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 2005 **Visit our web site at: www.sarasotadolphin.org**

Sarasota Dolphin Research Program: A Continuing Commitment to Conservation, Research, Education, and Animal Care

By Randall Wells, PhD

The "world's longest-running dolphin research program" is now in its 35th year. It continues as a full-time, year-round operation involving 7 full-time staff members, 2 part-time staff, 5 off-site contract staff, 12 graduate students, and a dozen or more volunteer student interns, joined each month by up to five Earthwatch Institute volunteers. 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.

Our desire with each research project 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 insure the continuity of the long-term dolphin research in Sarasota. The Conservation Biology 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, 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, Disney Wildlife Conservation Fund, Dolphin Quest, Mote Scientific Foundation, 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), since 2001 the Chicago Zoological Society and Mote Marine Laboratory have been the recipients of congressionally-directed funds, through NOAA Fisheries, for dolphin research that have provided crucial sustaining support.

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 2004. 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) "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

Hearing Abilities of Bottlenose Dolphins in Sarasota Bay

By Mandy Cook, PhD student, University of South Florida

Bottlenose dolphins are exposed to a wide variety of natural and anthropogenic noise in their environment, and there is increasing concern that these noises may have negative effects on their hearing. Because dolphins rely heavily on acoustics to both navigate and forage, hearing losses in these animals can be especially detrimental. As a third-year Ph.D. student at the University of South Florida in St. Petersburg with Dr. David Mann, I have been investigating the hearing abilities of free-ranging bottlenose dolphins. Dolphin hearing ranges from about 75 Hertz to over 150 kiloHertz, with peak sensitivities between 8 and 32 kiloHertz (for reference, most humans can hear from 20 Hertz to 20 kiloHertz). Variations in hearing ability do occur between individual animals, and a few studies on captive dolphins have shown that hearing abilities decrease as a function of increasing age (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 brainstem response (ABR) protocol based on techniques used to measure hearing in human infants. Short duration tones of varying frequencies and intensities are played to the dolphins using a jawphone while each animal is on the processing 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 threshold.

Data have been collected from 38 bottlenose dolphins (18 females and 20 males) ages 2-26 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. A summary of these data was presented at the 148th Meeting of the Acoustical Society of America in November, 2004. Future datasets will be collected during capture-release sessions in February and June of 2005. 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.

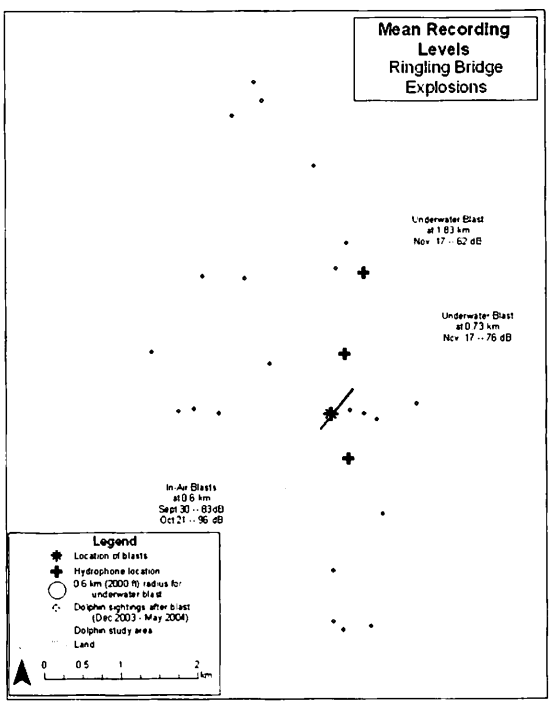
Support for this research has been provided by: Harbor Branch Oceanographic Institution, Inc. Protect Wild Dolphin Program, Dolphin Quest, the P.E.O. Scholar Award, the Jack Lake Endowed Fellowship, the Paul L. Getting Memorial Endowed Fellowship, the Von Rosenstiel Endowed Fellowship, and USF College of Marine Science Graduate Assistantships.

Measuring hearing capabilities with non-invasive ABR technique.

Responses of Bottlenose Dolphins and Manatees to Construction and Demolition of Underwater Structures

By Kara Buckstaff, MSc, and Janet Gannon, MSNR

Evaluating the effects of anthropogenic noise on marine mammals is a rapidly-developing field of scientific inquiry. The goal of this project, funded by the Disney Wildlife Conservation Fund, NOAA Fisheries, and Earthwatch Institute, was to expand our understanding of the suite of threats facing bottlenose dolphins and Florida manatees in coastal waters by investigating a source of potential mortality, injury, or disturbance that has received relatively little research attention to date – marine construction and demolition. In Sarasota Bay the construction of a fixed-span bridge was completed in July 2003, followed by two in-air explosions and a final underwater explosion to demolish the pre-existing Ringling Bridge. Before, during, and after these events occurred boat-based dolphin surveys and aerial manatee surveys were conducted to compare distribution of sightings during bridge construction/demolition to historical sightings records. Additionally, underwater sound levels were recorded at 6 listening stations within a small study area designated to the north and south of the Ringling drawbridge.



In comparing distance from the construction site before, during, and after construction, we found a significant difference in distribution of both bottlenose dolphins and manatees in the post-construction stage. This may indicate that long-term exposure to construction/demoliton noise may cause shifts in habitat use, and may in fact have more impact than acute noises during construction. Observations made during the underwater detonation at distances of 0.73 km and 1.83 km from the explosion site indicated that dolphins do exhibit behavioral responses. While it was not possible to quantify their reactions, observable changes in at-the-surface behaviors were evident. Responses were not assessed for manatees during the underwater explosion as there were no manatees present. Source-level estimates of 160 dB re 1iPa-m and 176 dB re 1 iPa-m were calculated for the in-air explosions and 147 dB re 1 iPa-m was calculated for the underwater explosion. Both in-air explosions were louder *underwater* than the underwater explosion that was contained by a steel coffercell. A permit that required a Marine Species Watch Program within a designated danger zone of 1000 ft was implemented for the underwater explosion, however this was not recommended for the in-air explosions. Based on these findings, in-air explosions occurring close to water level (< 15 ft altitude) should be considered for the potential to affect marine life as well.

Effects of Boat Noise on Dolphin Behavior and Distribution

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

Previous research conducted by SDRP has demonstrated short-term behavioral and acoustical responses of bottlenose dolphins to vessel traffic. High levels of boat traffic can lead to injuries or disturbance, as manifested by changes in behavior and use of acoustic signaling. Additionally, yearly increases in Sarasota Bay vessel activity have created an underwater acoustic environment that is significantly different from the acoustic environment even thirty years ago. The purpose of this project is to understand how underwater noise generated by increased vessel activity affects behavior and distribution of resident dolphins in Sarasota Bay.

Temporal and spatial variation in boat noise may produce differences in habitat use, habitat selection, and behavioral patterns of resident dolphins. To evaluate the potential effects of increased vessel activity, I propose to examine the quantitative relationships between levels of boat traffic and resultant noise. Geographic Information Systems (GIS) will be used to examine historical patterns of habitat use by Sarasota Bay dolphins over a 5 year period relative to the distributions and activities of vessels during the same period, as collected by Sue Hofmann and her Earthwatch volunteer teams. I will also use focal follows and line transect surveys to evaluate the effects of short term increases in vessel activity, such as peaks that occur on weekends or holidays.

Through the methods outlined above, I hope to develop a clear understanding of how increased vessel activity affects the Sarasota Bay resident dolphins. Results from this project will aid conservation efforts directed towards coastal cetaceans in other regions of increased anthropogenic noise due to vessel activity. 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 Earthwatch Institute, NOAA Fisheries, and the UCSC Ocean Sciences Department.

Dynamics of Group Fission-Fusion: What is a Temporary Group in the Bottlenose Dolphin?

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

One of the objectives of my dissertation project is to evaluate the definition of a group for the bottlenose dolphin and to examine how dolphins communicate with each other during the formation and division of groups. I am currently working on the data analysis of 107 focal animal behavioral follows and 10 sound transmission experiments conducted in 2003. In particular, I am evaluating the definition of a group based on the traditional parameters of distance and activity, and of new parameters such as duration of an association and of communication range. The evaluation of distance as a parameter to define a group is important because some definitions consider some dolphin species to be members of a group if they are within 10 m (about 30 ft) 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 of focal females 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 within a radius of approximately 100 m. However, dolphins that did not join a focal female were also observed in this radius. I called such individuals satellites and their mean distance from focal females was 100 m. This distance was significantly greater than the distance of separation of calves and other associates from focal females. Nevertheless, the range of distances in which satellites were observed overlapped with the distance of separations of associates (range = 40-200 m). Thus, if only the criterion of distance is used to define a group the presence of satellites would make it difficult to distinguish associates from satellites.

I am also evaluating the use of activity to define a dolphin group because some definitions consider dolphins to be a member of a group if they are involved in similar activities. Preliminary analyses suggest that activity alone is not a good predictor of group membership. Coordinated activities between focal females and dependent calves were frequently observed when the distance of temporary separations was equal to or less than 100 m. This may be related to the observer's limited capability to record activities at greater distances. At distances equal or less than 100 m, focal females were observed traveling and probably feeding. At greater distances, focal females were probably feeding and milling whereas their dependent calves were traveling. It is possible that calves were also feeding at greater distances but that such activity was difficult to record when the calf was far away from the research vessel. In the case of non-calf associates, their activity was similar to that of focal females when the mean distance of separation was 60 m. However, contrary to the activity of dependent calves, other associates temporarily separated from focal females were traveling. The results from the distance and activity to evaluate the definition of a dolphin group were presented at the 41st Annual Animal Behavior Meeting, June 12-16, 2004, Oaxaca, Mexico. Field work and my studies at USF have been supported by a several funding agencies: NOAA Fisheries, The Chicago Zoological Society, the USF Acoustic Laboratory, the USF Physiology Laboratory, the USF Jack Lake Fellowship, and the USF Garrels Fellowship.

Group of closely spaced moms and calves in Sarasota Bay.

What's in a Voice?

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

Dolphins are known to produce individually distinctive signature whistles. A previous study involving playback experiments with Sarasota dolphins showed that dolphins recognize one another's signature whistles. However, it is not known what features of whistles dolphins use to recognize one another. Two possible cues are the contour, or shape of the whistle, or more subtle features commonly called "voice cues". These are the cues that we use to recognize the voices of our friends, even if they don't tell us who they are.

To explore these questions, recordings are played through underwater speakers to dolphins held during capture-release projects for health assessment in Sarasota Bay. An earlier set of playback experiments (2003-4) 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. 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, or variant, 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.

Aside from the intrinsic benefit of understanding how dolphins communicate with each other, this research also has potential conservation benefits. An understanding of what features of whistles are perceptually important to dolphins will improve our ability to understand how various sources of anthropogenic noise may impact their ability to communicate.

This work is currently being funded by a Protect Wild Dolphins Grant to L. Sayigh and R. Wells from the Harbor Branch Institute of Oceanography, and a Royal Society University Research Fellowship from the UK to V. M. Janik.

Acoustic recordings are obtained via a suction-cup hydrophone both in the water and on the deck of the research boat during health assessment sampling.

Socializing subadult bottlenose dolphins observed off the bow of one of SDRP's research vessels.

Behavioral and Ecological Influences on Survival Strategies of Juvenile Bottlenose Dolphins in Sarasota Bay

By Katherine McHugh, PhD student, University of California Davis (Animal Behavior Graduate Group)

The juvenile life stage is both an extremely vulnerable and formative time for bottlenose dolphins. In the years between weaning and maturity, bottlenose dolphins face many risks and must learn to navigate a complex ecological and social landscape in order to survive and become successful adult members of the Sarasota area population. The focus of this project will be to better understand strategies for survival by juvenile bottlenose dolphins in Sarasota Bay. I plan to combine information from the long term data-sets maintained by SDRP with new information that I will collect through focal animal behavioral follows with current juveniles in the Sarasota population to test hypotheses regarding the critical influences on juvenile survival strategies. By comparing and contrasting different behavioral, social, and ecological elements of the lives of juvenile dolphins, we hope to determine crucial ages of independence, better define social and behavioral maturity, and better understand patterns of mortality and survivorship of free-ranging juvenile dolphins. Field work will likely begin in Summer 2005 so stay tuned for updates!

This work will be made possible through the generous support of NOAA Fisheries, the UC Davis Graduate Scholars Fellowship in Animal Behavior, and a NSF Graduate Research Fellowship.

Health Assessment Modeling and Effects of Environmental Contaminants

By Ailsa Hall, PhD and Randall Wells, PhD

Man has had a large impact on the health of the marine ecosystem. Over-fishing, pollution, oil exploration and shipping activities, to name a few, have indirectly affected marine mammals throughout the world. Many of these impacts have been to affect the 'health' of the individuals in the population so that their reproductive capacity or survival is depressed.

In the light of these global impacts the purpose of this study is to investigate the health of the population of Sarasota Bay bottlenose dolphins and find out how this has changed over time. In support of this goal, health assessment projects were conducted in February and June of 2004, resulting in sampling and evaluation of 31 dolphins. This work supported more than 20 different research projects. Because we also have a great deal of knowledge about the structure and dynamics of the Sarasota Bay population we are investigating how we can integrate information on the health of the individuals that make up the population (such as from clinical chemistry information and exposure to contaminants) and their relationship to changes in abundance, fecundity and survival. Bottlenose dolphins are important sentinel species; with this in mind, our program published a paper in EcoHealth this year that describes initial efforts to develop a system for evaluating the health of dolphin populations from evaluation of clinical blood parameters. This study also forms part of a wider investigation of different populations of dolphins from New Jersey to Florida.

So far we have found that certain clinical blood chemistry measures fluctuate significantly with age, sex and seasonally. Clearly we need to take these variations into account when we look at decadal changes that might be a function of longer-term alterations in the quality of the Sarasota Bay environment.

We have also constructed an 'individual based model' to help provide a particular type of risk assessment framework for the Sarasota Bay population. We suspect that when calves are exposed to high levels of environmental contaminants such as polychlorinated biphenyls (PCBs) in milk from their mothers their first year survival probability is significantly reduced. From data collected in Sarasota Bay on levels of organochlorine environmental contaminants such as PCBs in the blubber of females (Figure 1), females appear to transfer PCBs and related contaminants to their calves through milk. Their first calf gets a particularly heavy dose, and the survival of the first calf is particularly low. Our model then allows us to test what effects various exposure and response scenarios will have on the potential population growth rate. In this way we have been able to highlight where future research efforts should be directed in order to say with some certainty what effect such contaminants are likely to be having on the long-term dynamics of the Sarasota Bay community of bottlenose dolphins.

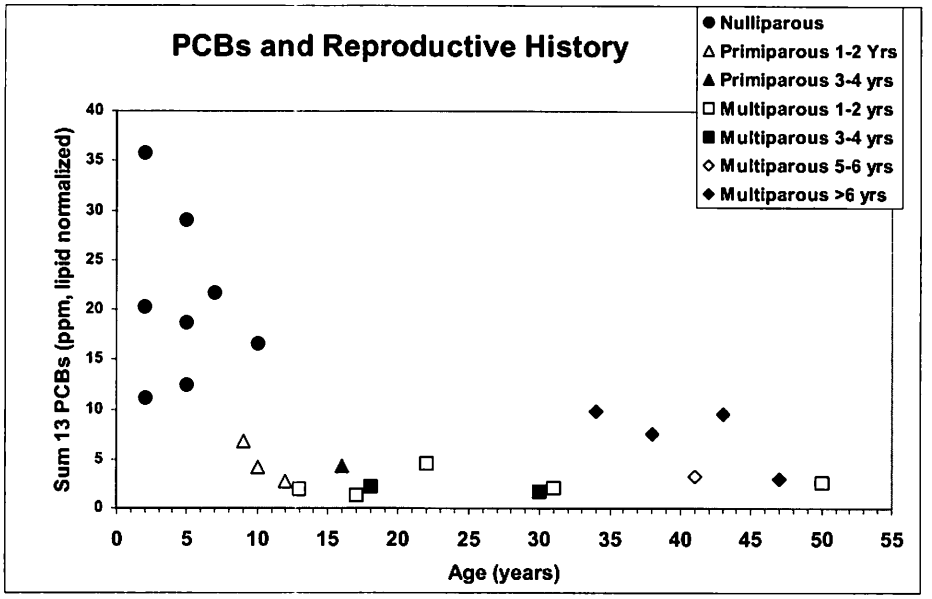


Figure 1. Blubber concentrations of PCBs in female dolphins in Sarasota Bay relative to their reproductive status. Concentrations of 13 kinds of PCBs (in parts per million – ppm) are shown relative to a mother's age and her calving history. "Nulliparous" refers to females that have not yet given birth and lactated, "Primiparous" refers to first-time mothers, and "Multiparous" refers to mothers that have given birth and lactated more than once; the number of years since birth are indicated. Note the steep decline in females's PCB concentrations when they start lactating, and the increase as lactation declines several years post-birth. For perspective, in human health, concentrations of more than 10 ppm are considered to be of concern.

Emerging Contaminants in Bottlenose Dolphins from Sarasota Bay

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

Thousands of anthropogenic (man-made) chemicals have been detected in air, soil and water worldwide. Emerging compounds, such as perfluorinated chemicals, which are used in paints, adhesives, polishes, and fire-fighting foams as well as stain repellent for clothes, furnitures and carpets have recently been detected in human blood and wildlife. Perfluorinated compounds are known to be toxic in laboratory mammals but their effects on marine mammals are still unknown. The objectives of this project were to assess the concentrations of emerging contaminants in biological samples of dolphins. Capture, sampling and release of dolphins in the Sarasota Bay provides a unique opportunity for scientists to understand the distribution of these pollutants in the marine ecosystem. Since November 2002, blood samples from 50 dolphins have been collected for analysis of fluorinated compounds. Analysis of samples showed that high concentrations of ten perfluorinated compounds are detected in plasma of dolphins. Perfluorooctane sulfonate (PFOS) was the dominant compound in all animals with concentrations ranging from 0.2 to 1.8 ppm in plasma. Water, sediment, and fish have been collected during the past year in order to understand the possible entry of these contaminants into dolphins. In addition, parallel analyses of immune function parameters may help us understand if these contaminants adversely affect the health of these cetaceans.

Another group of contaminants of interest are hydroxylated polychlorinated biphenyls which are degradation products of PCBs. PCBs have been used extensively before being banned in the 1970s. Today, their concentrations in the environment are still high and were detected in elevated concentrations in blubber of Sarasota dolphins. It is believed that mammals have the capacity to biotransform PCBs into toxic by-products such as hydroxylated PCBs which are known to affect the endocrine system. Blood samples from dolphins were analyzed for these pollutants which were detected in all animals.

Age, gender and reproductive history data gathered during the long-term monitoring of this population will help us determine trends and patterns of accumulation of these pollutants in small marine mammals. The collection of samples over different seasons could enable the determination of temporal trends, increasing our knowledge on exposure and metabolism in free-ranging dolphins. In addition, analyses of stranded dolphin carcasses will enable the study of the body distribution of perfluorinated compounds which have already been detected in liver and kidney of Sarasota Bay dolphins. The monitoring of wild populations and their environment is essential in order to protect an ecosystem that has been, and still is, greatly disturbed by human activities.

Mercury and Selenium: A Contaminant and Nutrient Interaction Assessment

By Carla Willetto, DVM, Victoria Woshner, DVM, PhD, and Todd O'Hara, DVM, PhD

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 and mercury from a "functional" perspective in bottlenose dolphins sampled in the Sarasota Bay area. Selenium and mercury interact in a yet unknown way that likely alters the toxicity of mercury and alters the nutritional and toxic properties of selenium in cetaceans. For this reason we proposed to include functional assays (such as glutathione peroxidase) in the suite of indicators to address mercury and selenium status in bottlenose dolphins in concert with the current sampling for determining mercury and selenium concentrations in blood and skin. In a few animal and human studies it was observed that deficiency of selenium could cause pregnancy complications. Therefore, we propose to evaluate the blood and plasma levels of mercury and selenium, and glutathione peroxidase in blood to better develop a functional understanding of this mercury and selenium interaction and the health status of the Sarasota dolphin population.

Preliminary data indicate that the mean total mercury concentration in whole blood of 31 Sarasota bottlenose dolphins is about 100 fold higher than the recommended threshold level established for humans by the US Environmental Protection Agency. It is recommended that people who are found to have "elevated" blood mercury levels decrease their fish intake – not a feasible option for the dolphins. However, how meaningful is this criteria level to a fish eating small cetacean? Some cetaceans exhibit even higher levels of mercury in their blood. Research to further elucidate the relationships between mercury and selenium and health, and to validate the functional assay is continuing, with the assistance of Ms. Katrina Knott. Funding for this research has been provided by NOAA Fisheries, through the Chicago Zoological Society.

Dr. Jay Sweeney collects blood samples as part of a regular health checkup.

Dolphin Immunology Research

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

This project is designed to provide a state-of-the-art assessment of the immunologic health of the dolphins in Sarasota Bay. Advanced techniques are being applied to peripheral blood samples to characterize and/or identify leukocyte (white blood cell) subpopulations, lymphocyte function and inflammatory mediators. Such measures complement the conventional immunologic data provided by a complete blood cell count (CBC) and serum chemistry panel. Our current goal is to identify associations between specific immunologic perturbations and relative levels of environmental contaminants in various tissues. In an attempt to identify contaminant-associated immunologic dysfunction, two additional approaches are being employed. Firstly, blood samples are being obtained immediately upon capture, and then again just prior to release, in an attempt to associate an increased immunologic stress response with relatively high tissue contaminant levels. More recently (initiated in 2003), mRNA has begun to be isolated from peripheral blood leukocytes and cryopreserved for the purpose of utilizing differential gene display for identifying immunologic and/or physiologic perturbations as a function of tissue contaminant load. A panel of bottlenose dolpohin-specific genetic probes is currently being developed for identifying abnormal expression of a variety of pro- and anti-inflammatory immunologic mediators, heat shock proteins, endocrine pathways and metabolic enzymes associated with breakdown of environmental contaminants.

Baseline values for peripheral blood leukocyte subpopulations have been established for this free-ranging population of dolphins. This data has identified significant age- and sex-associated differences in all leukocyte subpopulations. This information indicates we need to sample a greater number of animals such that each age and sex group is sufficiently represented. This will ultimately allow meaningful statistical comparison of contaminant levels and immunologic status. Young animals have relatively high numbers of T and B lymphocytes, with these subpopulations declining rather dramatically by 30 years of age. There is also a shift from naïve T lymphocytes (never exposed to antigen) to memory T lymphocytes as animals age. Lymphocyte function, as determined by non-specific stimulation with T and B cell mitogens, is largely consistent, regardless of age and sex, assuming the animal is in a healthy state.

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. While the application of differential gene display technologies will revolutionize our ability to identify contaminant-associated perturbations in animal health, leukocyte phenotyping and lymphocyte function data are already suggesting associations between total PCB's and immunologic health. While only two years of data have been analyzed to date, there is evidence that those animals with high contaminant loads have relatively decreased numbers of memory T lymphocytes and T:B lymphocyte ratios. From a functional perspective, lymphocytes appear to be marginally compromised in those animals with the highest levels of contaminants in the year 2000. This was not evident the following year (2001). Immunologic and contaminant data will need to be analyzed from subsequent years to determine if the cell dysfunction in 2000 was merely an aberration or a reflection of as-yet-unidentified seasonal influences. The modest dysfunction identified in lymphocytes derived from those animals with the highest levels of contaminants in 2000 was supported by decreased function following the stress of capture. Those animals with the highest tissue levels of contaminants had a tendency to be those that experienced the greatest loss of T lymphocyte function following capture (comparison of the sample obtained immediately upon capture to the sample obtained just prior to release).

In summary, these immunologic 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. Funding for this research has been provided by NOAA Fisheries, International Whaling Commission, Office of Naval Research, Dolphin Quest, and the Laboratory for Marine Mammal Immunology, School of Veterinary Medicine, University of California-Davis

Humoral Immune Function of Bottlenose Dolphins: Establishing Baseline Parameters

By Hendrik Nollens DVM, MSc, PhD student, Elliott Jacobson, DVM, PhD, 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. Among other disciplines, 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. Of the different sero-diagnostic tests, the indirect ELISA (Enzyme-Linked Immuno-Sorbent Assay) has surfaced as a test with extremely broad application for managing health problems of both wild and captive animals. The indirect ELISA is of value in health assessment programs, retrospective disease surveys using archived serum samples, prospective monitoring of disease agents of concern, and measurement of total antibody levels. Total antibody levels have been suggested as markers of immune health and as a tool for triage during strandings and rehabilitation. However, normal ranges of total antibody levels, as present in healthy, wild bottlenose dolphins, have not yet been determined.

We have recently made use of an on-going vaccination program in captive bottlenose dolphins to develop and validate such an indirect ELISA for bottlenose dolphins. The first application of this assay will be to establish normal ranges of total antibody levels of bottlenose dolphins. Over the past year, a set of serum samples has been collected from the Sarasota dolphin community, and additional serum samples will be collected during the course of this year. Once collected, this second set of sera will complete the necessary bank for establishing normal reference values, using the newly developed ELISA assay.

What Can Dolphin Exhalations Tell Us About Their Health and Reproduction?

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

Volatile organic compounds in exhalant breath are a reflection of biochemical constituents circulating in the blood. Non-invasive monitoring of such compounds may give health, reproductive, physiological and seasonal information about wild dolphins. For the last several years we have been collecting the exhaled breaths of Sarasota Bay dolphins during health assessment sessions. 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 2004, our sample was extended from 24 to 47 from which we have analyzed exhalant breath. We continued to identify and try to quantify now 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; and aldehydes and isocyanato compounds that may also prove to be diagnostic. With our developing interest in metabolism related to seasonal changes - either diet or endocrine-based - isoprene and 6-methyl-5-hepten-2-one levels were closely watched. We will be continuing to monitor concentration changes that may (1) be indicative of a bacterial infection, (2) reveal seasonal changes related to fat metabolism or, (3) demonstrate chemical clues about reproductive condition. We plan a publication on at least one of these aspects in 2005.

Fatty Acids in Bottlenose Dolphins

By Dana L. Wetzel, PhD, John E. Reynolds, III, PhD, Jay Sprinkel, BS, and Randall S. Wells, PhD

Analyses of fatty acids in tissues of dolphins and their prey is no easy task because so many fatty acids are present. For example, dolphins have more than 100 different fatty acids present in their blubber, and some of their prey have approximately twice that number. As we have collected and analyzed samples, we decided to first test the hypothesis that fatty acids in maternal blubber, milk, and calf blubber are similar.

Samples of milk, maternal blubber and calf blubber were collected during health examinations of eight free-ranging female dolphins and their calves in Sarasota Bay, Florida in summer 2001 and 2002. Fatty acids were derivatized to nitrogen (picolinyl) esters, then analyzed using gas chromatography-mass spectromentry (GCMS). Hierarchical clustering analyses of all identified fatty acid components showed that (a) blubber of mothers and their calves was not different, but (b) milk samples were significantly different from both types of blubber. Fatty acid composition and variety in all matrices varied across sampling years, with samples taken in 2002 having considerably more fatty acids than did those from 2001.

Inter-annual variation in fatty acids (presumably reflecting dietary changes to at least some extent) is not surprising for bottlenose dolphins, given their wide range of prey and documented inter-annual differences in inshore productivity; nor is it surprising that mothers and calves had similar fatty acid constituents in their blubber. However, given assumptions about fatty acid metabolism and dietary transfer in many mammals, the fact that the fatty acid profiles of milk differed significantly from those of both maternal and calf blubber is puzzling. Funding for this research was provided by NOAA Fisheries, through the Chicago Zoological Society, and the Harbor Branch Oceanographic Institution Protect Wild Dolphins Program.

Effects of Red Tide Toxin 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 marine animal die-offs, including marine mammals. In recent years, several large mortality events involving bottlenose dolphins in the Gulf of Mexico and on the Atlantic coast have been suggested to be caused by red tide. Brevetoxin, the neurotoxin produced by the red tide algae *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. Support for lab analyses and field observations has been generously provided by Long Marine Laboratory, Disney Wildlife Conservation Fund and NOAA Fisheries, through the Chicago Zoological Society.

Investigating the Thermal Response of Sarasota Bay Dolphins to Changing Environmental Temperatures

By "Team Thermal" – Ann Pabst, PhD, Bill McLellan, PhD, Andrew Westgate, PhD, Erin Meagher, PhD candidate, Michelle Barbieri, MSc student, Ari Friedlaender, PhD candidate

The goal of our work with the Sarasota Dolphin Research Program is to better understand reproductive and whole-body thermoregulatory (body temperature regulation) function in bottlenose dolphins. The long-term, health-monitoring program for Sarasota Bay dolphins offers us a unique opportunity to study thermoregulation in wild cetaceans. Our current project is 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 32°C (90°F) in the summer.

Bottlenose dolphins in Sarasota Bay may invoke a suite of physiological modifications to cope with their changing thermal environment. The goal of our current study is to describe seasonal variation in the thermal responses of bottlenose dolphins in Sarasota Bay. We investigate thermal function in dolphins using multiple measurement techniques, which include 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 measured in Watts/m^2. Deep core temperatures, measured with a specialized colonic probe, and blubber thicknesses, measured using ultrasound are also recorded. A dorsal fin "Trac Pac" is deployed on a subset of dolphins, recording skin surface temperatures and heat flux values, as well as velocity and time-depth records. These Trac Pacs are attached to the fin's surface using suction cups, and are deployed for periods lasting up to 8 hours. Infrared thermal imaging is used to measure skin surface temperatures of wild dolphins, both during temporary restraint and while they are free-swimming.

Our research team has collected this suite of physiological data on Sarasota dolphins during summer health-monitoring studies over the past three years. These data suggest that dolphins must actively dissipate body heat during the summer to maintain constant body temperatures. Our current study has permitted us the first opportunity to investigate the mechanisms used by wild dolphins to maintain homeothermy over the course of a year, as they experience a wider range of environmental conditions.

Dolphins use their appendages (dorsal fin, pectoral flippers and flukes) to either conserve or dissipate body heat, thus, these body sites are considered thermal windows. This study examines the roles of thermal windows and other body surfaces in regulating the body temperature of dolphins. Heat flux provides a real-time, dynamic method of assessing the thermal status of an individual animal. 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.

These heat flux measurements are taken seasonally on individual, wild bottlenose dolphins to examine how they vary their whole body conductance to adjust to changing environmental temperatures. Heat flux values will be related to seasonal changes in blubber thickness within individual bottlenose dolphins. To date, heat flux data have been collected during six separate capture-release events in three seasons (June 2002, 2003 and 2004, Fall 2002, Winter 2003 and 2004). There are a total of 38 animals included in the summer data set (20 males, 18 females), 3 animals in the fall data set (2 males, 1 female), and 13 animals in the winter data set (4 males, 9 females).

Overall, mean heat flux in winter was significantly higher than that in summer. Generally, the highest mean heat flux values in winter were found at the base of the dorsal fin and at the tailstock. In summer, mean heat flux values were generally lower and showed less variation than those measured in winter. Mean blubber thickness measurements at the lateral body wall and at the tailstock for dolphins in this study were significantly higher in the winter than in the summer.

Preliminary results suggest that bottlenose dolphins in Sarasota Bay do not necessarily respond to decreased ambient temperatures by decreasing heat loss across the body surface. Rather, heat flux values across the lateral body wall and tailstock were significantly higher in the winter, relative to those measured in the summer. These winter increases in heat flux occurred despite significantly thicker blubber layers at these sites in winter.

Although we expected heat flux values across the dolphin's thermal windows (dorsal fin, pectoral flippers and flukes) to be higher in the summer, due to an increased need to dissipate body heat in tropical water temperatures, surprisingly there was no significant difference between summer and winter heat flux values at most of these sites. These results suggest that bottlenose dolphins resident to Sarasota Bay, FL may be using alternative mechanisms to dissipate excess body heat in the summer, such as enhanced respiratory evaporative heat loss or spending more time in cooler microclimates. These alternative mechanisms are currently under investigation.

We deployed our first thermal Trac Pac on a Sarasota bottlenose dolphin during the summer of 1999, and have deployed the thermal Trac Pac an additional 51 times. These deployments have provided us with over 100 hours of unique data on the thermal biology of free swimming bottlenose dolphins. We have gained many insights into the thermal behavior of wild dolphins from the data we have collected. For example, we have learned that dolphins are profoundly affected be small differences in water temperature. Differences as little as 1° C can bring about significant changes in the amount of heat an animal loses to the water. These experiments have reinforced the idea that bottlenose dolphin thermoregulatory function is much more complex than we had previously imagined. The data we have been fortunate to collect will allow us to investigate this complexity in detail.

The temperature difference between a body surface and the environment is one factor that contributes to heat loss from an organism. The goal of this study was to investigate how dolphins may use this temperature differential to thermoregulate across large

seasonal changes in water temperature. We chose to study the dorsal fin because it is a poorly insulated and dynamic thermal exchange surface that exits the water upon surfacing. Infrared thermography was used to non-invasively measure dorsal fin surface temperatures of bottlenose dolphins (n=551 images) encountered during synoptic surveys of the Sarasota study area in the summer, fall, and winter

from 2002-2004. There is a significant positive, linear relationship between dorsal fin surface temperature and water temperature, as mean temperature differential (0.9°C) was similar across all seasons. Thus, dorsal fin surface temperatures appear to be modulated in response to water temperature to maintain a steady dorsal fin temperature differential across seasons. This implies that there is a much larger temperature gradient between the dolphin deep body core and the dorsal fin surface in winter than in summer. Thus, in winter, increases in insulation, both integumentary (*i.e.* blubber) and vascular (*via* reduced perfusion and utilization of heat exchangers) must account for the protection of core temperature and stability of the temperature differential.

Preliminary results suggest that bottlenose dolphins in Sarasota Bay do not necessarily respond to decreased ambient temperatures by decreasing heat loss across the body surface. Rather, heat flux values across the body wall are significantly higher in the winter, relative to those measured in the summer. These winter increases in heat flux occurred despite significantly thicker blubber layers at these sites in winter, and despite relatively stable temperature differentials.

These combined data suggest that the responses of wild bottlenose dolphins to changing environmental temperatures are complex. We are, however, beginning to gain a better understanding of the physiological responses of wild Florida dolphins to changing environmental temperatures. This study has also offered two of our current graduate students, Ms. Erin Meagher (PhD) and Ms. Michelle Barbieri (MS), the opportunity to gather data critical to their thesis research on dolphin thermoregulation. Support for this project has been provided by an HBOI Protect Wild Dolphins grant, by Dolphin Quest, by the Disney Wildlife Conservation Fund, and by NOAA Fisheries through the Chicago Zoological Society.

Bottlenose Dolphin Population Health Assessments

By Randall Wells, PhD

Beginning in the 1980's, the Sarasota Dolphin Research Program pioneered the concept of population-level health assessments of free-ranging bottlenose dolphins. The impetus for developing this approach of safely capturing, examining, sampling, and releasing wild bottlenose dolphins to evaluate their health derived from the increasing occurrence of large-scale dolphin mortality events around the world. We were responsive to a need to better define health in wild dolphins, and to identify health problems proactively, before mortalities occur. Based in large part on the success of our approach, several health assessment operations are currently being conducted by other organizations along the Atlantic coast of the United States, and other projects are in the planning stages. In particular, the Sarasota Dolphin Research Program has been asked to participate in plans being developed to investigate the population of dolphins in the region of a large scale mortality event in Spring 2004 in the Florida panhandle, in the vicinity of St. Joseph Bay. More than 100 dolphins died over a period of several weeks. While preliminary analyses point toward the involvement of brevetoxin, many questions remain unresolved. We also participated in a recent reconnaissance trip to the Upper Gulf of California with Dr. Lorenzo Rojas-Bracho to explore the possibility of a health assessment project in collaboration with Mexican colleagues. One of the factors of interest in this area is potential effect from the near cessation of flow of the Colorado River into the Gulf.

Bottlenose dolphins in the delta region of the Upper Gulf of California, Mexico.

Bottlenose Dolphin Dietary Studies in West Central Florida: Assessing Variability in Different Geographic Scales

By Nélio Barros, PhD

Understanding the feeding ecology of free-ranging dolphins is crucial for the interpretation of data obtained on distribution and movements, behavioral and social structure, human interactions and competition with fisheries, ecophysiology, and bioaccumulation of contaminants and pollutants through the food chain. To assess geographic variability in bottlenose dolphin diet along the west central coast of Florida, analyses of stomach contents from beach-cast animals and stable isotopes in tissues of predator (dolphin) and prey (fish) are being conducted. Earlier studies with RandyWells in Sarasota Bay have shown that resident dolphins preyed exclusively on fish. Analyses of additional samples collected since then extended the known list of prey in Sarasota Bay to 30 species of fish and one squid. In contrast, dolphins of unknown history that stranded along the Gulf coast of the barrier islands have a different prey composition, and prey more often on squid (Fig. 1). These findings are similar to those obtained for estuarine and exposed-beach populations of dolphins in east Florida (research by Barros) and North Carolina (work by Damon Gannon and colleagues). In those areas, bottlenose dolphins are thought to employ different foraging strategies, preying upon soniferous fish in estuaries and relying more heavily on squid and schooling fish in more open habitats.

As many dolphins strand with empty stomachs, or do not contain diagnostic remains of prey (fish earbones or squid "beaks"), analyses of stable isotopic ratios provide an alternative method of studying diet, as particular elements (e.g., carbon and nitrogen) assimilated by the predator are thought to reflect those of their prey. Previous analyses of carbon and nitrogen isotopic compositions in teeth of dolphins from different central west Florida populations have shown distinct signatures between populations (estuarine and coastal marine). In addition, isotopic ratios suggest ontogenetic differences in diet for known Sarasota Bay dolphins, with older animals showing enriched carbon and depleted nitrogen values. Funds are being sought to investigate the isotopic variability (spatial and seasonal) among three adjacent estuarine systems (Tampa Bay, Sarasota Bay, Charlotte Harbor) in tissues of dolphins and their prey. As multiple element isotope ratio studies often provide much better insights into ecosystem processes than single element studies, sulfur will be added to the list of elements being currently analyzed. Whereas there appears to be little or no enrichment in sulfur isotopes per trophic level, the sulfur is useful in distinguishing benthic versus pelagic producers, and marsh plants versus estuarine phytoplankton. In tropical estuarine systems, variables such as terrestrial versus marine inputs to the system, seasonality, different primary producers in the area are of particular interest as they may influence the isotopic signatures of dolphins and their main prey. The results obtained in this study will shed light onto how applicable these data are to other Florida estuarine systems. This approach highlights the importance of developing and refining trophic models in smaller geographic scales as applied to bottlenose dolphins, so as to allow for meaningful comparative studies. Funding for this project was provided by NOAA Fisheries, through the Chicago Zoological Society, and Harbor Branch Oceanographic Institution Protect Wild Dolphins Program.

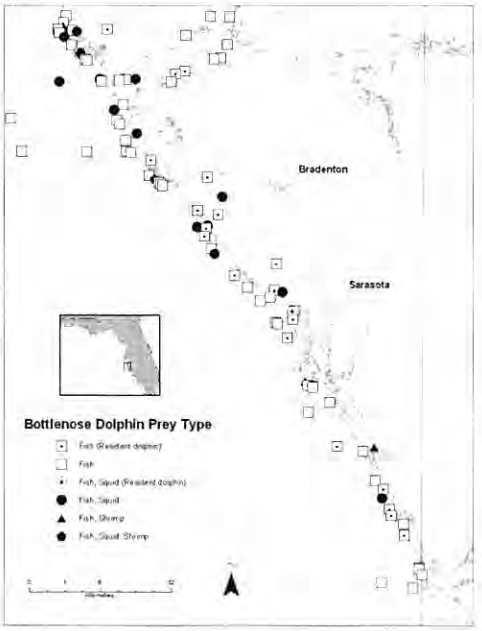


Figure 1. Different types of prey consumed by resident and unknown bottlenose dolphins in central west Florida.

Habitat Quality and Prey Availability for Bottlenose Dolphins in Sarasota Bay

By Elizabeth Berens, MSc, and Damon Gannon, PhD

Bottlenose dolphins of Florida inhabit some of the most urbanized coastlines in North America. Currently, the habitat requirements of dolphins are poorly known. We are looking to answer several different questions in the present study, including:

-What qualities do dolphins look for when selecting habitat?
-To what degree do the distributions of prey, predators, and competitors influence their habitat preferences?
-How does the presence of humans affect dolphins' use of coastal waters?

Answering these important questions will give us a better understanding of the habitat requirements of dolphins in urbanized areas, an understanding essential for the conservation of dolphins within Sarasota Bay.

To address 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. From June to September we made

84 seine sets and 152 passive acoustic recordings, despite being tormented by Hurricanes Charlie, Frances, Ivan (twice), and Jeanne. In total, 26,872 fish were caught, measured, and released. Preliminary analyses have determined that the abundance of dolphin prey species in sea grass and mangrove habitats is at least two orders of magnitude higher than in sandflat, open bay, and shallow Gulf of Mexico habitats. The average sizes of several important prey species—hardhead catfish, *Arius felis*; menhaden, *Brevoortia* spp.; pigfish, *Orthopristis chrysoptera*; pinfish, *Lagodon rhomboides*; spotted seatrout, *Cynoscion nebulosus*; sheepshead, *Archosargus probatocephalus*; and spot, *Leiostomus xanthurus*—differed significantly between habitats. The sizes of the fish are important because dolphins tend to select prey within the size range of about 6 to 16 inches (15-40 cm). Therefore, prey availability for dolphins appears to vary substantially among the habitats found within Sarasota Bay. Since specific habitats may support more prey, dolphin conservation in Sarasota Bay may depend more on the conservation of a couple specific types of habitat. Future analyses on the current data will test for statistical differences among habitats regarding species richness and the occurrence of dolphins. Our sampling will resume in December and run through March 2005. Collecting summer and winter seine data will result in seasonal comparison of how dolphins and their target prey species are distributed throughout Sarasota Bay over the course of a single year.

Coupling the fish data from this study with our long-term database documenting dolphin and human uses of Sarasota Bay will allow us to quantify habitat quality for bottlenose dolphins. With this knowledge, a simple index of habitat quality will be created that will allow scientists and government managers to determine the quality of any habitat for bottlenose dolphins. This index could greatly benefit the conservation of bottlenose dolphins worldwide by helping resource managers predict the consequences of altering different types of habitat. In addition, our data on fish abundance and distribution will be used to create an ecosystem-based model of Sarasota Bay's food web, which in turn can predict how changes to one part of the food web will affect every other part of the food web. For example, this model will be able to predict how an increase in fishing activity would affect different fish species in the Bay, as well as dolphins, manatees, seagrass, and mangroves. Predicting these changes in the Bay's food web could potentially allow researchers and managers to focus on key ecological changes likely to occur from proposed coastal development projects and to focus further research efforts on specific factors that influence the Bay's dolphin population.

As a further benefit of the research, we are collecting our data for Sarasota Bay using the same techniques the Florida Wildlife Research Institute is using for the neighboring estuaries of Tampa Bay and Charlotte Harbor. Thus, we will be able to fill in a geographical gap in the state's ongoing assessment of fish stocks. The present research project would not be possible without the help of many interns and volunteers who generously donate their time and effort to this ambitious project. Essential funding was provided by NOAA Fisheries (U.S. Department of Commerce) and by Harbor Branch Oceanographic Institution's Protect Wild Dolphins Program.

Expanding Capabilities of the *Vortex* Population Modeling Software

By Robert Lacy, PhD, Chicago Zoological Society

The *Vortex* simulation software for population viability analysis (PVA) is used globally to make projections of wildlife populations under various assumptions about species biology, habitats, and the impacts of human activities. These analyses can help to identify the most threatening processes, and the best options for management and conservation of the species. The large amount of data collected over the years on the dolphins of the Sarasota area provides the opportunity to use PVA models to make projections of the long-term trajectory of the population. The multiple and significant impacts of human activities on the dolphins provide strong reasons for us to assess the likely fate of the dolphin populations under various scenarios about changing human activities. However, the social system of dolphins and the spatial structuring of the dolphin populations add complexities to the population dynamics that would not be modeled well with any existing PVA model.

We are therefore working to extend the capabilities of the *Vortex* PVA software, to provide options to model more complex social systems (for example, making breeding success dependent on the social environment and on whether the female is a first-time mother), spatial structure of the populations (for example, allowing the overall population to be comprised of a number of social units that differentially use sections of the bays and coastal waters), and differences in habitat quality in various parts of the overall range of the population. To add these capabilities to the PVA model, we have allowed the program to assign and monitor variables that represent important characteristics of individual dolphins (such as past breeding history and subpopulation membership) and of the habitat (such as food resources, and local threats caused by human activities). We are now also making *Vortex* a component of a "meta-model", in which the *Vortex* representation of the dolphin population can be linked to other computer models of habitat change, human activities, and wildlife disease. We will soon be testing this new meta-model with data on the Sarasota area dolphin populations, making projections under various scenarios of human activities, and comparing the results to those from other kinds of population models.

These efforts will provide us with the ability to integrate diverse kinds of data and knowledge into a more complete picture of the processes influencing the dolphin populations. In addition, by using the very extensive data on the dolphins to test and refine these new analysis tools, we (and the dolphins!) will be helping many more species that similarly are facing diverse threats from changing habitats and human activities. For example, people studying elephants in Burma, lion tamarins (a small monkey) in Brazil, elk in Canada, and cheetahs in Namibia are all eager to use our enhanced population models to explore the long-term prospects for their species. Funding for developing these conservation tools has been provided by NOAA Fisheries, the Chicago Zoological Society, and the Conservation Breeding Specialist Group of the World Conservation Union.

Earthwatch Institute Dolphin Monitoring Program: Sarasota Dolphin Community Status

By Jason Allen and Sue Hofmann

We have been able to continue our year-round monthly monitoring of the Sarasota dolphin community thanks to support from Earthwatch volunteers. The Sarasota bottlenose dolphin community is the most thoroughly known free-ranging dolphin population under study in the world. 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 the distribution, social and reproductive patterns of these animals.

Photographic identification surveys were conducted on 108 days from October 2003 through October 2004 with the assistance of 39 Earthwatch volunteers from 17 states and 4 countries. These volunteers contributed over 2,100 hours to our project.

During the past year, we had 678 group sightings that totaled 2,330 dolphins (including resighted animals). Our average number of sightings per day and dolphins per sighting have remained fairly constant throughout the past several years. We averaged 6 sightings per day with about 3 or 4 dolphins per sighting. During this same time period, our annual average of the number of dolphins sighted per day was slightly lower, at 21.6, than in the previous four years (which averaged 22.5 dolphins/day). We had a high of 17 sightings in one day during a July 2004 survey and a high of 71 dolphins on the same day.

We documented the births of ten new calves during the spring/summer of 2004 while monitoring the Sarasota dolphin community. Big Shout and FB 55 had their second calves while Pecan Sandie and Claire had their fourth. Killer was both a new mother and new grandmother this year; she and her eight year old daughter, Lizzie, were both seen with new calves in early June. Other new mothers include FB 54, FB 79, FB 93, and "Pi look-a-like". "Pi look-a-like" has been seen off and on in Sarasota Bay since 2001. She returned in June shortly before giving birth in July. All of these calves (except FB 54's calf who is missing) were doing well as of this writing.

Since January 2004, one of the 1999 and five of the 2002 calves have been examined and sampled during health assessment operations. Moonfin look-a-like, FB 175, and FB 65 had sons while Saida Beth, Pumpkin, and Merrily had daughters. We also examined Fat Top, a female we have sighted since 1983, Fat Top's two year old calf, and another female initially sighted in 2001.

During the past year, we lost three long-term Sarasota Bay community members. Bar Dot, a female seen since 1989, died following complications from a stingray barb puncture to her left lung. Bobby Jo (RP 27), a 13-year-old female, died in July. She was orphaned at only 16 months and survived to have two calves of her own. Her first, Annie, is now 6 and doing well. Her second is only 2, but we hope that she will be as strong as her mother was in the same situation. Rose, a 14-year-old female, died in August and is also survived by a young calf (~15 months). We have seen her calf twice since it was orphaned and it appears to be doing well. Through our Earthwatch-sponsored surveys, we have accounted over 90% of the Sarasota community members. As of October 2004, the number of dolphins regularly using Sarasota Bay and the surrounding waters stands at approximately 160 animals.

From left: Stormy, FB 165, Pup's 2002 calf, FB 138, Pup, and FB 228 traveling together during a sighting in August 2004.

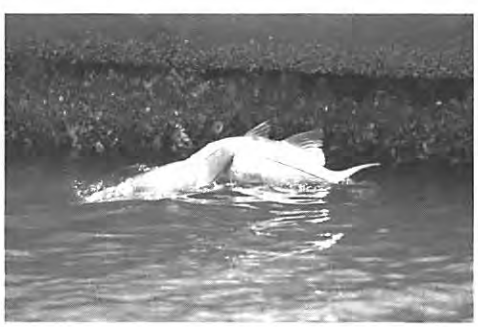
Sue Hofmann and Spencer Fire with Earthwatchers Dana Wilks and Kim Kreimeyer on 7 October 2003.

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

Earthwatcher Melanie Geary observes Remo in an aerial display off the bow on 22 October 2004.

Earthwatcher's Kim Kreimeyer and Dana Wilks record data and take photographs of Scooter on 17 October 2003.

Lizzie and her "young-of-the-year" calf with Lightning on 2 June 2004.



Rose's 2003 calf catches a snook off this seawall on Longboat Key on 25 June 2004.

Charlotte Harbor Update

By Kim Bassos-Hull, MSc

We began three years of seasonal surveys in Charlotte Harbor, an estuary on the southwest coast of Florida, in September of 2001 as part of an integrated study of the Harbor's ecosystem by several research centers based at Mote Marine Lab. Our program's primary goal was to determine the abundance and distribution of bottlenose dolphins during summer and winter and to better understand the health and population structure of these dolphins through biopsy darting efforts. As of March 2004 we have completed our six seasonal surveys, and are now moving forward with data entry, photo-id, and analyses. This work has established a unique baseline that can be used, among other things, to evaluate the environmental changes brought on by Hurricane Charley when it passed through the middle of our study area on the 13th of August 2004.

We have spent 253 days on the water since 2001 and collected 1,685 group sighting records. Two types of search effort were used to collect sighting information; (1) a 1 km grid transect design which included cross-harbor, edge, and contour transects that were replicated two times each season and (2) opportunistic transects both within the defined study area and in the Gulf coastal waters and inshore areas to the north and south of the study area. With about 75% of the photo-analysis complete we have identified 676 different marked dolphins, each with between one and eighteen sightings since 2001. Repeated sightings of at least 471 different marked individuals show they are present year-round (sighted in at least one September and one February field season). During 1990-96 we conducted photo-id surveys in this region and at least 390 dolphins that were identified then have been re-sighted since 2001 showing long-term site fidelity in this area.

Ninety-three blubber/skin biopsy samples have been collected from 88 different dolphins (65 males and 23 females) within the estuary and nearshore Gulf waters outside the passes (thanks Patty Rosel and Anna Sellas for running the gender analyses). Of the 88 sampled dolphins, 60 have been identified and catalogued and have from 1 to 25 sightings. So far eleven samples have been examined for organochlorine contaminant concentrations, providing suggestions of lower levels than in Sarasota Bay .

When Hurricane Charley passed through Charlotte Harbor in August 2004 the storm caused major ecological disturbance throughout the ecosystem. Now there is interest from government agencies in assessing the post-hurricane impacts on the health and abundance of bottlenose dolphins in the Harbor especially since we have several years of pre-hurricane data. Therefore, we may be conducting more abundance surveys and collecting more biopsy samples to detect potential changes in coming years. As a first step we conducted a subset of our transect surveys from August 24-28 to look at potential immediate impacts from the hurricane. With photo-analysis still underway we resighted several of our catalogued individuals present in the estuary during these surveys. One carcass of a male dolphin that we have known since 1996 was recovered within a week after the hurricane. Funding for this project has been provided by the Mote Scientific Foundation and NOAA Fisheries.

A dolphin leaps near Captiva Pass in Charlotte Harbor on 30 September 2004. Note the hurricane-damaged mangroves in the background.

Genetic Analyses of Bottlenose Dolphin Stock Structure in Tampa Bay

By Kim Urian, MSc

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 interested in determining how much gene flow occurs among these five communities and how well these 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 July and August 2004.

To ensure representative coverage from all communities in Tampa Bay, our goal is to collect at least 30 genetic samples from each of the putative communities. We focused our recent efforts in northern and western Tampa Bay, including the waters of Old Tampa Bay, Hillsborough Bay, and St. Petersburg. Thanks to Eckerd College, we were able to keep our research boat at their facility, which greatly facilitated access to these areas. We focused on dolphins identified in previous surveys and, in particular, we targeted known members of each of these communities. Despite

inclement weather, we collected 25 samples over the course of 7 field days. Our success was due in large part to the skill of Brian Balmer, who conducted the biopsy sampling. Our field program supplemented the genetic samples we collected from dolphins in Tampa Bay during 2000, 2002 and 2003; 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 and 25 from Old Tampa Bay and Hillsborough Bay. We already have more than 30 samples from each of the remaining two communities, thanks largely to the previous efforts of Anna Sellas during her Master's degree research. Analysis of the digital images we obtained to determine the identities of the dolphins we sampled is nearly complete, and the biopsy samples have been provided to NOAA Fisheries for genetic analyses.

The preliminary results of the photo-analysis of dorsal fin images of dolphins photographed during the biopsy surveys in 2003 and 2004 show that a large proportion of dolphins first identified in Tampa Bay in the late 1980's are still found in these waters. And, of the images of the dolphins sampled that meet our criteria for dorsal fin distinctiveness and image quality, nearly half have been matched to our Tampa Bay photo-identification catalog. Echo, one of two dolphins returned to Tampa Bay in 1990 after two years at a research facility in California, was photographed near downtown St. Petersburg on August 20, 2003, during our biopsy surveys; his most recent sighting by the SDRP was recorded in 1992 in Old Tampa Bay.

Once the genetic analysis is 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 the NOAA Fisheries, through the Chicago Zoological Society.

Echo on 20 August 2003 near Pinellas Point in Tampa Bay.

Current Status of Bottlenose Dolphin Populations in the Florida Panhandle

By Douglas Nowacek, PhD, Florida State University and Brian Balmer, MSc student, UNCW

Within the past five years, there have been two unusual mortality events in the Florida Panhandle, resulting in over 200 dead bottlenose dolphins. The single-celled organism responsible for red tide, Karenia brevis, is suspected to be involved in both cases; the degree of involvement in each is still in debate. This area of the Gulf Coast has had relatively little research performed on its bottlenose dolphin populations. St. Joseph's Bay, the region where the majority of strandings has occurred, was last surveyed by NOAA scientists in 2000, leading scientists to estimate the population of the bay at that time to be zero. In April and May of 2004, a joint effort between the Sarasota Dolphin Research Program, and the Department of Oceanography at Florida State University spent 11 days surveying and biopsy darting animals in the waters from St. Andrew Sound east to the Ochlocknee Bay. Animals in the region were seen over a range of habitats, including St. Joseph's Bay. A total of 67 biopsy samples was obtained. The biopsy samples are currently being analyzed genetically to clarify population structure and measure contaminant loads of the sampled animals.

Future research will focus initially on two areas of the eastern end of the Panhandle; St. Joseph's Bay and Apalachicola Bay-St. George Sound, which are contiguous. The current plans for St. Joseph's Bay are to continue intensive surveying and biopsy efforts of the waters inside and outside the bay. The goals of this research are to determine population structure and an overall population estimate for the region after two mass mortality events. In April 2005, a capture-release health assessment is planned for St. Joseph's Bay. Animals will be sampled similar to protocols established in Sarasota Bay. Select animals will also have VHF tags attached to their dorsal fins, allowing for radio tracking over the following month. This work will serve as the basis for Balmer's Master's thesis research through the University of North Carolina, Wilmington.

The community structure work is part of a larger effort to study the coastal dolphins of the eastern Panhandle and the 'Big Bend' area of Florida. Nowacek is initiating a photo-identification effort, working in collaboration with the Apalachicola Bay National Estuarine Research Reserve (ANERR). We will be conducting surveys in the area to address questions such as 'are the dolphins in this area seasonal or are they year-round residents?' We will also be investigating the habitat use patterns and foraging ecology of the dolphins in the area. The last component of this larger study is to sample the acoustic activity and environment of the dolphins. We will be listening for both dolphin-made sounds as well as any sounds produced by fish in the area. We know from experiments in Sarasota Bay that dolphins respond strongly to sounds produced by their prey, and we will be documenting the occurrence of fish sounds in this area near the Florida State University Marine Lab.

After this preliminary research, the goal of both SDRP and FSU is to expand research over the entire Florida Panhandle, allowing for definite conclusions about the effects of multiple mortality events on an unknown bottlenose dolphin population. Funding for this project was provided by NOAA Fisheries through the Chicago Zoological Society.

DOLPHIN RESCUES, RELEASE, AND FOLLOW-UP MONITORING

Bottlenose Dolphin "Placida" Update

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

In the last issue of "*Nicks 'n' Notches*" we reported on the capture, treatment, and immediate release by SDRP and Mote Marine Lab staff of a young female bottlenose dolphin calf near Placida Harbor, after our field teams had observed her with monofilament fishing line trailing from boat propeller wounds. We are pleased to report that "Placida" has been seen numerous times during 2004, from Placida Harbor northward into Lemon Bay, with her presumed mother, and with her wounds appearing well-healed (though she will carry deep propeller wound scars for life).

"Placida" on 2 March 2004 in Placida Harbor.

Rescue and Release of Bottlenose Dolphin "Toro"

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

Entanglement in monofilament fishing line appears to be a growing concern in the Charlotte Harbor area. SDRP staff began observing a young female dolphin on 20 February 2004 in the vicinity of Bull Bay in Charlotte Harbor, Florida, with monofilament fishing line embedded in, and trailing from the dorsal fin, as well as additional line wrapped tightly around the right flipper, with apparent lesions covering much of the flipper's surface. From photographs, the dolphin appeared to be in relatively good body condition, and it was observed capturing prey successfully on several occasions. Following three subsequent observations by SDRP staff in approximately the same location, with no change in the entanglement, it was decided that the animal would likely benefit from intervention to remove the gear, examine the wounds, and provide treatment either on site, or if warranted, at Mote's Dolphin and Whale Hospital. With the approval and assistance of NMFS, it was captured on 9 March 2004 to remove the fishing line and evaluate the wounds. Upon examination, the right pectoral fin was completely encircled with multiple wraps of monofilament fishing line that had lacerated the tissue down to the bone. It was decided that without medical care the dolphin would lose the pectoral fin and likely its life. Therefore, it was transported by Mote personnel to Mote Marine Laboratory's Dolphin and Whale Hospital for medical attention. The dolphin, designated "Toro," responded well to treatment and was released back into Bull Bay on 4 May. Radiotracking and frequent resightings have shown her to be doing well (even after Hurricane Charley) and have identified the waters of Bull Bay and the immediate vicinity as her relatively limited home range.

"Toro" with algae encrusted monofiliment fishing line cutting through her dorsal fin on 22 February 2004 in Bull Bay.

Intern Ina Ansmann radiotracking "Toro" in Bull Bay on 5 May 2004.

Follow-up Monitoring of Bottlenose Dolphin "Caesar II"

By Randall Wells, PhD

A large male bottlenose dolphin, designated "Caesar II", was found stranded on Pass-a-Grille Beach, St. Petersburg, Florida on 23 March 2004 and was immediately transported by staff of the Florida Wildlife Research Institution's (FWRI) Pathobiology Lab to Mote's Dolphin and Whale Hospital for care. Although his body was not heavily scarred, his large size and the fact that all of the teeth were worn nearly to gum level, suggested that he was an old dolphin. No cause of stranding was obvious other than infection as evidenced by high white blood cell counts. Further diagnostics revealed a small puncture wound on the dolphin's side consistent with a possible stingray barb injury that penetrated into the abdominal cavity to cause a peritonitis, but ultrasonography and radiography both failed to reveal any barb. Auditory brainstem response tests indicated that the dolphin was essentially deaf. The animal responded favorably to antibiotics, and with the approval of the NMFS, he was released offshore of Egmont Key at the mouth of Tampa Bay on 15 June. The dolphin was tracked by SDRP via satellite-linked transmitter signals through 19 July. The tag also recorded and transmitted dive information.

Caesar II re-stranded and was pushed off the beach at Manasota Key, FL near dawn on 23 June (Day 8), and came into very shallow waters within several km of the Florida Panhandle on 26-27 June (Days 11-12). The remainder of the time Caesar II moved unpredictably through the Gulf of Mexico, from the Panhandle nearly to Cuba and Yucatan, crossing some of the shallowest and deepest waters of the Gulf of Mexico in a pattern not previously described for bottlenose dolphins. Soon after release he dove as deep as 160 m and dove for more than 5 min, but dives moderated through the track. For the last 5 days of the track before cessation of transmissions, his daily rate of travel declined significantly. The reason for loss of contact with Caesar II after 35 days is unknown. Transmitted tag diagnostics did not indicate any hints of imminent battery, tag, or attachment failure, but it is possible that the tag failed prematurely or the dolphin could have shed the tag.

Follow-up Monitoring of Bottlenose Dolphin "Jack"

By Brian Balmer, SDRP Research Assistant and MSc student, UNCW

On October 30, 2003, an adult, male bottlenose dolphin stranded in Nassau Sound, near Jacksonville, Florida. The animal had numerous health issues including pneumonia, gastritis, enteritis, sinus and GI tract parasites, as well as severe sunburn over his dorsal surface. MML0334 was brought to Mote Marine Laboratory's Dolphin and Whale Hospital and became known as "Jack" to animal care staff. Over the next four months, hospital staff put extraordinary effort into rehabilitating this dolphin.

On March 12, 2004, Jack was successfully released back into Nassau Sound. He was fixed with a small VHF radio transmitter to track his progress for the following month. The first two days after his release, SDRP and Mote hospital staff and Florida Fish and Wildlife Conservation Commission (FWC) biologists visually confirmed Jack traveling south, along the Florida coast. Jack was observed socializing and being in the presence of several other groups of bottlenose dolphins during this time. Over the next month, I completed three aerial surveys and one vehicle survey searching for Jack. He was visually confirmed by aerial survey on March 18, socializing and traveling with a large group of 15-20 animals

approximately one mile offshore of Daytona Beach, Florida. High wind conditions prevented intensive tracking, and the other two aerial surveys resulted in no signal from Jack. On March 30, due to continued poor conditions for aerial surveying, I headed to the east coast of Florida by truck in an attempt to locate the rehabilitated animal. The vehicle survey began in Daytona Beach, Florida and progressed south to Fort Pierce Inlet, where I picked up his radio signal. Over the 18 days of tracking, Jack traveled over 200 miles south along the Atlantic Florida coast. The animal was observed in the vicinity of other animals, and had a normal respiration pattern. The post monitoring success of Jack would have not been possible if not for the fortitude of the FWC Jacksonville biologists braving 5-7 foot swells on the first two tracking days and the determination of aerial survey pilot Bud Freeman.

SARASOTA DOLPHIN RESEARCH PROGRAM INVOLVEMENT IN OTHER MARINE MAMMAL STUDIES

International Dolphin Conservation Projects

By Randall Wells, PhD

In partnership with the Aquatic Conservation Program of Wildlife Trust, plans are moving forward for radio-tracking Franciscana dolphins in Argentina early in 2005, as described in the previous issue of "*Nicks 'n' Notches*". This small species is believed to be heavily impacted by fishing activities through most of its range in the coastal waters of South America, but little is known of its population structure or trends in abundance. The status of the species was a focus of discussions at the annual meeting of the Scientific Committee of the International Whaling Commission in Sorrento, Italy, in June, where project leader Pablo Bordino made several presentations resulting from his work to date. Most of the necessary funding (including a major grant by Disney Wildlife Conservation Fund) and permits have been secured. The radio-tracking will indicate the feasibility of such field techniques with this species, and hopefully will provide preliminary information on ranging patterns and habitat use, two parameters of critical importance to conservation.

The "baiji", or Yangtze River Dolphin is the likely the world's most endangered cetacean species. Recent estimates suggest that fewer than 100 of these dolphins exist in the river, and fish pressure, pollution, boat traffic, damming, and habitat loss appear to be contributing to the tragic decline of this species toward extinction. Chinese officials are suggesting that the only possible way to save the species is to remove all of the remaining individuals from the river, and place them in a semi-natural preserve. Randall Wells has been invited to participate in a workshop in Wuhan, China in December 2004 to discuss options for this highly endangered species.

Spatial Relationships of Mother-calf Pairs within Hawaiian Spinner Dolphins

By Virginia Fuhs, MSc candidate

Some anecdotal, but little quantifiable, evidence suggested that Hawaiian spinner dolphin *(Stenella longirostris)* mother-calf pairs gravitate to the center of a group under certain conditions, especially as a protective measure. To test this hypothesis, data collected by Randall Wells, during aerial surveys in 1979 and 1980, as part of a large-scale study by a team led by Dr. Ken Norris of the biology and behavior of spinner dolphins off the coast of the Big Island of Hawaii, were examined.

The objectives for analyzing these aerial survey data were threefold: 1) to assess whether the presence of calves in a group of spinner dolphins influences group size, group density, or the position of individuals within their group with respect to the group's center, 2) to determine if certain external variables, such as location, seafloor substrate, human disturbance, season, and time of day affect group size or group density, and 3) to see which external variables are of most influence in the variability of the geographic location of the dolphins. Information on the spatial patterns of spinner dolphins in the wild may be useful in the study of other cetacean groups or as baseline data to measure changes over time, and has implications for the conservation and management of this population.

Statistical analyses indicated that all external variables (presence/absence of human disturbance, substrate type, bay/offshore location, water depth, time of day, and season) were important in explaining the variance in geographic location for dolphins with or without a calf. All of the external variables were also significantly predictive of dolphin group size and all except the presence/absence of a disturbance were predictive of group density. The presence of calves was associated with smaller group sizes and a longer distance to the group center, but no significant difference in group density. These data do not support the idea that mother-calf pairs gravitate to the center of a large group for safety.

Studies of Manatees Demonstrate Responses to Approaching Boats

By Stephanie Nowacek, MSc, Doug Nowacek, PhD, Randall Wells, PhD

Our lab has completed two phases of manatee research investigating the behavioral responses of manatees to approaches by various types of watercraft. The first phase of that work was done in Sarasota Bay, Florida. The results were recently published in Biological Conservation in volume 119 in 2004. In summary, we found that manatees respond to boats by increasing swimming speed and moving towards/into deeper water. This flight response can enable manatees to get out of the way of approaching vessels provided that the animals have enough time to reach sufficient depths.

Phase two of work involved putting non-invasive digital acoustic tags (DTAG) on manatees in Belize. These tags recorded fine scale changes in pitch, roll, heading and depth. Additionally, the tag measured received sound levels at the manatee. These tags enabled our team to examine fine scale behavioral responses to approaching vessels. In our previous study we were only able to see the animals within about a meter of the surface of the water so changes or responses made at depth were missed. The DTAGs allowed us to record changes in behavior that would have been impossible to see. While we did not acquire data sets from as many individuals as we would have liked; the results obtained were striking, and demonstrated correlations between boat noise and manatee behaviors. Those data are currently being prepared for publication. We hope that studies like these will enable wildlife managers to better protect manatees from recreational boating accidents. These studies were funded by the Florida Fish and Wildlife Conservation Commission, with additional support from Wildlife Trust, Mote Marine Laboratory, and the Chicago Zoological Society.

Distribution, Habitat Use and Abundance of Coastal Tucuxi and Bottlenose Dolphins in the Gulf of Morrosquillo, Colombia

By Salomé Dussán-Duque, MSc

In Colombia the status of many of the dolphin species and populations from the Atlantic and the Pacific Oceans is still unclear. Despite the lack of information, through the results of few previous studies and direct observations, some of these species are now considered "vulnerable." Being "vulnerable" means a species faces a moderate risk of extinction due to a population size reduction of 30% or more in the last 10 years (IUCN). In addition, coastal dolphin species are considered more vulnerable than the others due to direct and indirect anthropogenic impacts. Although the initial focus of this project was to study the ecology of tucuxi (*Sotalia fluviatilis guianensis*), considered vulnerable in Colombia, the need for information about bottlenose dolphins in the area led me to modify this purpose. The main goal of this research is to evaluate the distribution, habitat use, and relative abundance of tucuxi and bottlenose dolphins in the Gulf of Morrosquillo, Colombia to develop guidelines for the future management and long-term conservation of these species and their habitat.

In the two years since this project started I have accomplished, through observations made by boat, a total of 13 months of field data collection on both species. This field time makes this project the longest ongoing research on coastal dolphins in Colombia. To determine the distribution and the habitat use of these species I am collecting environmental (tidal state, wave height, wind speed and direction, salinity, water superficial temperature and Beaufort state), physical (bathymetry, coastline type and bottom type) and behavioral data (group size, structure and behavior). To quantify relative abundance I am using the mark-recapture methodology, (through photo-ID) since the intent of using line transect sampling failed due to scarcity of sightings. All the data have been plotted on digital maps with geo-morphological information, analyzed using geographic information systems (GIS). These results are being compared with previous studies of the same species in the area.

Some of the preliminary results are: 1) The sightings of both species appeared to be less frequent than reported in 1994. 2) The use from both species of Cispatá Bay is less than the use reported in 1998. 3) There was a change in the frequency of tucuxi and bottlenose sightings in some of the areas compared to previous findings. 4) Even though both species use most of the study area, there is a high tendency to have the higher number of sightings in the area adjacent to the Cispatá Bay. 5) Some individual tucuxi seem to be permanent residents of the area over the last 10 years.

To analyze and discuss the results we need to understand changes that have occurred in this ecosystem since the first studies were made. The anthropogenic pressure on natural resources has increased through the years, and we know very little about the level of capacity of the ecosystem. Different scientists and Institutes are working with diverse topics (plankton, fisheries, mangroves, top predators, etc.) in this area trying to put the puzzle together. The majority of us agree that the main ecological problem in the Gulf is a change in fish abundance and distribution. The reasons for this change could be many, but the ones that we consider the most relevant are: 1) Depletion due to over-fishing, 2) Change in the plankton community due to a hydroelectric plant and 3) Loss of habitat due to deterioration of mangrove communities.

Taking into account the results of this study, the changes in the abundance, distribution, and habitat use of tucuxi and bottlenose in the study area are worth noting. I do not yet know and probably won't know exactly if these changes are caused by the shift in prey abundance and availability. Hopefully, through more research in the next years I will have a better idea of the status of both species in this area; we hope that through knowledge, education and legal actions we can minimize the anthropogenic impact on this ecosystem and its species. This research project is being supported by Sarasota Dolphin Research Program, USA, Corporación Regional de los Valles de los Ríos Sinú y San Jorge (CVS), Colombia, Iniciativa para Especies Amenazadas, Colombia y Conservación Internacional, Colombia.

Tucuxi leap off Columbian coast.

Bermuda Dolphin Tracking Project

By Leigh Klatsky, MSc

The Bermuda Dolphin Tracking Project has provided baseline information about the habitat use and dive behavior of offshore bottlenose dolphins residing in the deep waters around the Bermuda Pedestal during the summer months. In 2003, three dolphins were tracked using satellite-linked time-depth recorders from 5 to 45 days. The three dolphins traveled an average distance of approximately 28 km/day (15 nm/day) and exhibited a preference for water depths less than 2186 meters (7,170 ft).

The data from the depth recorders revealed the deep diving capabilities of offshore bottlenose dolphins including regular nighttime dives to depths greater than 450 meters (1,500 ft) and in durations longer than five minutes. An increase in the average number of dives at dusk and deep dives at night indicates the possibility of nocturnal foraging on fish and squid associated with the nightly vertical migrations in the deep scattering layer.

The second stage of this project started in November 2004 with the goal of investigating seasonal differences in movement behavior and to further investigate the dolphins' deep diving behavior. This project is funded by Dolphin Quest and Quest Global Management, with additional support from the Bermuda Zoological Society and the Chicago Zoological Society.

EDUCATION

Education is 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.

In Fall of 2004, Mote Marine Lab opened a new Immersion Cinema theater, with 165 seats sharing computer consoles, the largest of the more than 20 such interactive theaters in existence in North America. A new program to be distributed through the network of studios, "Dolphin Bay," is loosely based on our long-term dolphin research and conservation program in Sarasota Bay. Participants are able to investigate threats to bottlenose dolphins in the imaginary bay and attempt to resolve the threats for the animals by applying field research techniques, performing rescues, caring for dolphins in a hospital setting, and participating in polls to inform a congressman of their selection from a variety of population-level protection measures. 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" (described elsewhere in this newsletter in more detail), indicating the population size 50 years hence.

Students at all levels are crucial elements of conservation. Through the encouragement of long-time program supporters and participants John and Ronnie Enander and Bill Scott, we worked with 5th grade teachers in Sarasota County on a program to educate students about dolphins and manatees, their needs, and how to treat them in the wild, through classroom visits by Randy Wells. In preparation for these classroom visits, each class was provided with free copies of Wells' book "Dolphin Man: Exploring the World of Dolphins."

For high school students, education staff at the Chicago Zoological Society's Brookfield Zoo and Mote Marine Lab are working with us to develop curricula for distance learning programs on dolphins, taking advantage of our long-term datasets to develop student activities that mirror some of the ways the scientists address current research topics (see below, "Secret Life of Dolphins").

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 (12 doctoral dissertation and 19 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 in the University of Florida's SEAVET program this year for the first time.

Our efforts to provide information to our colleagues and wildlife management agencies continues through publication of numerous scientific articles, invited presentations at various scientific conferences and participation in national/international panels such as the Atlantic Scientific Review Group, the Working Group on Unusual Marine Mammal Mortality Events, the International Whaling Commission, the IUCN Cetacean Specialist Group, and the IUCN Reintroduction Specialist Group.

Intern Perspective

By Stephanie Schilling, BS

How does someone from Arizona become a marine mammalogist? This was the challenge that I faced after I graduated from Northern Arizona University in December of 2002. I decided that participating in internships would be the most beneficial way to get a start in the field of marine mammalogy. In December 2003 I met Kim Bassos-Hull at the Society for Marine Mammology's biennial conference in Greensboro, NC and she invited me to apply for an internship with the Sarasota Dolphin Research Program (SDRP) based at Mote Marine Lab. In February of 2004, I arrived in Florida and began my internship at SDRP working with Kim and her supervisor, Dr. Randy Wells, on their research in Charlotte Harbor. The first four weeks of my internship were based at Mote's Pine Island Field Station. During my time there, I had the opportunity to spend almost every day on the water, learning field techniques and observing the dolphins of Charlotte Harbor. When we weren't on the water, there was plenty of data entry and photo identification for us to do.

When we returned to Sarasota, I began helping Kim and other interns update the Charlotte Harbor fin identification catalog. After observing the animals in the wild it was interesting to be able to learn more about them by looking at the distribution of their sightings and their association patterns. I also had the opportunity to do field work in Sarasota

Bay, where I participated in surveys looking at the distribution and life history of the resident dolphins, focal follows for Spencer Fire's red tide research, purse seining with Dr. Damon Gannon, and capture-release health assessment. I occasionally went out with other programs, such as the manatee and offshore cetacean research programs, and volunteered with Mote's dolphin hospital. Perhaps my favorite experience was working with Toro, a Charlotte Harbor dolphin that we first sighted in February with line embedded in her dorsal fin and pectoral flipper. After repeated observations indicated that she was not going to shed the line on her own, our SDRP field team caught her, removed the line, examined her wounds, and determined that she would benefit from intensive care at the dolphin hospital. I worked as many shifts with her as possible at the hospital. I was then able to assist with her release and continue monitoring her through radio tracking. When I was not in the field or helping with Charlotte Harbor surveys, I worked with our GIS expert, Janet Gannon. I helped digitize location zones and map the long-distance offshore movements of a released rehabilitated dolphin outfitted with a satellite-linked radio transmitter.

My internship at SDRP has been invaluable to me, through the contacts I made, the skills I learned, and being able to get a glimpse into the world of a marine mammalogist. In fact, I enjoyed my internship so much that I still haven't left! I now work as a Research Assistant for Dr. Wells, continuing the projects I had started as an intern.

SDRP Contributes to Mote's Research Experiences for Undergraduates Program

By Damon Gannon, PhD

Each summer, Mote Marine Laboratory (MML) 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 MML, 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 Katie Brueggen from College of the Ozarks in Missouri. Katie was one of the core members of the dolphin prey survey crew and her independent research project was called "Effects of bottlenose dolphin sounds on the acoustic behavior of spotted seatrout spawning choruses." Katie's research showed that choruses of spawning male spotted seatrout (*Cynoscion nebulosus*) responded to the sounds of echolocating dolphins by becoming quieter. This is probably an adaptation to avoid predation by dolphins that use passive listening to detect prey. Seatrout choruses also become quieter in response to the disturbance calls of Atlantic croaker (*Micropogonias undulatus*). Many species of fish produce disturbance calls when they are threatened by predators, and there is a great deal of similarity among the disturbance calls of fish from a variety of families. Since croaker and seatrout are both preyed upon by dolphins, it is not surprising that they respond to each other's calls.

Katie's research project was selected from among all the REU projects at Mote to be presented at the conference of the American Society of Limnology and Oceanography, which will be held in Salt Lake City in February 2005. This is an honor for Katie and the Sarasota Dolphin Research Program. For more information on Mote's REU Program, see their web site at: http://www.mote.org/~jimg/reu.htm.

"Secret Life of Dolphins" Update

By Robin Dombeck, Chicago Zoological Society

This has been an amazing year for the Secret Life of Dolphins project! This joint project of the Chicago Zoological Society and Mote Marine Laboratory, funded by the U.S. Department of Education, has grown to near completion.

The curriculum package utilizes diverse media to encourage student learning. We have now completed pilot versions of the classroom teacher guided explorations for high school students, interactive data analysis software, videoconference sessions, and field trips. At the Chicago Zoological Society's Brookfield Zoo, the Dolphin Theater is complete, allowing classes and the general visitors to vicariously experience being on a research boat with Randy Wells. At Mote Marine Lab, the Immersion Cinema experience is up and running, with a school preview on November 19, and an official opening on November 24.

The SLD team hosted teacher workshops at both Brookfield Zoo and Mote Marine Lab. Twenty three middle and high school teachers attended at BZ in May, and 11 middle, high school and two Marine Mammal Alliance educators attended at MML in July. At the workshops, educators learned about how scientists study dolphins and how that knowledge is applied, both in the wild and in zoos and aquariums dolphin research. They tested the classroom activities and software and experienced a videoconference. They have learned how to manipulate and analyze authentic data to answer questions, such as those being asked by marine mammal scientists. They also received a copy of the curriculum to test in their classrooms, and are invited to take their classes on a field trip.

As the development and teacher workshops have progressed, so too has our evaluation of the project. Our evaluator contractors continue to survey teachers, visit classrooms and compile data.

The development of the Secret Life of Dolphins project will draw to a close in December of 2004, but we will continue to offer teachers and their students this amazing opportunity to participate in our innovative program as we disseminate the materials. It's by far the best curriculum out there on dolphin health, anatomy, physiology, social structure, study of the Sarasota Bay ecosystem, dolphin communication and dolphin diets, if we say so ourselves! Thank you to all the SLD team, researchers, MML staff, BZ staff, US DOE, and so many others who have made this possible.

SARASOTA DOLPHIN RESEARCH PROGRAM OPERATIONS

Keeping Track: SDRP Databases and Applications

By Janet Gannon and Stephanie Nowacek

Every year, SDRP staff collect data on a wide range of topics: from dolphin distribution to acoustic recordings to health assessment information. These data are the basis for all of our analyses, and considerable effort goes into verifying, entering, and maintaining information for future analyses. Our most extensive collection of data, relating to dolphin distribution, dates from 1975. We have more than 25,000 discrete field sightings of dolphin groups, adding hundreds each year. For each group sighting, our photo-ID staff members identify known animals, giving us over 70,000 sightings of known animals.

Until now, SDRP has used a combination of Microsoft FoxPro and Excel to manage our dolphin sighting and health assessment data. The inability to link those data sets however, prompted us to explore better options. This year we are developing a new database application designed to make working with data easier. The application, based in Microsoft Access, has verification procedures and data analysis built in. For example, when questionable data (such as unusual latitude or longitude) are entered by users, a popup message appears asking for verification. This often prevents errors such as typos from ever being entered, simplifying later verification, improving accuracy, and speeding up processing times. The application as written provides some data analyses such as coefficients of association (a measure of the frequency of concurrent sightings between dolphins) and simple mapping of sightings. Although development is still in progress, the database will soon also aid our photo-ID staff by making it possible to query through photos of known animals according to fin attributes. In time, we hope to link these datasets with dorsal fin identification photographs, body measurements, blood values and other health records, contaminant data, and whistle patterns, for example.

Maintaining data integrity, making data entry easier and faster, and expanding data analysis capabilities all help us be one of the premier marine mammal research groups in this country. 2004 was a productive, data-filled year, as we know next year will be too!

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.

Peer-reviewed Journal Articles and Book Chapters

Wells, R.S. 2003. Dolphins (Delphinidae). Pp. 41-58 *In:* V. Geist, M. Hutchins, and M.C. McDade, eds., Mammals IV, Vol. 15 of Grzimek's Animal Life Encyclopedia. The Gale Group, Farmington Hills, MI.

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Theses and Dissertations

Klatsky, L.J. 2004. Movement and dive behavior of bottlenose dolphins (*Tursiops truncatus*) near the Bermuda Pedestal. MSc. Thesis, San Diego State University.

Manuscripts In Press, In Revision, or In Review

Gannon, D.P., N.B. Barros, D.P. Nowacek, A.J. Read, D.M. Waples, and R.S. Wells. In press. Prey detection by bottlenose dolphins (*Tursiops truncatus*): an experimental test of the passive-listening hypothesis. Animal Behavior.

Fripp, D., C. Owen, E. Quintana-Rizzo, A. Shapiro, K. Buckstaff, K. Jankowski, R.S. Wells, and P. Tyack. In press. Bottlenose dolphin (*Tursiops truncatus*) calves model their signature whistles on the whistles of community members. Animal Cognition.

Tornero, V., A. Borrell, A. Aguilar, R.S. Wells, J. Forcada, T.K. Rowles, and P.J.H. Reijnders. In press. Effect of organochlorine pollutants and individual biological traits on blubber retinoid concentrations in bottlenose dolphins (*Tursiops truncatus*). Journal of Environmental Monitoring.

Watwood S.L., E.C.G. Owen, R.S. Wells, and P.L. Tyack. In press. Signature whistle use by free-swimming and temporarily restrained bottlenose dolphins. Animal Behaviour.

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.

Watwood, S.L. and Owen, E.C.G. In revision. Adult male bottlenose dolphins, *Tursiops truncatus*, use whistles to initiate reunions between alliance partners. Journal of Comparative Psychology.

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. In review. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. The Science of the Total Environment.

Hall, A.J., B.J. McConnell, T.K. Rowles, J. Kucklick, L. Schwacke, and R.S. Wells. In review. Population consequences of polychlorinated biphenyl exposure in bottlenose dolphins – an individual based model approach. Environmental Health Perspectives.

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Martien, K.K., A.B. Sellas, P.E. Rosel, B.K. Taylor, and R.S. Wells. In review. A new approach to defining management units for Gulf of Mexico bottlenose dolphins. Marine Mammal Science.

Gannon, D.P. In review. Evidence for acoustic contact calling in a fish, *Micropogonias undulatus* (Sciaenidae). Ethology.

Gannon, D.P. In review. Passive acoustic techniques in fisheries science: promises and pitfalls. Transactions of the American Fisheries Society.

Technical Reports

Wells, R.S. 2004. Small cetacean electronic tag attachment workshop, June 11-12, 2003. Report to the U.S. Marine Mammal Commission, Contract No. T03326587.

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Schwacke, L., Hall, A., Wells, R., Bossart, G., Hohn, A., Fair, P., Kucklick, J., Rosel, P., and Rowles, T. 2004. A 5-year plan for health and risk assessment for bottlenose dolphin populations along the southeast U.S. coast. International Whaling Commission Report SC/56/E20.

Hall, A., Wells, R.S., Stott, J., Wilson, J., Aguilar, A., Borrell, A., Tornero, V., Donovan, G.P., O'Hara, T., Rowles, T., Siebert, U., Bjørge, A. and Reijnders, P.J.H. 2004. Biomarkers of contaminant exposure and relationships with blubber contaminant levels in bottlenose dolphins *Tursiops truncatus*. International Whaling Commission Report SC/56/E15.

Presentations at Professional Meetings

Wells, R.S., Tornero, V., Borrell, A., Aguilar, A., Rowles, T.K., Rhinehart, H., Hofmann, S., Jarman, W., Hohn, A., Sweeney, J. 2004. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Annual Meeting of the Scientific Committee, International Whaling Commission, 4 July 2004, Sorrento, Italy.

Wells, R.S. 2004. Integrating life history, health, and reproductive success data to examine potential relationships with organochlorine contaminants for bottlenose dolphins in Sarasota Bay, Florida. National Water Research Institute, Environment Canada, Burlington, Ontario.

Wells, R.S. 2004. Implications of bottlenose dolphin stock structure for health assessment on Florida's west coast. National Ocean Service, Charleston, SC.

Wells, R.S. 2004. Health assessment of bottlenose dolphins in Sarasota Bay, Florida. Forum on "Estrategias para el Manejo y Aprovechamiento de Delfines (*Tursiops* spp.) en México. 1-2 May 2004, La Paz, Mexico.

Bassos-Hull, K., R.S. Wells, C.A. Shepard, J.B. Allen, and B.C. Balmer. 2004. Bottlenose dolphin abundance, distribution, population structure, and health in the Charlotte Harbor ecosystem: update and findings 2004. 5-6 October 2004, Charlotte Harbor Conference, Mote Marine Laboratory, Sarasota, FL.

Bassos-Hull, K., R.S. Wells, C.A. Shepard, J.B. Allen, and B.C. Balmer. 2004. Bottlenose dolphin abundance, distribution, population structure, and health in Charlotte Harbor, Florida. 26-28 March 2004, SEAMAMMS, Harbor Branch Oceanographic Institution, Fort Pierce, FL.

Dussán, S., R.S. Wells, and K. Bassos-Hull. 2004. Preliminary Results of the Distribution and Habitat Use of Coastal Sotalia (*Sotalia fluviatilis*) in the Gulf of Morrosquillo, Colombia11ª Reunión de Trabajo de Especialistas de Mamíferos Acuáticos de América del sur. 5° Congreso de la Sociedad Latinoamericana de Especialistas en Mamíferos Acuáticos. Septiembre 12-17, 2004. Quito, Ecuador. (Poster)

Houde, M., T.A.D. Bujas, B.C. Balmer, G. Bossart, P.A. Fair, R.S. Wells, K.R. Solomon and D.C.G. Muir. 2004. Perfluorinated compounds in three free-ranging bottlenose dolphin populations from southeastern U.S. waters. Annual Meeting, Society for Ecotoxicology and Chemistry. (poster)

Houde, M., T.A.D. Bujas, B.C. Balmer, G.J. Pacepavicius, M. Alaee, G. Bossart, P.A. Fair, R.S. Wells, K.R. Solomon and D.C.G. Muir. 2004. Assessment of hydroxylated polychlorinated biphenyls (OH-PCBs) in plasma of free-ranging bottlenose dolphins. Annual Meeting, Society for Ecotoxicology and Chemistry. (poster)

Gannon, J.G., D.P. Gannon, and R.S. Wells. 2004. Using GIS, relational databases, and application programming to improve ecological sampling design: an example involving bottlenose dolphins and their prey. Southeast and Mid-Atlantic Marine Mammal Symposium. 26-29 March 2004, Ft. Pierce, Florida, (poster presentation).

Watwood, S.L. 2004. Social communication and behavior in marine mammals. MIT Alumni group, Woods Hole Oceanographic Institution.

White, C.E., G. Tagliarini, L. Sayigh and S. Narayan. 2004. Automatic computer classification of dolphin signature whistles. Sigma Xi Spring Meeting, UNCW, 4/15/04.

Invited Participation in Legislative Activities

Wells, R.S. 2004. U.S. House of Representatives, Subcommittee on Fisheries Conservation, Wildlife and Oceans. Invited Participant, Stakeholder Meeting, Marine Mammal Protection Act Reauthorization, H.R. 2693. 20 January 2004.

Invited Public and University Lectures

Wells, R.S. 2004. Bottlenose dolphin conservation based on long-term behavior, ecology, life history, and health research. Biology of Marine Mammals, University of Miami.

Wells, R.S. 2004. The secret lives of Sarasota Bay's bottlenose dolphins. MaST Research Institute, Sarasota High School, Sarasota, FL.

Wells, R.S. 2004. Dolphin family values. Lowell Lecture Series, New England Aquarium, Boston, MA.

Wells, R.S. 2004. Conservation Matters, Brookfield Zoo, Brookfield, IL.

Cook, M.L.H. 2004. Hearing measurements in bottlenose dolphins. WV P.E.O. Chapter B fall meeting, Morgantown, WV.

Wells, R.S. 2004. Bottlenose dolphin conservation based on long-term behavior, ecology, life history, and health research. SEAVET course, University of Florida.

Wells, R.S. 2004. Caring for and caring about bottlenose dolphins – perspectives from 34 years of collaborative dolphin research. Invited Presentation, Marine Mammal Alliance Educator's Annual Meeting, Orlando, FL.

Wells, R.S. 2004. Integrating life history, health, and reproductive success data to examine potential relationships with organochlorine contaminants for bottlenose dolphins in Sarasota Bay, Florida. Marine Mammal Toxicology, Woods Hole Oceanographic Institution.

Cook, M.L.H. 2004. Hearing measurements in free-ranging bottlenose dolphins. Department of Social Sciences, New College of Florida, Sarasota, FL.

Wells, R.S. 2004. Dolphins, manatees, and sea turtles from Osprey to Boca Grande: Current Mote Marine Laboratory research and conservation activities, and plans for the future. Gulf Coast Community Foundation of Venice, Venice, FL.

Professional Activity Summary cont.

Wells, R.S. 2004. Dolphin family values. Sarasota Boat Club, Sarasota, FL.

Wells, R.S. 2004. CZS Sarasota Dolphin Research Program: Helping to make CZS a place where conservation, research, education, and animal programs intersect seamlessly. Board of Trustees Retreat, Chicago Zoological Society, Brookfield, IL.

Wells, R.S. 2004. History and overview of Mote Marine Lab's Marine Mammal Stranding Response Program. MML Animal Care Class, Sarasota, FL.

Wells, R.S. 2004. Discovering dolphins and manatees in our backyards. Brentwood Elementary School (two 5th grade classes), Sarasota, FL.

Wells, R.S. 2004. Discovering dolphins and manatees in our backyards. Philippi Shores Elementary School (5th grade class), Sarasota, FL.

Wells, R.S. 2004. Discovering dolphins and manatees in our backyards. Venice Elementary School (two 5th grade classes), Venice, FL.

Watwood, S.L. 2004. Social communication and behavior in marine mammals. MIT Alumni group, Woods Hole Oceanographic Institution.

Janik, V.M. 2004. Using acoustic playbacks to study signature whistles and their significance in dolphin communication. Invited plenary lecture presented at the 18th Annual Conference of the European Cetacean Society, Kolmarden, Sweden

Janik, V.M. 2004. Vocal learning in marine mammals: mechanisms and functions. Invited lecture at the University of South Florida at St Petersburg, USA

Janik, V.M. 2004. How do bottlenose dolphins encode identity in whistles? Invited lecture at Odense University, Denmark

Sayigh, L.S. 2004. Bottlenose dolphins. Invited speaker at the Cape Fear Sierra Club meeting, March 2004

Sayigh, L.S. 2004. Bottlenose dolphin signature whistles: fact and fiction. Invited talk at the Duke University Marine Laboratory, December 2004

Bassos-Hull, K. 2004. Bottlenose dolphin abundance, distribution, population structure, and health in the Charlotte Harbor ecosystem. Invited speaker at Useppa Island Museum, Pineland, Florida, February 2004.

Bassos-Hull, K. 2004. Bottlenose dolphin abundance, distribution, population structure, and health in the Charlotte Harbor ecosystem. Invited talk at the University of St. Andrews, Scotland, August 2004.

How You Can Make a Difference

Endowment for Long-term Program Continuity — The staff and volunteers of the Sarasota Dolphin Research Program would like to be able to maintain our continuing ambitious level of field work, analyses, publishing, and presenting, but we need to expand our base of support in order to make this possible. We would like to establish an endowment of **$2,000,000** to ensure the continuity of the most basic monitoring activities of the world's longest-running dolphin research program.

Dolphin Rescue Fund — Because of our expertise and specialized gear, we are increasingly involved in rescuing dolphins suffering from human interactions. These rescues typically involve up to 4 vessels and 20 people, with direct field costs of about $1,000 per day, not including staff salaries. Tags for follow-up monitoring cost $250 for a VHF tag, and about $3,500 for satellite-linked location monitoring tags with dive recording capabilities. These efforts currently have no source of support. We would like to establish a Dolphin Rescue Fund of at least **$10,000** to make sure that we are able to continue to provide the level of immediate response that can optimize our chances for success, so we can have more positive outcomes such as those for "Placida" and "Toro" as described in this newsletter.

Contributions can be directed to our program through any of three not-for-profit organizations, Dolphin Biology Research Institute, Chicago Zoological Society, or Mote Marine Laboratory. Dolphin Biology Research Institute (IRS-EI#59:2288387) is a Florida-based, 501{c}3 not-for-profit corporation; thus donations of funds and/or equipment are tax-deductible (Florida State Solicitations Registration No. SC-01172). Donations go almost entirely to offset research and education program expenses. During the most recent fiscal year, less than 2% of funds received by DBRI were spent on fund-raising activities. No salaries were paid by DBRI to any of its Officers or Directors. The Chicago Zoological Society and Mote Marine Laboratory also have mechanisms for accepting funds specified for use by the "Sarasota Dolphin Research Program."

We would like to take this opportunity to acknowledge the support and contributions to Dolphin Biology Research Institute, Chicago Zoological Society, and Mote Marine Laboratory in support of Sarasota Dolphin Research Program activities from:

Edward McCormick Blair, Jr. **Anne Cooper** **Ronnie and John Enander** **Eric Frick and Pam Salaway**
Don and Lee Hamilton **Richard Kasten** **The Whales of Randy Puckett** **William and Sandra Scott**
Pat and Cliff Terry **Trac Pac** **United Way of Delaware** **Cannons Marina, David and Lucille Miller**
Mote Scientific Foundation **NOAA Fisheries** **Chicago Board of Trade** **Disney Wildlife Conservation Fund**
Disney's Animal Programs **Earthwatch Institute** **Surfview Beach Resort** **Dolphin Quest, Jay Sweeney and Rae Ston**
Harbor Branch Oceanographic Institute's Protect Wild Dolphins Program

Staff During 2004

Randall S. Wells, Ph.D., Program Manager
Sue Hofmann, B.Sc., Field Coordinator
Stephanie Nowacek, M.Sc., Lab Manager
Kim Bassos-Hull, M.Sc., Research Associate
Damon Gannon, Ph.D., Post-Doctoral Investigator
Janet Gannon, MSNR, Senior Biologist
Elizabeth Berens, M.Sc. Candidate, Staff Biologist
Jason Allen, B.Sc., Research Assistant
Brian Balmer, B.Sc., Research Assistant
Christine Shepard, B.Sc., Research Assistant
Aaron Barleycorn, B.Sc., Research Assistant
Stephanie Schilling, B.Sc., Research Assistant
Michael Scott, Ph.D., Secretary-Treasurer, DBRI
Blair Irvine, Ph.D., Vice-President, DBRI

Contract Staff During 2004

Kim Urian, M.Sc., Research Associate
Kristi Fazioli, M.Sc., Research Associate
Kara Buckstaff, M.Sc., Research Associate
Sue Hofmann, B.Sc., Research Associate
Lori Schwacke, Ph.D., Consultant

Master's Students During 2004

Michelle Barbieri, University of North Carolina, Wilmington
Meghan Bolen-Pitchford, University of California, Santa Cruz
Virginia Fuhs, Western Illinois University
Leigh Klatsky, San Diego State University
Brian Balmer, University of North Carolina, Wilmington

Doctoral Students During 2004

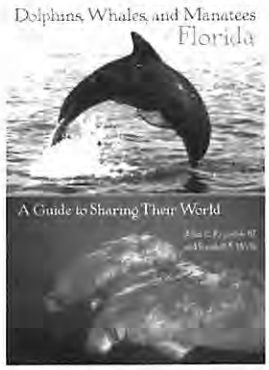
Spencer Fire, University of California, Santa Cruz
Mandy Cook, University of South Florida
Magali Houde, University of Guelph
Erin Meagher, University of North Carolina, Wilmington
Ester Quintana, University of South Florida
Katie McHugh, University of California, Davis
Christine Shepard, University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

Interns During 2004

Alison Campbell	Chloe Tatum	Andrea Guerrini	Lindsey Dryden	Jessica Atwell
Stephanie Schilling	Andrea Swinehart	Mridula Srinivasan	Eva Hartvig	Tenaya Norris
Jennifer Way	Hillary Lane	Athena Rycyk	Katie Brueggen	Kris Meranda
Ina Ansmann	Nicole Knauer	Sandra Bohn	Kate Williams	

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.



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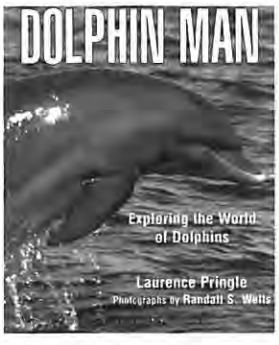

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Howard, Carol J. 1995. Dolphin Chronicles. Bantam Books, New York, NY. 304 pp. ISBN 0-553-37778-7

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