data for the two years could not be combined, which limited the power of the statistical tests used. So even though the differences were large in both years, they were not statistically different. However, these results may be biologically significant and additional sampling should result in statistical significance.

Volunteer Perspective

By Bill Scott, Bermuda

There is not much that is more rewarding than to be a volunteer on projects that lead to new discovery or leading edge research. I was fortunate to have this opportunity twice this year. In March I accompanied the SDRP team and others to Argentina to work with Pablo Bordino. There was a fair amount of trepidation and tension leading up to the first tagging, not alleviated by the usual frustrations of engine problems and weather. Nobody had tried tagging these delicate animals before and equally did not know how the animals might react. Much to everybody's relief the animals seemed to remain relatively calm. I do not think I will ever forget the unmitigated joy, tears, and smiles of the team when we tagged "Patricia," the first of three animals. It was particularly inspiring to see so many young university students demonstrate such passion about what they were doing. I was also impressed by the fact that the local fishermen were involved in the project. The entire team was the warmest, most welcoming and greatest fun loving group you could meet. I would go back in a heartbeat! (Hint. Hint.). I did leave a fair amount of blood in the bellies of mosquitoes the time that we went radio tracking at midnight. Small price to pay for so much fun!

In May I joined Leigh Klatsky on the Bermuda project – right in my own backyard. Having lived here for over 30 years it was great to be helping science understand a population of animals that the majority of Bermuda residents don't know exists. It's a little like looking for a needle in a haystack looking for dolphins around Bermuda but with the help of fishermen and others we succeeded. Having experienced the capture techniques in Sarasota it was fascinating to see the "hoop net" technique employed here – and the subsequent efforts to get the animals up on the deck! The fact that you could subsequently follow the track of the tagged animals on Dolphin Quest's web site was great as it enabled the sharing of information with the public at large and school children in particular.

Having retired from a career in financial services it is particularly stimulating to be involved in these adventures, even if I up the average age a few years!! Thanks Randy, Pablo and Leigh for the opportunities. I am available (and cheap).



Returning a female Franciscana dolphin to the water following tagging, for release.

Volunteer intern perspective: Landlocked states continue to produce marine mammal researchers

By Robin Perrtree, BSc

When I graduated from college in 2002 in my home state of Missouri I had no marine mammal experience. However, I always knew that cetacean research was my path because I was drawn to the ocean and fascinated by dolphin behavior, so my first step was gaining experience through internships. The Sarasota Dolphin Research Program internship interested me early on, but for a variety of reasons I did my first couple of internships elsewhere (Texas A&M University at Galveston studying bottlenose dolphins and the Whale Center of New England studying humpbacks and other large whales). I finally made it to Mote Marine Laboratory in January 2004 as an intern with the Offshore Cetacean Ecology Program and then I moved from there over to SDRP. In the late summer of 2004 I left for previously scheduled research experiences in South Carolina and Georgia with a government bottlenose dolphin biopsy project and in Hawaii with Dr. Robin Baird tagging beaked whales and surveying other cetacean species, but in January 2005 I called Kim Bassos-Hull and asked about returning.

In the spring of 2005 as a lab intern (or "re-tern" as they liked to call me) I spent most of my time helping with photo-identification of both Sarasota and Charlotte Harbor dolphins. I was also able to take advantage of many other opportunities that arose both in the lab and the field. In the lab I got involved in data manipulation and analysis using techniques such as mark-recapture and making charts displaying discovery curves. In addition I learned to use ArcGIS to calculate the number of dolphins seen per kilometer of survey effort. In the field I worked with graduate students including Spencer Fire looking at the impact of Red Tide on the dolphins, Katie McHugh studying juvenile behavior, and Christine Shepard studying the impact of boats on the dolphins. I also participated in synoptic surveys, Earthwatch surveys, and the capture-release health assessment project. In addition I got involved in other programs at Mote Marine Laboratory, volunteering with the Dolphin and Whale Hospital, and further helping the Stranding Investigations Program recover both living and dead cetaceans.

All of these varied experiences have broadened my view of the marine mammal research field and opened new doors for me. I have been hired as a Biological Technician in the SDRP lab. I look forward to continuing down this path as it opens up additional opportunities.

SARASOTA DOLPHIN RESEARCH PROGRAM OPERATIONS

SDRP Database Progress

By Stephanie Nowacek, MSc, SDRP Lab Manager, and Janet Gannon, MSNR, SDRP GIS Manager

Some of the most important, but least visible, aspects of science are how data are collected and stored. Considering that during the summer months of 2005 alone, SDRP had 110 boat days, with 454 sightings involving 2,241 animals, this can be a very large task involving dozens of people. We use a custom built Microsoft Access application to enter, verify, and query our extensive database. We maintain a "front end-back end" arrangement for this database, keeping our valuable verified data on a server and accessing it through interfaces on each workstation. This allows us to protect data integrity while using the data for conservation and research.

On any given day, staff and interns in our office might be sitting down at a computer entering sighting data, verifying photo identification data, and extracting data from the database for use in analyses. Our bottlenose dolphin database is one of the most detailed in the world with 29,235 group sighting records since 1975, and growing larger every month. We know 2006 will see many more entries in the database, allowing even more projects to come to fruition.

Identifying dolphins through pictures of their dorsal fins (photo-id) continues to occupy our staff. This year two huge accomplishments were reached: the first is finishing matching images for all backlogged field days enabling the lab to be in real time for photo-id. The second is the development of a fully digital catalog. We have about 3,070 recognizable dolphins in our catalogs which span the waters from Tampa Bay to Charlotte Harbor including the gulf and bay waters. Searching through these catalogs can be quite time-consuming. The digital catalog should allow for faster searching and matching. We are using ACDSee 8.0 for the catalog and each fin picture is categorized based on its fin features as well as primary sighting location area. We hope that this tool will enable the lab to continue to be in real time for photo-id.

Staff Members During 2005

Randall S. Wells, PhD, Program Manager
 Stephanie Nowacek, MSc, Lab Manager
 Kim Bassos-Hull, MSc, Research Associate
 Jason Allen, BSc, Field Coordinator
 Damon Gannon, PhD, Staff Scientist
 Janet Gannon, MSNR, Senior Biologist
 Elizabeth Berens, MSc, Staff Biologist
 Aaron Barleycorn, BSc, Research Assistant
 Stephanie Schilling, BSc, Research Assistant
 Robin Perttree, BSc, Biological Technician
 Katie Brueggen, BSc, Research Technician
 Gene Stover, Operations Manager
 Michael Scott, PhD, Secretary, DBRI
 Blair Irvine, PhD, Vice-President, DBRI

Contract Staff During 2005

Kim Urian, MSc, Research Associate
 Kara Buckstaff, MSc, Research Associate
 Sue Hofmann, BSc, Research Associate
 Lori Schwacke, PhD, Consultant

Interns and Lab Volunteers During 2005

Bill Kayser	Kate Wells
Salome Dussan	Eva Hartvig
Carly Gaebe	Kathy Young
Kristen Clark	Jordan Levinson
Zuzana Slovackova	Colleen Young

Master's Students During 2005

Michelle Barbieri, University of North Carolina, Wilmington
 Brian Balmer, University of North Carolina, Wilmington
 Lance Miller, University of Southern Mississippi
 Laura Monaco, Western Illinois University
 Virginia Fuhs, Western Illinois University
 Colleen Bryan, College of Charleston
 Carter Esch, University of North Carolina, Wilmington

Doctoral Students During 2005

Spencer Fire, University of California, Santa Cruz
 Mandy Cook, University of South Florida
 Magali Houde, University of Guelph
 Erin Meagher, University of North Carolina, Wilmington
 Ester Quintana, University of South Florida
 Katie McHugh, University of California, Davis
 Christine Shepard, University of California, Santa Cruz
 Jennifer Yordy, Medical University of South Carolina

Christy Schuchardt	Ryan Bobholz	Jenna Voss
Marsha Thompson	Neil Dorrian	Douglas Wood
Vanessa Jordan-Sardi	Laura McCue	
Leslie Curren	Leo Procise	
Olivia Lee	Allison Sherman	

Professional Activity Summary

One accepted measure of the productivity of a research program is its record of achievement in providing information to the scientific community, wildlife management agencies, and the public. The following list includes our program's products since the publication of our last newsletter, including the relevant work of our collaborators from partner institutions. Copies of specific papers can be obtained upon request for the cost of copying and postage, or in some cases as pdf files.

Peer-reviewed Journal Articles and Book Chapters

- Wells, R.S., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn, and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Science of the Total Environment* 349:106-119.
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- Manuscripts In Press, In Revision, or In Review**
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- Owen, E.C.G., D.A. Duffield, and R.S. Wells. In revision. Cooperation between non-relatives: alliances between adult male bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, Florida. *Animal Behaviour*.
- Hall, A.J., B.J. McConnell, T.K. Rowles, A. Aguilar, A. Borrell, L. Schwacke, P.J.H. Reijnders, and R.S. Wells. In press. An individual based model framework to assess the population consequences of polychlorinated biphenyl exposure in bottlenose dolphins. *Environmental Health Perspectives*.
- Sayigh, L.S., L.E. Williams, R.S. Wells, and A.A. Hohn. In review. Modifications of signature whistles in adult female bottlenose dolphins. *Animal Behavior*.
- Wetzel, D.L. J.E. Reynolds, III, J. Sprinkel and R.S. Wells. In review. Fatty acids in blubber of the bottlenose dolphin (*Tursiops truncatus*): diversity, inter-annual variation, and similarities between fatty acid profiles of mothers and their calves. *J. of Comparative Biochemistry and Physiology*.
- Sellas, A.B., R.S. Wells, and P.E. Rosel. In press. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. *Conservation Genetics*.
- Buck, J.D., R.S. Wells, H.L. Rhinehart, and L. J. Hansen. In review. Aerobic microorganisms associated with healthy wild dolphins (*Tursiops truncatus*) in Gulf of Mexico and North Carolina waters – a twelve year perspective. *Journal of Wildlife Diseases*.
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- Wells, R.S. 2005. Marine mammal health assessment: Summary of perspectives and opportunities. Florida Marine Mammal Health Conference II, 7-10 April, Gainesville, FL.
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Professional Activity Summary cont.

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- Brueggen, M.K., D.P. Gannon, and R.S. Wells. 2005. Effects of bottlenose dolphin sounds on the acoustic behavior of spotted sea trout. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Brueggen, M.K., and D.P. Gannon. 2005. Effects of bottlenose dolphin (*Tursiops truncatus*) sounds on the acoustic behavior of spawning spotted seatrout (*Cynoscion nebulosus*). Aquatic Sciences Meeting (American Society of Limnology and Oceanography), Salt Lake City, UT.
- Bryan, C.E., S.J. Christopher, W.C. Davis, R.D. Day, A.A. Hohn, and R.S. Wells. 2005. Establishing baseline trace element concentrations for bottlenose dolphins in Sarasota Bay, Florida through non-lethal monitoring of tissues and further exploring mercury levels in relation to life history data. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Cook, M.L.H., R.S. Wells, and D.A. Mann. 2005. Auditory evoked potential (AEP) hearing measurements in free-ranging bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Dussán-Duque, S., R.S. Wells, and K. Bassos-Hull. 2005. Distribution, habitat use and abundance of coastal Tucuxi (*Sotalia fluviatilis*) in the Gulf of Morrosquillo, Colombia. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Esch, H.C., L.S. Sayigh, and R.S. Wells. 2005. Whistles as potential indicators of stress in bottlenose dolphins. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Fauquier, D., M. Kinsel, M. Dailey, G. Hurst, N. Barros, M. Stolen, S. Rommel, R.S. Wells, and F. Gulland. 2005. Assessing the impact of lungworm infection on the health of wild bottlenose dolphins in central west Florida. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Fauquier, D., F. Gulland, S. Fire, L. Flewelling, J. Lansberg, N. Barros, M. Dailey, G. Bossart, D. Duffield, J. Gannon, M. Kinsel, C. Manire, J. Ramsdell, S. Rommel, M. Peterson, L. Schwacke, M. Stolen, R. Pierce and R. Wells. 2005. Assessing the impact of lungworm infection and red tide intoxication on the health of wild bottlenose dolphin populations. Florida Marine Mammal Health Conference II. Gainesville, FL. 7-10 April.
- Fauquier, D.A., G.E. Hurst, N.B. Barros, J.D. Grimes, J. Gannon, L. Schwacke, M. Stolen, T. P. Lipscomb, M.J. Kinsel and R.S. Wells. 2005. Causes of mortality in bottlenose dolphins (*Tursiops truncatus*) stranded along central west Florida from 1985 – 2004. National Marine Mammal Health and Stranding Conference. Lansdowne, VA. 4-6 April.
- Flores, P.A.C., M. Bazzalo, L. Zago, and R.S. Wells. 2005. Evidência de residência individual e ocorrência de lesões epidérmicas em golfinhos *Tursiops truncatus* na Baía Norte, SC, Brasil. 3rd Brazilian Conference of Mammalogy, 12-16 October 2005, Aracruz, ES, Brazil.
- Gannon, D.P. and E. Berens. 2005. Fisheries science for marine mammalogists: factors to consider when selecting a method for sampling fish populations. Southeast and Mid-Atlantic Marine Mammal Symposium. University of North Carolina, Wilmington, North Carolina.
- Gannon, D., E. Berens, and R.S. Wells. 2005. Fisheries science for marine mammalogists: Factors to consider when selecting a method for sampling fish populations. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Gannon, J.G., R.S. Wells, and S. Hofmann. 2005. Fine-scale natal philopatry and sex differences of bottlenose dolphins in Sarasota Bay, Florida. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Gannon, J. G., D. P. Gannon, E. J. Berens, and R. S. Wells. 2005. Evaluating two methods of assessing differences in distribution, Syrjala's procedure and Williamson's index of spatial overlap, with case studies in *Tursiops truncatus*/ecology. Workshop on the Application of GIS Spatial/Temporal Prediction Models for Marine Mammal Scientists and Management, 16th Biennial Marine Mammal Conference, San Diego, CA, USA.
- Houde, M., B.C. Balmer, T.A.D. Bujas, R.S. Wells, A.A. Hohn, J.C. Sweeney, G.D. Bossart, P.A. Fair, K.R. Solomon, and D.C.G. Muir. 2005. Emerging perfluorinated contaminants in bottlenose dolphins (*Tursiops truncatus*) from the Atlantic Ocean and the Gulf of Mexico. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Houde, M., Balmer, B.C., Bujas, T.A.D., Wells, R.S., Solomon, K.R. and Muir, D.C.G. 2005. Perfluorinated alkyl compounds in free-ranging bottlenose dolphins from the Sarasota Bay, Florida, USA and their food web. 15th Annual meeting of the Society of Environmental Toxicology and Chemistry (SETAC), Lille, France, May 2005.
- Houde, M., Bujas, T.A.D., Balmer, B.C., Bossart, G.D., Fair, P.A., Wells, R.S., Solomon, K.R., Muir, D.C.G. 2005. Tissue distribution of perfluorinated alkyl acids in bottlenose dolphins (*Tursiops truncatus*). 15th Annual meeting of SETAC, Lille, France, May 2005.

- Hurst, G.E., D.A. Fauquier, K. Bassos-Hull, N.B. Barros, C.A. Manire, J.D. Grimes and R.S. Wells. 2005. Fishery-interactions of bottlenose dolphins. *Tursiops truncatus*, in central and southwest Florida. National Marine Mammal Health and Stranding Conference. Lansdowne, VA. 4-6 April.
- Janik V. M. 2005. Referential communication in bottlenose dolphins. Invited talk at the Workshop on "Animal models in cognitive neuroscience" (NWO Advanced Study Program), Oud-Poelgeest, The Netherlands.
- Janik V. M., L. Sayigh, and R. Wells. 2005. Signature whistle shape conveys identity information to bottlenose dolphins. Spoken presentation at the 29th International Ethological Conference, Budapest, Hungary, 20-27 August 2005.
- Janik, V.M., L.S. Sayigh, and R.S. Wells. 2005. Signature whistle shape conveys identity information to bottlenose dolphins. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Karczmarski, L., R.S. Wells, B. Würsig, and S. Gowans. 2005. Social behavior and social evolution in delphinids. 9th International Mammalogical Congress, 31 July – 5 August, Sapporo, Japan.
- Klatsky, L., R.S. Wells, and J. Sweeney. 2005. Bermuda's deep diving dolphins - Movements and dive behavior of offshore bottlenose dolphins in the northwest Atlantic Ocean near Bermuda. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Klatsky, L.J., R.S. Wells, and J.C. Sweeney. 2005. Diving behavior and movement information of offshore bottlenose dolphins near the Bermuda Pedestal. Dolphin Neonatal and Reproduction Symposium. Indianapolis, Indiana. October 8-11, 2005.
- Kucklick, J., J. Yordy, A. Peck, R.S. Wells, A. Hohn, J. Litz, L. Schwacke, B. Balmer, L. Hansen, E. Zolman, and T. Rowles. 2005. Spatial and temporal trends of brominated flame retardants in dolphins from the western North Atlantic Ocean and eastern Gulf of Mexico. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Morrisette, H. C., L. Sayigh, and R. Wells. 2005. Quantifying stereotypy of bottlenose dolphin signature whistles. Poster presentation at the Southeast and Mid-Atlantic Marine Mammal Meeting, 18-20 March 2005. (*won best MSC poster award*)
- Pabst, D.A., W.A. McLellan, S.A. Rommel, M.D. Scott, A.B. Irvine, J.C. Sweeney, R. Stone, A.S. Friedlaender, E.M. Meagher, A.A. Hohn, and R.S. Wells. 2005. Ontogeny of temperature regulation of the testes of male bottlenose dolphins (*Tursiops truncatus*): insights from long-term field studies. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Procise, L. and D.P. Gannon. 2005. Effects of mangrove trimming on the mangrove-associated fish community. Fall 2005 Meeting of the Indiana Academy of Sciences.
- Quintana-Rizzo, E., D. Mann, and R.S. Wells. 2005. Communication range of social sounds used by wild bottlenose dolphins during fission-fusion events (*Tursiops truncatus*). 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Reynolds, III, J.E., D.L. Wetzell, R.S. Wells, and J.M. Sprinkel. 2005. Fatty acids in bottlenose dolphin (*Tursiops truncatus*) milk differ significantly from those in maternal and calf blubber: evidence using a novel analytical approach. Florida Marine Mammal Health Conference, 7-10 April 2005, Gainesville, FL.
- Sayigh, L.S., V.M. Janik, and R.S. Wells. 2005. What's in a voice? Cues used by dolphins in individual recognition of signature whistles. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Sayigh, L., V. M. Janik, and R. Wells. 2005. What's in a voice? Cues used by dolphins in individual recognition of signature whistles. Invited spoken presentation at the Acoustical Society of America Meeting, Minneapolis, MN, 17-20 October 2005.
- Schwacke, L.H., A.J. Hall, R.S. Wells, L. J. Hansen, A.A. Hohn, J.R. Kucklick, F. Townsend, R. Varela, T.K. Rowles. 2005. A health assessment framework for free-ranging bottlenose dolphins along the southeast U.S. Coast. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Shah, R.S., K.L. West, O.L. Oftedal, R.S. Wells, and J.C. Sweeney. 2005. Milk mineral values in free-ranging and captive bottlenose dolphins (*Tursiops truncatus*). 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Spradlin, T.R., F.M.D. Gulland, R.S. Wells, T.J. Ragen, and T.K. Rowles. 2005. Review of marine mammal unusual mortality events in the United States: 1992-2005. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- West, K.L., O.T. Oftedal, R.S. Wells, D.P. Costa, and M.B. Kretzmann. 2005. Milk composition and calf growth in free-ranging bottlenose dolphins (*Tursiops truncatus*). 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Westgate, A.J., E.M. Meagher, W.A. McLellan, R.S. Wells, and D.A. Pabst. 2005. Seasonal differences in skin temperature and heat flux across the dorsal fin of free-ranging bottlenose dolphins (*Tursiops truncatus*). 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- White, C., L. Sayigh, and G. Tagliarini. 2005. Autonomous detection of bottlenose dolphin signature whistles. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Yordy, J., J. Kucklick, R.S. Wells, B. Balmer, B. Swarthout, and T.K. Rowles. 2005. Partitioning of contaminants between blubber, blood and milk in free-ranging bottlenose dolphins: implications for bio-monitoring. 16th Biennial Conference on the Biology of Marine Mammals. December 12-16, 2005, San Diego, CA.
- Yordy, J., R.S. Wells, J. Kucklick, T.K. Rowles, B.C. Balmer, J. Keller, and S. Vanderpol. 2005. Maternal Transfer of contaminants via lactation in the bottlenose dolphin, *Tursiops truncatus*. SEAMAMMS 2005. April 2005. Wilmington, NC

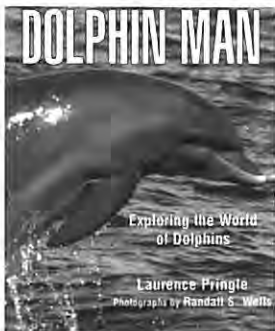
Invited Public and University Lectures

- Wells, R.S. 2005. Career Ladder for dolphin research and conservation. Brookfield Zoo, Brookfield, IL.
- Wells, R.S. 2005. Wild dolphin societies: Lessons from 36 years and 5 generations. Purdue Alumni Club, Sarasota, FL.
- Wells, R.S. 2005. Dolphin family values. SunCoast Reef Rovers Dive Club, Nokomis, FL.
- Wells, R.S. 2005. Wild dolphin societies: Lessons from 35 years and 4 generations. Northwestern University Alumni Club, Sarasota, FL.
- Wells, R.S. 2005. Dolphin family values. Longbeach Village Association, Sarasota, FL.
- Wells, R.S. 2005. Dolphin Immersion at Mote: 35 years in the making. Monday at Mote, Sarasota, FL.
- Wells, R.S. 2005. Dolphin family values: Bottlenose dolphin conservation based on long-term behavior, ecology, life history and health research. Evening Tide Talks, The Florida Aquarium, Tampa, FL.
- Bassos-Hull, K. 2005. Bottlenose dolphin abundance, distribution, population structure, and health in the Charlotte Harbor ecosystem. Gasparilla Island Conservation and Improvement Association, Boca Grande, FL.
- Bassos-Hull, K. 2005. Bottlenose dolphin abundance, distribution, population structure, and health in the Charlotte Harbor ecosystem. Charlotte Harbor National Estuary Program staff and volunteers at Mote Marine Lab, Sarasota, FL.

Want to learn more?

The following books on dolphins and manatees, produced by our staff or by colleagues working closely with our program, are currently available. To purchase copies, please stop by the Brookfield Zoo or Mote Marine Lab gift shops, contact your local bookseller, or look for them on-line.

Reynolds, John E., III, and Randall S. Wells. 2003. *Dolphins, Whales, and Manatees of Florida: A Guide to Sharing Their World*. University Press of Florida, Gainesville, FL. 150 pp. ISBN 0-8130-2687-3



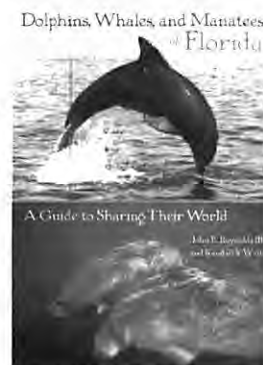
Pringle, Laurence and Randall S. Wells. 2002. *Dolphin Man: Exploring the World of Dolphins*. Boyds Mills Press, Honesdale, PA. 42 pp. ISBN 1-59078-004-3

Reynolds, John E., III, Randall S. Wells and Samantha D. Eide. 2000. *The Bottlenose Dolphin: Biology and Conservation*. University Press of Florida, Gainesville, FL. 289 pp. ISBN 0-8130-1775-0

Reynolds, John E., III and Sentiell A. Rommel, (eds.). 1999. *Biology of Marine Mammals*. Smithsonian Institution Press, Washington, DC. 578 pp. ISBN 1-56098-375-2

Norris, Kenneth S., Bernd Würsig, Randall S. Wells and Melany Würsig. 1994. *The Hawaiian Spinner Dolphin*. University of California Press, Berkeley, CA. 435 pp. ISBN 0-520-08208-7

Howard, Carol J. 1995. *Dolphin Chronicles*. Bantam Books, New York, NY. 304 pp. ISBN 0-553-37778-7



How You Can Make a Difference

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Protect Wild Dolphins Program

Randy Puckett offers new dolphin sculpture to support our operations

World-renowned whale and dolphin sculptor Randy Puckett's newest sculpture, *Blitzen*, is named after a rough-toothed dolphin (steno) that was rescued and treated at Mote Marine Laboratory and released successfully to the sea in 1998. *Blitzen* was one of a group of about 60 stenos which stranded on the Florida panhandle in December 1997. About half were pushed back out to sea, and some were taken to rehabilitation facilities, including four that were taken to Mote. Of those four, two survived: Alvin and *Blitzen*. These two were treated for pneumonia, wounds, liver and kidney problems, and anemia. By March, 1998, Alvin and *Blitzen* were healthy. They were fitted with satellite-linked radio tracking transmitters and released back into the sea about 85 miles west of Tampa Bay. *Blitzen*'s transmitter sent signals for 112 days, sending out a record of his travels. They spent most of their time in about 600 feet of water near the Florida panhandle in an area previously not known to be inhabited by this species of dolphin. Both Alvin and *Blitzen* were observed, without their transmitters and with other dolphins, five months after release, and appeared to be doing well.

Blitzen, the sculpture, measures about 12" high, 8 ½" wide, and 8" deep. It is bronze, in an edition limited to 350 with 35 Artists Proofs, and is mounted on a revolving walnut base. It will be released through galleries in May of 2006 at a price of \$1,500.00 (or \$1,875.00 for an Artists Proof). Prior to May 2006, *Blitzen* is available to you for \$800.00 (or \$1,100.00 for an Artists Proof), providing you make a contribution of \$400.00 or more to Mote Marine Laboratory for their new Marine Mammal Research building, which will house the Sarasota Dolphin Research Program. By purchasing it during this pre-release offer, you will be helping the Sarasota Dolphin Research Program and you will save \$300.00 from the release price. To order *Blitzen*, please obtain an order from the web site: www.whalesofrandypuckett.com and return it to the above address with your contribution check, payable to Mote Marine Laboratory, and your reserve deposit of \$400.00





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