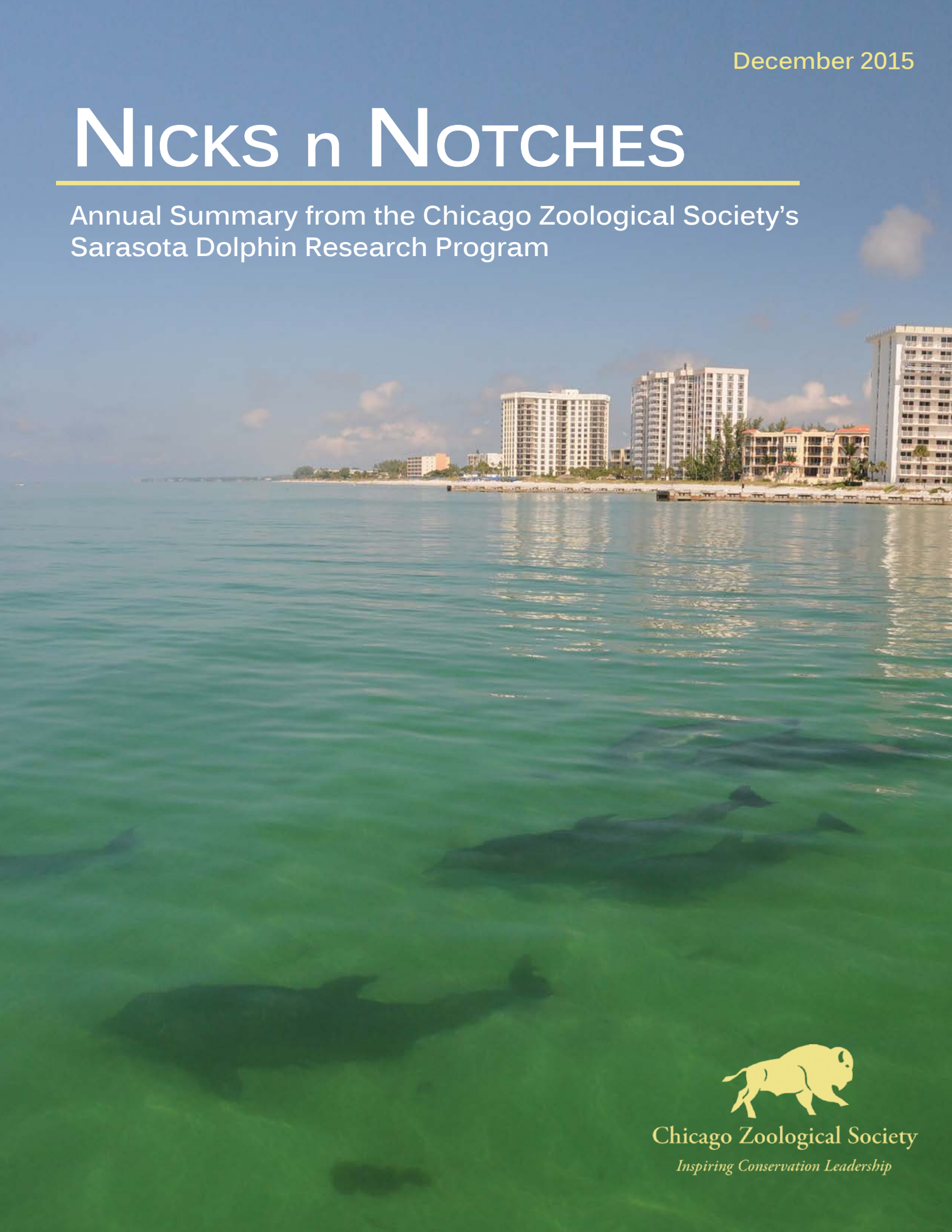
December 2015

Nicks n Notches

Annual Summary from the Chicago Zoological Society's Sarasota Dolphin Research Program



Chicago Zoological Society

Inspiring Conservation Leadership

The mission of the

Chicago Zoological Society

To inspire conservation leadership by connecting people with wildlife and nature

Celebrating 45 Years of Dolphin Research, Conservation, and Education

The Chicago Zoological Society operates "the world's longest-running study of a wild dolphin population." The Sarasota Dolphin Research Program (SDRP) has been studying bottlenose dolphins since 1970, through photographic-identification surveys, capture-release health assessments, focal animal behavioral follows, dolphin prey fish surveys, and tagging and tracking. The program monitors the multi-decadal, multi-generational, year-round resident population of dolphins in Sarasota Bay, FL, and this year documented the oldest known-age bottlenose dolphin, a 65-year-old resident female. Through the unique, long-term SDRP operations, Sarasota Bay: 1) serves as a model for understanding bottlenose dolphins and the threats they face in Sarasota Bay and elsewhere, through research projects and collaborations, 2) provides opportunities to test new conservation research and threat mitigation methodologies, 3) provides training opportunities for students, colleagues, and international scientists, and 4) provides a unique resource of experience and expertise that can be applied broadly to marine mammal conservation issues around the world.

As a result of the ongoing, long-term efforts of the SDRP, the Sarasota Bay dolphins have been recognized and used by the National Oceanic and Atmospheric Administration (NOAA) as a unique and crucial reference population for investigating impacts of human-caused and natural catastrophes on dolphin populations elsewhere. The information and expertise provided by the SDRP is playing an important role in the investigation of the *Deepwater Horizon* oil spill, the nation's largest environmental disaster, by helping to identify health and population impacts on dolphins. Similarly, the SDRP is assisting NOAA with an investigation of the impacts on bottlenose dolphins of an EPA Superfund site in Brunswick, GA, where the highest levels of PCB contaminants measured in dolphin tissues anywhere have been found. In 2015, SDRP staff members have also been called upon to consult on recovery plans for endangered species and stocks, including the most endangered porpoise in the world, the Vaquita in the upper Gulf of California, and the endangered Southern Resident Killer Whales, inhabiting waters near Seattle.

The SDRP is also funded by NOAA to characterize and mitigate adverse human interactions with dolphins, including recreational fishery interactions that are the leading human-induced cause of death for bottlenose dolphins in the southeastern U.S. With Office of Naval Research funding, the SDRP is engaged in a study to identify biologically meaningful indicators of dolphin disturbance as might be caused by such sources as naval sonar, an important concern affecting marine mammals around the world.

So far in 2015, SDRP research efforts have resulted in 16 peer-reviewed scientific publications, with five more in press, and seven others submitted for review. One doctoral student has completed her dissertation, and six more doctoral research programs associated with the SDRP are in progress, one Master's thesis has been completed and two more are in progress, and 14 interns have participated in the program from six countries. In addition, a dolphin conservation curriculum has been introduced into the Sarasota County, FL public school system, with much acclaim from teachers. As a result of the experience, expertise and productivity of the SDRP, in May 2015 program director and CZS Senior Conservation Scientist Randall Wells was asked to become one of nine members of the U.S. Marine Mammal Commission's Committee of Scientific Advisors, to consult on marine mammal conservation issues of national and international importance.

For 45 years, the SDRP has continued to make a positive difference for dolphins – thanks in large part to your help!

In This Issue

Our Approach Toward Helping Dolphins

Our desire with each research or conservation project in Florida or elsewhere is to contribute to a better understanding of the structure and dynamics of populations of small cetaceans (dolphins, whales, and porpoises), as well as the natural and anthropogenic factors (factors of human origin) that impact them. We use an interdisciplinary and collaborative approach in conducting studies of bottlenose dolphins within a unique long-term natural laboratory. The primary goals of our 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 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 collaborative work done toward achieving these goals is conducted under the umbrella of the "Sarasota Dolphin Research Program." This name links the efforts of several organizations and individuals that work together to ensure the continuity of the long-term dolphin research in Sarasota Bay. The SDRP has been operated by the Chicago Zoological Society (CZS) 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 small research vessels, towing vehicles, computers, cameras, field equipment, etc. Since 1992, the program has been based at Mote Marine Laboratory 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 opportunities primarily through the University of Florida, the University of California Santa Cruz, and Duke University.

All of our bottlenose dolphin research in the United States is conducted under NOAA Fisheries Service Scientific Research Permit No. 15543 and Institutional Animal Care and Use Committee approvals through the appropriate institutions.

The Florida-based staff of the Chicago Zoological Society's Sarasota Dolphin Research Program can be reached c/o:
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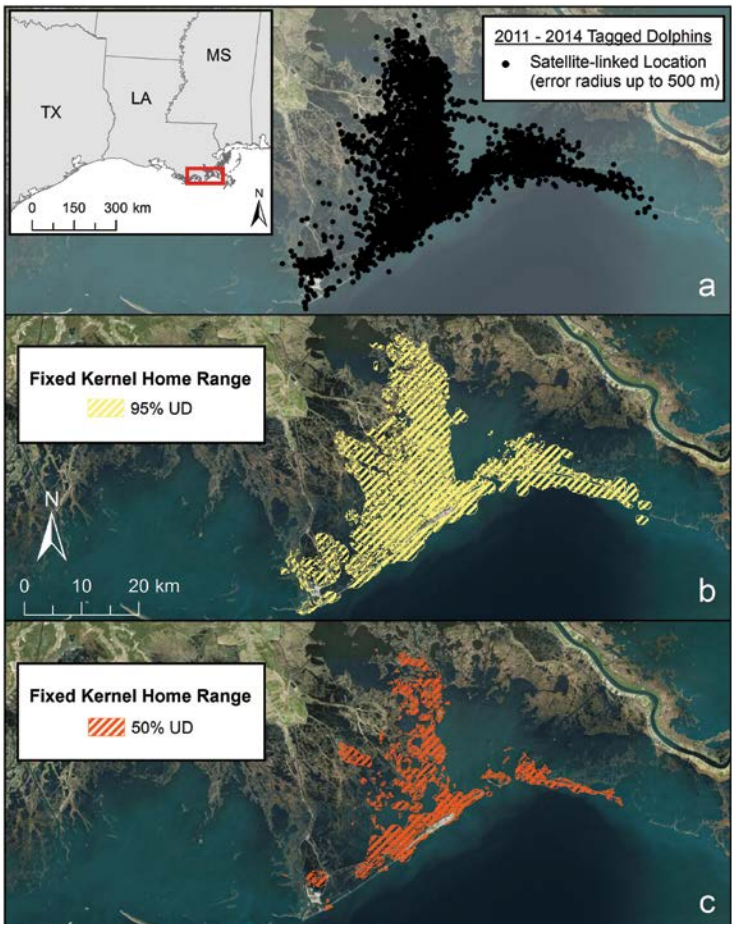
The May 2015 dolphin health assessment team pictured with F155 and F290 as acoustic recordings are completed for these two dolphins.

Deepwater Horizon **oil spill investigation update**

Randall Wells, Chicago Zoological Society

On October 5, 2015, the U.S. Department of Justice lodged a consent decree as part of a proposed $20 billion comprehensive settlement among BP, the U.S. Department of Justice on behalf of federal agencies, and the five affected Gulf States to resolve liabilities arising from the 2010 *Deepwater Horizon* oil spill. As part of this settlement agreement, a draft Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS) was released documenting impacts from the oil spill and proposed restoration to address the natural resource damages. Results of data analyses involving injury to dolphin populations are included in the PDARP/PEIS, and findings from numerous studies are being prepared for publication in peer-reviewed scientific journals.

The Sarasota Dolphin Research Program (SDRP) has played a role in this investigation. Our long-term research in Sarasota Bay has provided crucial reference data on dolphin health, life history, and population dynamics for comparison with data from oiled sites in the northern Gulf, including Barataria Bay, Louisiana, and Mississippi Sound. The SDRP was responsible for tagging and tracking dolphins in Barataria Bay and Mississippi Sound to determine their ranging patterns. Our findings of remarkably strong site fidelity for Barataria Bay dolphins are being prepared in a manuscript for publication, and will be presented at the Society for Marine Mammalogy's Biennial Conference in San Francisco in December 2015. All of the movements of the 44 dolphins tagged with satellite-linked transmitters during 2011, 2013, and 2014 were within the Barataria Bay region.



Combined location data (high quality only) for all 44 dolphins tagged during 2011-2014: a) all locations for all tagged individuals; b) overall home ranges for all tagged dolphins; and c) core areas for all tagged dolphins.

Population Consequences of Disturbance

Lisa Schwarz, University of California Santa Cruz

We have combined the unique, long-term data sets collected by SDRP to determine how reduced prey affects behavior, physiology, health, and survival of bottlenose dolphins. The results of our efforts will help conservation managers predict how reduced foraging caused by human activities (such as noise exposure as a disturbance) will affect dolphin populations.

When individual animals respond to a stressor (anything that may cause an animal to change its physiology or behavior), what impact will such changes have on an entire population, and how will those changes occur? Those are two questions that have become increasingly important for conservation as the threats to marine mammals have become ever more subtle and pervasive. In addition, there is a need to know how exposure to multiple, seemingly-benign stressors can accumulate in an animal's body and eventually affect reproduction and even survival. In particular, the Office of Naval Research (ONR) is interested in understanding how exposure to noise affects individuals, and how those effects are carried over to the population.

One of the critical behavioral changes we might see in animals exposed to sound is reduced foraging effort. In particular, bottlenose dolphins have little-to-no fat reserves that could buffer against lost foraging, making them (and species like them) particularly vulnerable. While we do not want to perform experiments that would actually result in lower reproduction or survival, we can use data about natural disturbances that may create the same effect. In Sarasota Bay, we are investigating how red tide (which reduces prey availability) affects dolphin behavior, health, survival, and reproduction. We have found that the number of prey calories available to dolphins during the winter is reduced when red tides are more severe and longer. Mother-calf separation (an indication of weaning) is more likely during that year, and the repercussions of the red tide persist through the following year. Survival of juvenile and adult female dolphins declines the year after a red tide event, with evidence of a decrease in lipid stores at the end of that year.

Knowing the connection between survival and lipid stores as well as how mother-calf separation relates to lost foraging will aid in understanding the relationships we might see for species, or even other bottlenose dolphin populations, for which we have very little data. In addition, the study will help determine the most effective type of data to collect to evaluate the population consequences of disturbance.

Scooter, a well-known Sarasota resident mother, performs a fish toss.

Are dolphin distributions influenced by recreational boat traffic?

Fernando Noriega, University of Florida

The objective of my Master's thesis project, which is in its early stages, is to evaluate and map the possible relationships between distributions of bottlenose dolphins and recreational boating activities in Sarasota Bay.

Wildlife-vehicle interactions can have large direct and indirect effects on animal populations. Bottlenose dolphins are known to be impacted both physically and behaviorally by motorized vessels in their habitat. This is of great concern in Florida, the state with the greatest number of registered recreational boats. Boating in Sarasota Bay is a very popular activity and it shares the bay waters with a resident dolphin population. As indicated in several previous scientific publications from the SDRP, this represents a high potential for disturbance.

In this study I will integrate two main databases. The first database is a digitized representation of recreational boating patterns in Sarasota Bay that stems from a map-based mail survey implemented in 2005 by the Florida Sea Grant. The second consists of 3 years of dolphin distribution data extracted from the long-term sighting database of the SDRP. With the help of Geographical Information System software I seek to answer to answer the following questions:

- Is there a relation between the distribution patterns of recreational boating and bottlenose dolphins in Sarasota Bay?
- Do the distribution patterns change during the year in response to increments in boat traffic?
- Where are the main hotspots of recreational boating and dolphins in the bay? Do the hotspots change in different seasons?
- Is there more intense clustering at certain times of the year?
- Are dolphins moving to shallower areas when boat traffic increases in the bay?
- Are the dolphin groups moving to shallower areas significantly different in composition (Specifically are there more mothers with calves in these groups)? If so, are the mothers taking shelter experienced or first-time mothers?

I am hopeful that the study results will constitute a helpful and powerful addition to the current knowledge base of the Sarasota Bay dolphin population and potentially be useful in management, outreach, and education applications in Sarasota Bay and elsewhere.

Typical weekend boating activity in the Intracoastal Waterway near Sarasota Bay.

Human interactions in Sarasota Bay

Katie McHugh, Chicago Zoological Society

Adverse human interactions (HI) are an increasing problem for coastal marine mammals, including bottlenose dolphins in Sarasota Bay, whose ranges overlap frequently with human activities and human sources of food. Close encounters with boats or fishing gear have the potential to injure or kill dolphins. In addition, when animals are intentionally or accidentally fed by humans, this can contribute to adoption of unnatural foraging behaviors such as begging, scavenging, and feeding on bait or catch directly from active fishing gear, which put dolphins in harm's way.

The SDRP works to study and mitigate human interactions with wild dolphins in several ways, including conducting research in the long-term "natural laboratory" of Sarasota Bay to monitor human interaction (HI) trends, providing rescue and post-release monitoring support for injured animals, and participating in outreach efforts intended to reach a wide audience, most recently via educational videos highlighting the impacts of HI through stories of real Sarasota Bay resident dolphins.

As a part of these efforts, we are wrapping up a pilot study funded by the Mississippi-Alabama Sea Grant Consortium which utilized long-term SDRP data archives in concert with new data on human interactions collected in Sarasota Bay to determine the primary factors contributing to HI in our study area. With the help of collaborators Lars Bejder, Fredrik Christiansen, David Lusseau, and masters student Eilidh Siegal, we have completed several major analyses exploring spatial, temporal, and social contributions to the persistence and spread of unnatural foraging behaviors within the Sarasota Bay community. This research is critical to improving the lives of dolphins in Sarasota Bay and elsewhere by informing future outreach and management efforts.

Long-term records indicate that HI rates in Sarasota Bay are generally increasing and that a disturbingly high proportion of resident animals (~35%) were observed engaging in behaviors of concern from 1993-2014. Over this same period more than 70 individuals were observed with HI-related injuries (e.g., boat strike, fishing gear entanglement or ingestion), with ~30 leading to death or requiring intervention by human rescuers.

Although HI observations in Sarasota Bay fortunately remain less frequent than in other major hotspots in the Southeast USA, we continue to identify new individuals incorporating unnatural behaviors into their repertoires and suffering from boat or fishing gear-related injuries each year. In late June 2015, F222 (a 17-yr-old male Sarasota Bay resident), was observed with deep, fresh boat strike wounds (see photo). Despite a rather severe injury, F222 fortunately survived and has been seen several times near a local fishing pier with his external wounds now healed. Unfortunately, he now appears to have separated from his long-time male partner and is spending more time alone and engaging in risky behaviors, such as patrolling around active fishing gear, so we will continue to monitor him throughout his recovery.

F222 bearing his fresh wounds from a boat propeller. Despite his negative human interaction, he continues to engage in risky activities.

F284 tossing a fish next to a commercial crab trap. Several species of fish congregate around these traps, enticing dolphins to capitalize on the easy foraging they provide. However, crab trap lines can be a deadly source of entanglement, and this association puts dolphins at greater risk.

In addition, over the past year harassment of resident dolphins in our study area by recreational boaters and tour operators has continued to be a problem, and SDRP staff members have yet again been called upon to participate in disentanglement operations in other parts of Florida. These trends point to the need for continued focus on reducing potentially dangerous behaviors by both dolphins and humans, and the SDRP remains committed to these efforts in our research and outreach endeavors.

Testing tackle modifications and fish descender tools for reducing dolphin depredation and scavenging of sport fish

Steve Shippee, along with Katie McHugh and Randall Wells, Chicago Zoological Society

Our study is underway in the Florida Panhandle, designed to test if modifications to fishing techniques and gear can reduce adverse interactions between dolphins and recreational anglers. Anglers report that dolphins frequently remove bait and catch from their fishing gear, which can result in injury due to line entanglement and gear ingestion. In our past study, many dolphins were resighted frequently around fishing vessels over a two year period, and routinely scavenged on fish that sport anglers are required to release. This problem is common on offshore "deep-sea" fishing

Hannah Roth prepares to lower a reef fish using a Seaqualizer recompression device equipped with an underwater camera.

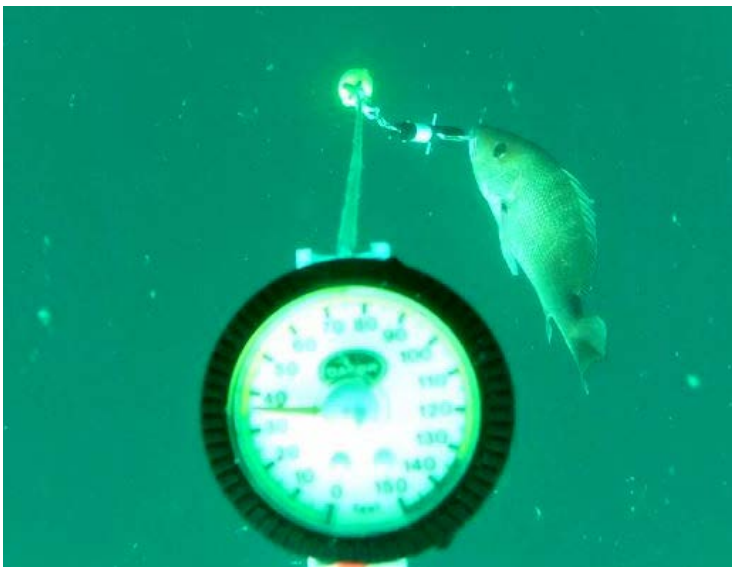
reefs near Destin, Pensacola, and Orange Beach, AL and it causes anglers to develop deep dislike of dolphins. Surveys we conducted in 2010-11 showed that the more experienced the fisherman, the more interest they have in finding ways to discourage dolphins from depredating (stealing bait and catch from lines) and scavenging their released fish. Our goal is to find promising and easily applied mitigation techniques, and then promote them for everyday use by the sport fishing community.

Studies in other locations have shown that stiff wires and streamers attached to fishing tackle may decrease dolphins' interest to depredate hooked fish, and various fish release tools now available commercially may allow anglers to return discarded fish back to the reef with sufficient vigor to avoid being scavenged by dolphins. Starting in October 2014, we began testing the applicability and effectiveness of using tackle modifications and fish descender devices aboard charter fishing vessels on deep-sea reefs. We have spent the majority of our effort to date developing data collection protocols and easy-to-deploy remote camera setups for observing dolphins underneath the fishing vessels. By summer 2015, we took six charter fishing trips to collect data on fish release devices such as the Seaqualizer recompression tool. Our preliminary findings indicate that commonly caught reef fish that were discarded during the trips visibly regained vigor and appeared to have good survival odds once recompressed and released at a depth of 50 feet (15 m). We did not observe any dolphins approaching or scavenging discarded fish during those fishing trips but we will increase our observations through 2015 and the coming year.

In addition to offshore reef trips, we are working with students from the Navarre Marine Science Station on a survey project to solicit feedback from anglers on the Gulf fishing pier at Navarre Beach, billed as the longest on the Gulf coast, located between Destin and Pensacola. This new pier opened to anglers in summer of 2010 after a five year period of reconstruction with no fishing at this site, making it an ideal location to monitor changes in dolphin activity over time. By comparison, the piers at Destin and Pensacola Beach have well known dolphin interaction problems. We ask anglers about their experience level, if they have encountered dolphins, and if they are familiar with "Dolphin Friendly Fishing Tips" that are widely available to the local fishing community. The survey results may help determine if "Fishing Tips" can be more effectively applied in a Gulf pier fishing scenario.

A third component to the project will be to implement our approach at inshore fishing spots in Sarasota Bay. Dolphin interactions with sport fishing are well documented in this area and we will explore fishing tackle modifications to evaluate mitigation potential in the shallow inshore waters and inlets. The results of our project will benefit outreach efforts encouraging use of mitigation techniques that reduce dolphin interactions, and ultimately will enhance conservation of both dolphins and sport fish stocks.

We appreciate the assistance of Hannah Roth, Christina Toms, and Savannah Koontz, and Chris Verlinde of Florida SeaGrant/IFAS. Funding for this project is being provided by Mississippi-Alabama Sea Grant Consortium.



Underwater image of a red snapper being descended on a Seaqualizer device, with depth in feet indicated on the dial.

The Sarasota Whistle Archive

Laela Sayigh, Woods Hole Oceanographic Institution and Vincent Janik, University of St. Andrews

Studies over the past few decades in Sarasota Bay have helped immensely to develop our understanding of how dolphins use whistles to communicate with one another. Identifying which animal is vocalizing continues to be one of the greatest challenges for research on cetacean communication, but the SDRP health assessments have enabled us to build up a library of whistles recorded with suction-cup hydrophones, placed directly on the melon of an animal. In this way, we (in collaboration with other scientists, including Peter Tyack, Michael Scott, Doug Nowacek and Stephanie Watwood) have acquired recordings from 269 individual dolphins over a period of 40 years, for a total of 862 recording sessions. Of these, 108 have been recorded only one time, and the remaining 60% have been recorded 2-16 times, with an average of 4.7 recording sessions per individual (for those recorded more than once), over periods of 2-31 years.

Adding to the value of these recordings is the fact that we have so much detailed, long-term, background information about the animals, including their sex, age, relatedness to other animals, and social associations over periods of decades in some cases. For example, we have recorded over 100 mother-calf pairs (some of the mothers have been recorded with multiple calves). This whistle archive is unique and immensely valuable for studies of many aspects of dolphin communication, including whistle structure, development, stability, and functions, and we have used these whistles as stimuli in a long-term set of ongoing playback experiments (see subsequent article by Sayigh and Janik). Numerous student thesis projects have used the archive, including those of 8 undergraduates, 5 masters, and 7 PhDs, and this work has resulted in numerous conference presentations and publications. We plan to continue collecting whistle recordings during health assessments and look forward to much exciting new research ahead.

F146 wears a suction-cup hydrophone to record his whistles.

Dolphin communication studies

Laela Sayigh, Woods Hole Oceanographic Institution and Vincent Janik, University of St. Andrews

Sarasota Bay's dolphins produce a variety of whistles, including individually-specific signature whistles, and others for which we are trying to learn the function. This past year we added whistles from seven new dolphins to our long-term database of whistles recorded during capture-release sessions. Six of these have known mothers in the community, adding to our large database of whistles from mother-calf pairs. These recordings enable studies of the development and stability of individually distinctive signature whistles, such as those being carried out by University of St. Andrews graduate student Braulio León-López. He found that when analyzing signature whistles, no parameters of the frequency modulation pattern that carries the identity information relate in any way to the size, sex or age of the animal. This supports the idea that signature whistles are truly arbitrary signals that are invented by the caller, and serve as a label for the dolphin that uses the whistle.

Our new recordings also add to our ongoing studies of stereotyped non-signature whistles, by providing a rich data set of recordings of known individuals in which to look for these whistles. Unlike the individually distinctive signature whistles of bottlenose dolphins, little is known about non-signature whistles, although they comprise a large portion of the whistle repertoire. In our recently completed experiments in which we played back non-signature whistles to dolphins during capture-release, we found that several individuals, more often males, produced a stereotyped non-signature whistle named the "M whistle." In collaboration with WHOI Research Assistant Claire Stuhlmann, we have since widened the search for "M" whistles in other capture-release recordings, and found 67 occurrences, of which 75% were made by a male associating with a female, and 66% were in response (within 1 sec) to another non-signature whistle. Non-signature whistles clearly play a very different role than signature whistles in the dolphin communication system. Based on these results we can conclude that non-signatures do not convey individual identity, but rather convey a form of context-specific information. While dolphins have been found to produce context-specific pulsed sounds, this is the first evidence for a shared, apparently context-specific non-signature whistle.

Our dolphin playback studies this year continued our experiments involving playbacks of unfamiliar whistles. We are testing the hypothesis that "M" whistles may actually be a response to unfamiliar, rather than strictly non-signature, whistles. Analyses of these data are currently underway, and will dictate the direction that our experiments will take next year. Ultimately we hope that these studies will provide some of the first insights into the role of non-signature whistles in the dolphin communication system.

Aggressive signals and click rates in bottlenose dolphins as revealed by acoustic and movement recording DTAGs

Peter Tyack (1), Laela Sayigh (2), Vincent Janik (1), Frants Jensen (3),
(1) University of St. Andrews,
(2) Woods Hole Oceanographic Institution,
(3) Princeton University

Bottlenose dolphins live in highly fluid societies where individuals routinely encounter other bottlenose dolphins, and where many interactions involve acoustic signals that transmit well through water. However, life is not always peaceful during such encounters. Pairs of males roam the coastal waters of Sarasota looking for potential mates. Some females that are encountered may be escorted by males for days to weeks, whereas other encounters end more quickly, often in brief but fast chases of females or female-calf pairs. While these encounters are often easy to observe from the surface, it is much less clear what acoustic signals are used by dolphins during these aggressive interactions.

During the past 4 years, we have been deploying suction-cup-mounted short-term digital archival tags, known as DTAGs, on paired animals upon release at the end of their health assessments, focusing primarily on mother-calf pairs and male alliances. The tags allow us to record the sound and motion of tagged individuals, and we combine these data with vessel-based observations of behavior and social interactions to understand the social lives and acoustic communication of free-ranging bottlenose dolphins.

These tags now allow us to understand how acoustic signals are used during aggressive encounters of wild dolphins. During interactions between males and females, bottlenose dolphins emit a suite of acoustic signals ranging from short, low-frequency quack-like signals to sudden, intense jaw claps and extended bursts of high-amplitude clicks. It is increasingly clear that most of these sounds, especially jaw claps and low-frequency narrowband signals, are used nearly exclusively by allied males during such interactions. Some of these signals, such as the low-frequency quack-like sounds, are low-amplitude, highly repeated signals that seem to be used for coordinating the behavior or movement of highly synchronized males and might also serve as an early warning signal for the nearby female. In contrast, jaw claps and burst pulses are more intense and appear to escalate conflicts. These sometimes precede more aggressive surface behaviors such as leaps and fast chases that can be observed during focal follows and measured by the inertial sensors of the tags. Many of the same sound types are also observed with dolphin under human care as well as in more extreme cases of aggression, including attempted infanticide between a pair of bottlenose dolphin males and a newborn calf in Savannah, Georgia, confirming their general importance for aggressive interactions with conspecifics.

Dolphins engaged in a potentially aggressive social encounter.

The use of acoustic signals varies greatly with context. To see what role echolocation plays in wild bottlenose dolphins, we also analysed the use of echolocation clicks with DTAGs. Bethany Roberts analysed click rates from 15 animals tagged over the last few years. Not surprisingly, click rates were highest during foraging bouts, but what we did not expect were long periods without any clicking when animals were travelling. This suggests that dolphins often rely on other senses or their memory for orientation. We also found that click rates differ greatly between individuals, suggesting that animals may rely on echolocation to different extents or that some of the click trains recorded have a communication rather than an echolocation function.

Can bottlenose dolphins compensate vocally for increased noise?

Goldie Phillips, Duke University

As noise in the marine environment is substantially increasing, it is important to understand the extent to which its inhabitants are able to compensate for this change – particularly for cetaceans, which rely on sound for vital activities such as foraging and communication. My dissertation research examines the effects of noise on various dolphin whistle characteristics with the aim of elucidating any adaptive mechanisms employed by these animals, which may have important management implications.

Documented responses to increased noise include increased signal redundancy through repeating calls or an increase in the number of syllables per call, increased call duration, and alterations in the frequency characteristics of the call. The effects of noise on these variables were examined using a linear mixed modeling approach on 12,497 bottlenose dolphin whistles recorded by four bottom-mounted acoustic sensors (DSG, Loggerhead Instruments Inc, Sarasota, FL). These sensors were deployed in Sarasota

Bay during September 4th, 2012 - May 15th, 2013, at two different sites that differed considerably in the frequency of noise exposure (high noise vs. low noise sites). Analysis results revealed that bottlenose dolphins are able to compensate for increased noise in their environment using a wide range of strategies. These strategies include modifying the frequency characteristics of their whistles, increasing whistle duration, and increasing whistle redundancy via increases in the number of whistle elements, loops, and repetitions of the entire call. These strategies are employed in a singular fashion or in various combinations, depending on the frequency content of the noise, the noise source, the time of day, and, possibly, the frequency of noise exposure at the animals' location. Much remains unknown, such as the limits to such adaptive ability. However, this study provides a solid foundation upon which such studies can be built.

F199 showing placement of the jawphone on the lower left jaw and AEP sensors on the animal's back. A recording hydrophone is located on the melon of the animal.

Hearing abilities of bottlenose dolphins in Sarasota Bay

Mandy Cook, Portland State University, and David Mann, Loggerhead Instruments

Bottlenose dolphins can hear at frequencies from about 75 Hertz (Hz) to more than 150,000 Hz, well beyond the range of human hearing (20-20,000 Hz). Because dolphins are exposed to a wide variety of both naturally-occurring and anthropogenic (human-caused) noise in their environment, there is concern that these noises may have negative effects on their hearing abilities. Hearing losses in these animals can be especially problematic because dolphins rely primarily on sound production and reception to navigate, find food, and to communicate with each other, especially in murky estuarine habitats such as Sarasota Bay.

We measured the hearing abilities of bottlenose dolphins in Sarasota Bay using auditory evoked potential (AEP) procedures based on techniques used to measure hearing in human infants. Short duration tones of varying frequencies and sound levels were played to the dolphins using a jawphone (a speaker embedded in a suction cup and attached to the lower jaw of the animal). The jawphone makes use of the fact that dolphins hear through their lower jaw, with sounds conducted to the ear through a fat channel associated with the jaw bone. Sensors in small suction cups placed on the dolphin's head measured tiny electrical signals produced by the brain in response to the tones. The brain's responses to the sounds were then analyzed to determine each dolphin's hearing abilities.

Data were collected from 5 females and 3 males, ages 3-31 years, during May's health assessments. Overall, our findings show that the bottlenose dolphins in Sarasota Bay do not exhibit increasing hearing losses with increasing age, nor are male dolphins more likely than female dolphins to have a hearing deficit. Also, these dolphins do not exhibit substantial hearing losses due to daily exposure to environmental noise, including anthropogenic sources of noise.

In addition, this year we measured the "auditory oddball" response in a subset of dolphins, in collaboration with Dr. Peter Tyack. This test evaluates an individual's ability to differentiate between two different sounds—one common, repeated sound, and one novel, rarely-presented sound. This paradigm has been used with human infants to study discrimination of phonetic sounds before they begin to speak. In dolphins, we hope to use the technique to learn about their ability to discriminate signature whistles. The Sarasota dolphin population is ideal for this study because of the long-term recordings of signature whistles from known individuals.

Foraging behavior of Antarctic humpback whales

Reny Tyson, Chicago Zoological Society

The SDRP is a leader in the study of marine mammal foraging ecology. Over the years, SDRP researchers have documented a variety of foraging behaviors used by bottlenose dolphins and have unveiled patterns of their habitat use and prey preference. This type of information is critical for the protection of these species and the environment in which they live. Prior to joining the SDRP team, I examined the foraging ecology of a much larger marine mammal, the humpback whale, in a much colder area, the Western Antarctic Peninsula, WAP, with several long-time SDRP affiliates (Doug Nowacek, Ari Friedlaender, etc.) to similarly learn about these animals so that they could be better protected. Humpback whales and other top predators in the WAP are facing decreases in quantities of their primary prey, Antarctic Krill, whose life is intimately tied

to the sea ice. Whether humpback whales can adapt to such changes in their prey source is unknown and requires a basic understanding of their foraging ecology in this region. Therefore, as part of my dissertation research at Duke University, I used digital acoustic recording tags (DTAGs) to examine the fine-scale diving and foraging behaviors of these large, marine predators.

Frequent readers of *Nicks n Notches* may recognize the term 'DTAG' in reference to a tool currently being used by colleagues at SDRP to examine coordination and communication of bottlenose dolphins in Sarasota Bay, Florida. DTAGs are a versatile research tool as they record the depth, pitch, roll, and heading of an animal 50 times a second as well as all the sounds an animal makes and hears. The rich dataset obtained from these tags can be used to uncover a wide-range of behaviors executed by tagged animals, such as signature whistles made by bottlenose dolphins and lunge feeding events executed by humpback whales. As part of a multi-disciplinary effort, 13 humpback whales were fitted with DTAGs in 2009 and 2010 in the near-shore waters of the WAP in an attempt to better understand their fine-scale behaviors. Using the data collected by these tags and a customized software program called TrackPlot, I was able to visualize the three-dimensional movements of these whales and to pinpoint their discrete feeding attempts. This information, combined with concurrent measurements of the density and distribution of the Antarctic Krill they were pursuing, have allowed me and my colleagues to uncover some of the basic (and impressive) life-history traits of this recovering Antarctic predator.

Some of the highlights of our research include our finding that the WAP is an important and persistent foraging region for humpback whales: high densities of humpbacks can be found in this region in the austral summer and fall feeding on super-aggregations of Antarctic Krill (these aggregations can be up to 10s of kilometers wide and 100s of meters thick with estimated biomasses of up to 2.0 million tons). Humpback whales appear to temporally and spatially track the movements of these aggregations and exhibit a feeding pattern that aligns with the movements of their prey. Humpbacks rest at the surface during the day when Antarctic Krill are at depth hiding from their predators, and feed primarily at night when krill come to the surface to feed. Our research has also revealed that humpbacks can make up to 900(!) lunges a night and often dive longer than is to be expected based on the amount of their presumed oxygen stores. Behaviors such as these suggest to us that humpback whales are taking advantage of the dense prey aggregations that occur in these waters, and they highlight the importance of this region and its resources in the recovery of this large Antarctic predator. While Sarasota Bay lacks humpback whales and Antarctic Krill, I hope to use the skills I gained doing this research to continue advancing our understanding of bottlenose dolphin foraging behavior and the areas of importance to their survival.

This research really was a team effort; therefore, there are many people whom I wish to thank. Specifically Doug Nowacek, Ari Friedlaender, Andy Read, Dave Johnston, Pat Halpin, Daniel Rubenstein, James Hench, Alison Stimpert, Colin Ware, Corrie Curtice, Elliot Hazen, Amanda Katlenberg, and the crews of United States Antarctic Program's RVIB Nathaniel B Palmer and ARSV Laurence M Gould greatly contributed to the success of this research. This research was conducted under NMFS MMPA Permit 808-1735, Antarctic Conservation Act Permit 2009-014, and was supported by NSF grant number ANT-07-39483.

Dr. Ari Friedlaender (Marine Mammal Institute, Oregon State University) attaches a DTAG to a humpback whale in Wilhelmina Bay, Antarctica.

Sarasota Bay health assessment project summary 2015

Randy Wells, Chicago Zoological Society

We successfully completed a health assessment project in Sarasota Bay during May 11-22. The team consisted of 177 people from around the world, with about 90 people out on 11 boats each day. In total, we sampled 22 dolphins, and data or samples were collected from each dolphin in support of more than 30 research projects. Of these 22 individuals, 7 were recaptures during the second week as part of a metabolic rate study (see below) that required follow-up sampling. Seven of the dolphins were first-time captures of residents, providing us with basic life history and health information to help interpret our ongoing observations of these individuals throughout their lives. The Sarasota Bay dolphins once again served as a reference population for NOAA dolphin health investigations, with samples being collected for analysis of the presence of morbillivirus, the virus responsible for the recent unusual mortality event along the east coast of the U.S. Fortunately, the Sarasota Bay dolphins were found to be morbillivirus-free.

A flotilla of health assessment vessels waiting in the distance as the R/V Nai'a (foreground) tracks tagged animals for recapture as part of the metabolic rate study.

Could a Sarasota Bay dolphin's diet help reverse diabetes?

Stephanie Venn-Watson, National Marine Mammal Foundation

Bottlenose dolphins in the wild and under human care can develop metabolic syndrome, which is similar to prediabetes in humans. Nutrition research led by the National Marine Mammal Foundation (NMMF) and in collaboration with the SDRP resulted in the discovery of a saturated fatty acid in fish that appears to reverse metabolic syndrome in dolphins.

Metabolic syndrome is a subclinical condition involving blood changes, including elevated insulin, lipids, and ferritin. Today in the U.S., one in every three adults has metabolic syndrome. Because of the increasing human health interest in fish-based omega-3 fatty acids, we measured 55 fatty acids in 49 dolphins (19 from Sarasota Bay and 30 from the U.S. Navy Marine Mammal Program), as well as in their different dietary fish types. Dolphins with higher blood levels of C17:0 (also called heptadecanoic acid) were more likely to have lower, healthier insulin and ferritin. Interestingly, fish types commonly eaten by Sarasota Bay dolphins (pinfish and mullet) had relatively high C17:0 content compared to other fish types. When we fed dolphins a diet higher in C17:0, their serum ferritin decreased within 3 weeks, insulin sensitivity increased within 12 weeks, and insulin, glucose, and lipids normalized within 6 months. This Office of Naval Research funded discovery was published in PLOS ONE during July 2015 and was highlighted on National Public Radio's Science Friday. While continuing to understand how changes in the ocean and prey influence C17:0 availability in fish, NMMF is also collaborating with children's hospitals to assess the ability to reverse metabolic syndrome in children by providing a diet higher in C17:0.

Bottlenose dolphin immunology

Sylvain De Guise, University of Connecticut

The immune system is very important in an individual's defense against pathogenic microorganisms that live in one's environment. Our work with Sarasota Bay dolphins has helped us better understand the normal immune system of bottlenose dolphins and establish reference intervals that can be used to assess the potential effects of man-made or natural stressors, such as the *Deepwater Horizon* oil spill in the northern Gulf of Mexico.

Using blood samples collected during bottlenose dolphin health assessments, our University of Connecticut lab has measured the function of different white blood cell types using functional assays. These assays include the ability of neutrophils and monocytes to engulf foreign particles approximately the size of bacteria (phagocytosis), as well as their ability to produce oxygen free radicals to kill such ingested microorganisms (respiratory burst). We also measure the ability of B and T lymphocytes to proliferate upon stimulation, which mimics the early phase of an immune response. Further, following preliminary results obtained in previous years, we validated the quantification of serum cytokines, which are small messenger molecules that direct the magnitude and direction for an appropriate immune response. The results obtained with Sarasota Bay dolphins have allowed, for the first time, the determination of confidence intervals ("normal values") for some of those functions for which sufficient numbers of animals have been sampled. Building on past year successes, samples from May 2015 will help fill the gaps and determine reference

intervals for additional immune functions. Those results in a relatively healthy population are currently used to assess the potential health effects of the recent exposure of dolphins to oil following the *Deepwater Horizon* spill.

This work has been supported in part by the Chicago Zoological Society, who provided logistical support and access to dolphin samples in Sarasota Bay over many years, as well as continued support from NOAA for similar analyses at different locations in the Gulf of Mexico.

Adrenal hormone reference intervals

Leslie Hart, College of Charleston

Life is stressful, especially if you are a dolphin. In addition to the stress that accompanies foraging, mating, and reproduction, bottlenose dolphins are susceptible to impacts from extrinsic stressors such as climate change, coastal development, and fishery interactions. In reaction to these extrinsic and intrinsic stressors, the mammalian adrenal gland secretes hormones to help maintain normal physiologic function. Thus, if there is an injury to the adrenal gland, the secretion of these hormones in response to stress is impacted, which could endanger the health and survival of an individual. We measure concentrations of these hormones by sampling blood from dolphins, and low concentrations can be indicative of an adrenal problem. But what is considered 'low'? The objective of this project was to develop quantitative reference intervals containing a range of concentrations that represent values we would expect to see for the vast majority (i.e. 95%) of dolphins sampled. Because this range of values represents what we expect for most dolphins, concentrations that do not fall within the reference interval can be considered abnormal.

To derive the reference intervals, it was necessary to run preliminary analyses that could identify factors or variables that influence the concentration of these hormones under normal circumstances. Statistical models examined the influence of age, sex, lactation and sampling time on the secretion of two adrenal hormones, cortisol and aldosterone. Hormone concentrations for 118 individual dolphins spanning 12 years of blood collection in Sarasota Bay were used for these analyses. The quantitative models demonstrated that cortisol concentrations were influenced by the amount of time that passed before blood was collected from the dolphin following net encirclement, while aldosterone concentrations were not influenced by any of the examined factors. Because of the influence of sampling time on cortisol, three distinct reference intervals were derived based on the time that elapsed between initial encirclement and blood collection. Since aldosterone concentrations were not influenced by sampling time considerations, a single threshold value was identified to be diagnostic of a potential adrenal issue.

These reference intervals were derived from a presumably healthy population that was not experiencing adrenal injury, thus enabling their use for identifying individuals with abnormal values in locations where adrenal function may be impacted from exposure to natural and anthropogenic stressors (for example, Gulf of Mexico dolphins following the *Deepwater Horizon* oil spill). Furthermore, analyses have demonstrated that the adrenal hormone reference intervals are applicable to free-ranging dolphins across different geographic locations in the southeastern U.S. and therefore provide another diagnostic tool to enhance real-time veterinary evaluations during bottlenose dolphin health assessments.

Funding for this project was provided by the Office of Naval Research's Marine Mammals and Biology Program.

Top and Left: Fishery interactions, like those pictured here, may be extrinsic stressors that cause hormonal responses in dolphins. Without these hormonal responses, normal physiologic functions would suffer.

Bottlenose dolphin oral fluid: Potential for examining animal welfare

Lance Miller, Chicago Zoological Society

The goals of the study are to determine the feasibility, reliability and validity of using dolphin oral fluid, or "saliva," for both positive and negative indicators of animal welfare based on the animal's physiology. Specifically, this project is exploring oral fluid for markers of adrenal system activity, autonomic nervous system activity, and immune system function or inflammation. The project is using samples collected from both wild bottlenose dolphins as well as those under professional care at the Brookfield Zoo. Samples are collected using oral swabs and are frozen until analysis. The first step in analysis includes running enzyme immunoassays for the different analytes to determine the feasibility of detecting these different indicators of welfare. For those analytes that can be detected, the next steps will be to ensure we can reliably measure them and we will use cases of both positive (dolphins playing) and negative (sick or injured animals) situations to validate the assays. The ultimate goal is to have both positive and negative indicators of animal welfare for bottlenose dolphins so that we can examine the welfare of animals under professional care, to ensure each individual has the opportunity to thrive. To date, we have collected 28 samples from wild dolphins and approximately 200 samples from dolphins at the Brookfield Zoo. Early results suggest we can detect at least one marker for adrenal activity which makes us optimistic other indicators of welfare should be possible. This project is a great example of how research with both wild dolphins and those under professional care can help us ensure the animals at the Brookfield Zoo and elsewhere are given the best care possible.

Heart rate in bottlenose dolphins

Birgitte McDonald, Moss Landing Marine Laboratory, Mark Johnson, University of St. Andrews, and Peter Madsen, Aarhus University

In May 2015, we attached suction-cup-mounted digital acoustic recording tags (DTAGs) that were modified to measure the electrocardiogram (EKG) on three Sarasota Bay dolphins, allowing us to study heart rate in free-ranging dolphins for the first time.

To predict and quantify how marine mammals will respond to man-made stressors, it is essential to understand their physiological limits, the plasticity of their diving physiology, and their physiological response to stress. The diving capability of a breath-hold diver is determined by 1) how much oxygen can be stored and how it is used during a dive and 2) how nitrogen loads are managed (important in avoiding decompression sickness). Decreased heart rate has long been considered central to the ability of breath-hold divers to dive for extended durations because it is one of the primary determinants of the rate and pattern of oxygen store utilization, and it may also be important in limiting nitrogen uptake. Additionally, increased heart rate is one of the more readily measured components of the physiological response to acute stress in most mammals.

Due to the technical difficulties of attaching a heart rate measuring instrument to a cetacean, very little is known about how wild cetaceans regulate their heart rate when diving, or if they have a cardiac response to acute stress. We have been developing, and successfully tested on captive porpoises, a modified DTAG3 that has two peripheral suction cup electrodes to measure EKG in addition to sound, acceleration and pressure. The SDRP health assessments provided us with a unique opportunity to test the newly developed tags on wild dolphins for the first time. Before releasing a dolphin with the EKG DTAG3, we were able to determine the best location for electrode and tag placement. We were also able to follow the dolphin from a distance to determine whether the tag affects the behavior of the dolphin and to observe how well the tag and electrode attachments performed. We successfully deployed and recovered the DTAG3 on three dolphins. Although we did not get very good EKG signals, these deployments gave us the opportunity to assess tag performance and make modifications to increase the quality of data we will obtain in future testing of a refined EKG DTAG3. This work was supported by the Danish Science Foundation, Carlsberg Foundation, the Frands Christian Frantsens Foundation scholarship, and the Oticon Foundation.

F254 wearing an EKG DTAG3, just prior to release. Unlike traditional DTAGs, this modified tag includes two peripheral suction cup electrodes for measuring heart rate, one of which can be seen here to the right of the main device.

Physiology of deep-diving dolphins off Bermuda

Andreas Fahlman, Texas A&M University-Corpus Christi, Jay Sweeney and Rae Stone, Dolphin Quest, Inc., and Michael Moore, Woods Hole Oceanographic Institution

Well-known to human SCUBA divers, decompression sickness is a problem caused by elevated nitrogen concentration in the tissues and blood, followed by rapid pressure reduction, which reduces the gas solubility and causes bubbles to form. The bubbles can lodge in the bloodstream, causing emboli, or initiate an immune response. In the last 15 years, scientists have collected an increasing body of support that indicates that marine mammals can experience decompression sickness under special circumstances, such as exposure to stressors that cause them to change their diving patterns. Microparticles are small cell fragments released by neutrophils following stress. They have been shown to increase in land mammals, including humans, following diving, and their blood concentration has been shown to increase with increasing depth and time at pressure. We therefore hypothesized that the microparticle level would be elevated in deep diving dolphins in and around Bermuda as compared with shallow diving dolphins in Sarasota Bay. This population also allows us to study general diving physiology, health, disease and contaminant load in a population that may be isolated from most other North American bottlenose dolphin populations. We hope to confirm the latter by deploying satellite-linked tags to provide info on movements and dive behavior of offshore bottlenose dolphins. Initial capture-release efforts in September 2015 were unsuccessful largely due to weather, but we hope to return to Bermuda to continue to pursue this research.

Field metabolic rates – exhalation sampling technique

Andreas Fahlman, Texas A&M University-Corpus Christi, Michael Moore, Woods Hole Oceanographic Institution, and Micah Brodsky

Dolphins, like all mammals, have lungs and breathe air. Metabolic rate, an indication of the energy used by an organism, can be described from counting how many molecules of oxygen are consumed over a given period of time. We recently developed a device that can be used to estimate the metabolic rate in dolphins in the field (such as from a boat). The device consists of a flow-meter that measures the amount of air they inhale and exhale, and also measures the concentration of oxygen when they exhale. Together, the flow and gas concentration are used to determine the metabolic rate. In addition to metabolic rate, these measurements can be used to look at other things, like lung health. Human doctors use similar equipment and measurements, in a process called pulmonary function testing, to look at lung health in people. Respiratory disease is very serious for dolphins and can be life threatening. If an unusually large number of dolphins have respiratory disease, this may indicate that there is an infectious disease spreading (this was recently the case with morbillivirus on the east coast of the U.S.) or that there is a problem in the ecosystem. By comparing respiratory health in different populations of dolphins, we can learn more about the health of those populations, and the marine environment in which they live.

We are also using this equipment to study how dolphins and whales dive to extreme depths and hold their breath for such a long time. For example, the dolphins in Sarasota Bay generally dive to depths up to a maximum of 6 meters, while members of the same species of dolphins in Bermuda dive to depths over 900 meters. Working with the SDRP and Dolphin Quest has allowed us to collect respiratory data from free-ranging dolphins in order to learn more about their incredible physiology and diving ability, their health, and the ecosystem we all share with these amazing animals.

A device is placed over this dolphin's blow hole in order to measure oxygen concentrations as the dolphin inhales and exhales. These data can then be used to determine the animal's metabolic rate.

Field metabolic rates – doubly-labeled water technique

Jen Maresh and Dan Costa, University of California Santa Cruz

This year, a group of researchers from the University of California Santa Cruz measured the metabolism (field metabolic rate) of four adult female bottlenose dolphins using a technique called the doubly-labeled water method. They measured three dolphins with calves and one without, wanting to understand how much energy from food each needs to survive, and how much harder mothers have to work to find enough food from their environment to support themselves and their calves, compared to themselves alone.

Doubly-labeled water measures metabolism by comparing the amounts of particular isotopes in the blood before and after a few days have passed. To do this, animals are given a solution of water with extra isotopes of heavy hydrogen and oxygen – these heavier isotopes occur naturally in the environment and are harmless when administered at higher concentrations like this. Then, a blood sample is taken a few days later to measure how much doubly-labeled water remains to determine how quickly the water was used by the body. This rate of water use is also a measure of how fast or slow that animal's metabolism was during that time, and therefore how many food calories it utilized.

Researchers believe that female dolphins with calves will have higher field metabolic rates than those without calves, a reflection of the extra calories they need to spend in order to support their growing offspring. Data collected during this first field season seem to confirm this, but more information (a larger sample size) is needed to be able to say this with confidence. The UCSC researchers are preparing for the 2016 health assessments by working to perfect the doubly-labeled method as applied to wild dolphins, as well as working in collaboration with some of the other research projects described elsewhere in this newsletter to make sure they are learning as much as they can from this project.

Plasma acute phase proteins in bottlenose dolphins and correlation with commonly used inflammatory indices

Jennifer Flower, Jennifer Langan, Sathya Chinnadurai, and Mike Adkesson, Chicago Zoological Society and Carolyn Cray, University of Miami

Acute phase proteins (APP) play an important role in the immune system and have been shown to be valuable markers, as increases can occur with inflammation, infection, neoplasia, stress and trauma. Little is known about acute phase protein responses in marine mammals, and if these protein levels can be used to detect health issues within a wildlife population. They may also be useful to detect subclinical infections prior to elevations in commonly used inflammatory markers, such as white blood cell count (WBC), erythrocyte sedimentation rate (ESR), and fibrinogen. The purpose of this study is to characterize the plasma concentrations of APPs (haptoglobin (Hp) and serum amyloid A (SAA)) and electrophoretic profiles in free-ranging and aquarium-maintained bottlenose dolphins and assess any possible correlations with these different commonly utilized inflammatory markers.

In 2014 and 2015, blood samples were obtained from 40 free-ranging bottlenose dolphins from Sarasota Bay, Florida as well as 37 others maintained in zoological institutions across the U.S. Automated assays were utilized to generate reference intervals for SAA, Hp, and electrophoretic profiles. Statistical analysis determined if there are any significant correlations between these protein concentrations and other inflammatory indices. Currently, sample collection for both dolphin populations has been completed and diagnostic results are pending.

Few studies have attempted to characterize the acute phase response in cetacean species, specifically bottlenose dolphins and these diagnostic parameters remain promising to characterize the health status in individual animals and can serve as the basis for assessing the health of wildlife populations as well as establishing improved health and welfare for dolphins under human care.

Ralph Piland, Deb Fauquier, and Sathya Chinnadurai prepare to draw blood from this dolphin's fluke for analysis of acute phase proteins as indicators of health status.

Bottlenose dolphin microbiome

Maria Robles, University of Florida

Marine mammals play an important role as sentinels of aquatic ecosystem health. Research into the diversity of their microbiome is vital to better understand the role of microbial communities in an animal's health.

The purpose of my Master's project is to characterize and compare the microbial communities present in different body sites of free-ranging bottlenose dolphins. Specimen collection included a total of 6 sites: respiratory (blow and culturettes), fecal, epidermal, gastric, genital swabs, and a matching environmental water sample. These samples were obtained through the SDRP health assessments. Molecular-based methods targeting the 16s rRNA gene and "next-generation" DNA sequencing will be used to detect these bacterial communities. We expect this will provide insight into: 1) the relationship between the microbial communities of bottlenose dolphins and their aquatic environment, 2) a comparison of the microbial communities among individuals of the same population, and 3) a comparison of the microbial communities among body sites. By including the microbial characterization of the water they inhabit, the study will help to develop potential risk assessment strategies when moving animals between different habitats.

This study will increase our understanding of the role of microbiota in bottlenose dolphin health. Specifically, the results of this study are expected to facilitate the diagnosis, management, and prevention of important microbial diseases in wild bottlenose dolphin populations. Additionally, characterizing the taxonomic and functional characteristics of the microbiota of a sentinel marine mammal species such as bottlenose dolphins, could have important implications for both human and veterinary medicine.

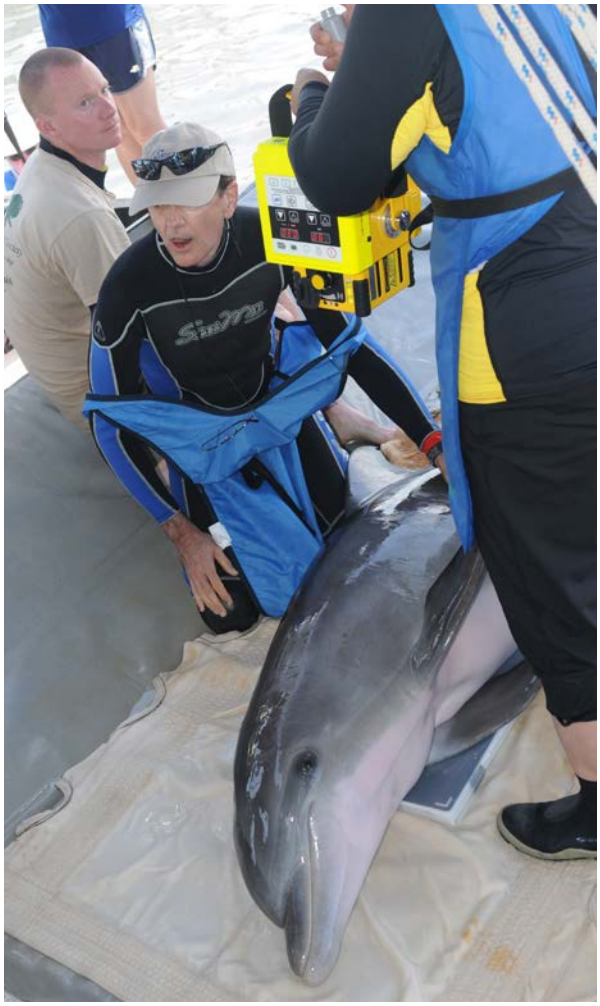
Use of mobile x-ray technology for dolphin health assessments

Mike Walsh, University of Florida

The determination of the health status of individual cetaceans as part of an evaluation of population health has dramatically changed over the years. While the sampling of blood has been the foundational approach to assess health it is widely recognized that additional technology such as ultrasound and other imaging techniques can add to the clarity of understanding of the health status of individuals.

In human care of dolphins, or your typical animal hospital, radiographs (x-rays) are also part of a health assessment. Just a few years ago the limits in applying this to animals in a field situation included the need for electricity to run the generator and a method for acquiring images that could be easily taken and stored electronically. The development of digital radiographs to replace the need to develop film in tanks like photographs was a great leap forward and brought us closer to taking the system in the field. With that challenge solved we still needed an electrical source for powering the unit that produces the x-rays and a sensitive plate that receives the exposure and sends the image back to a computer program that can be viewed almost immediately. Both of these needed to be safe and able to handle the presence of water.

Now there are battery operated generators and the next step in realizing the goal was the availability of a wireless plate that communicated directly with the computer eliminating the need for a cord between the plate and the computer. We began working with Vet Rocket, an imaging company founded by Andy Fu, that specializes in radiology equipment where the plate is extremely sensitive, giving great detail, as well as wireless and the generator is powered by a battery pack. We used the system first at Clearwater Marine Aquarium as part of the health assessments for dolphins to show it was quick and applicable. With that success we proposed using the system in the field. Last year was the first try and we imaged the chests of two large males to prove the system could acquire good images even with larger animals. The system worked beyond our hopes and we came back in 2015 to add more information and improve the steps needed to get the images quickly and safely. Our hope is to work in concert with the other technologies such as ultrasound and to help get even more information on chest disease and skeletal changes in this amazing population of animals in Sarasota Bay. We would like to thank the people who are supportive of this project and always making things better for the animals, including Craig Pelton, Andy Fu, Jeff Wood, and Ned Waters.



Top: Mike Walsh taking radiographs of a dolphin aboard the R/V Flip. Bottom: X-ray obtained from experimental field radiograph equipment.

Dental exams and radiology for dolphins

Jean Herrman, Companion Animal Dental Services, Coventry, CT

As your dentist will tell you, the mouth is an indicator of overall health. Poor oral health is linked to heart disease and other chronic health conditions in humans and our companion animals. The finding that a portion of a wild dolphin population in Louisiana was missing most of their teeth prompted the desire to investigate the oral health of wild dolphin populations in general.

It is common practice and standard care to not only examine the mouth, but also to take radiographs (x-rays) of the majority portion of the teeth that anchor them into the jawbone and are out of view to the eye. Radiographs may help understand the reasons underlying tooth loss, determining if it was just broken off, or if it is really completely missing. For dolphin mouth x-rays, a digital film plate is inserted within a holder and placed gently into a dolphin's mouth. A very low dose of x-rays is used with dolphins because the digital plate is very sensitive; the plate is then put through a small digital laser scanner to produce the image.

Dolphins have 76-108 teeth. They are all the same shape and they are born with their adult set of teeth. They are used to grab food only, not for chewing. Typically observed wearing down of teeth in bottlenose dolphins has even led to their name *Tursiops truncatus*, because their teeth seemed short or truncated compared to other toothed cetaceans. With radiography we have discovered that this typical wear does not affect the supporting bone and even teeth worn down to the gum-line remain vital and healthy. Also it is common for teeth to be broken, sometimes with the gum tissue growing over the roots of the teeth. Most of these roots stay vital and sometimes they remain dead and mildly diseased in the bone. Our radiographic findings also include pocketing around worn teeth especially in the front of the mouth. This is known as periodontal disease and is usually mild, mostly in older dolphins with less than 25% of the supporting bone affected. Occasionally the jawbone loss around teeth throughout the mouth is more severe, affecting a greater number of teeth and loss of greater than 75% of the supporting bone. It is diseased bone or a severe form of periodontal disease that is suspected to be the reason for extensive tooth loss, not normal wear and tear. This has only been confirmed by radiographs in one Sarasota Bay dolphin over the past 3 years, compared to multiple dolphins in other populations.

It will be interesting to be able to link oral disease to other health information being collected by projects on the same dolphins in order to provide a more complete health assessment of our wild dolphin populations. Another potential use for dental radiology will be to provide age information. Dental radiography is used for age determination in human forensics and archeology and I would like to extend this technique to wild dolphins. It would provide a non-invasive tool to age dolphins in health assessments, stranding events, and rehabilitation efforts. The Sarasota Bay population is an important contributor to health and age assessments since most of their life histories and ages are well-known.

A digital film plate and a handheld radiograph machine enable Jean Herrman to obtain dental x-rays on dolphins while aboard the R/V Flip.

Measuring bone density in live, free-ranging bottlenose dolphins

James Powell, Portland State University

Bone density is an indicator of health in many mammals, including humans. During the 2014 and 2015 Sarasota Bay health assessments, the first-ever measurements of bone density in live, free-ranging bottlenose dolphins were performed. Measurements of bone density in dead, beachcast dolphins are straightforward, as skeletal specimens can be collected and analyzed through traditional laboratory methods; however, novel technology and protocols had to be developed in order to include bone density assessments in the overall health evaluation of live dolphins. To date, bone density profiles have been established for 17 dolphins in Sarasota Bay.

In addition to these measurements, bone density values from archived skeletal specimens for nearly 300 dolphins from both Sarasota Bay and coastal South Carolina were recorded to develop the first ever reference dataset for bottlenose dolphin bone density. This reference dataset is being used as a baseline by which to compare bone density values for dolphins in areas where human impacts, such as high levels of contamination, are of great concern. In September 2015, bone density measurements were incorporated as part of the health diagnostics performed in a NOAA bottlenose dolphin capture-release health assessment in the estuarine and coastal waters near Brunswick, GA,

where some of the highest PCB concentrations ever recorded for dolphins have been documented. Bone density values for individual dolphins assessed during this project will be compared to Sarasota Bay resident dolphins and the bottlenose dolphin reference dataset to determine whether coastal bottlenose dolphins differ in bone density from estuarine resident dolphins and to examine whether estuarine bottlenose dolphins exposed to high levels of environmental contamination exhibit lower bone density than dolphins from Sarasota Bay.

Top: Riptorn, his severe case of scoliosis evident in his peduncle. Bottom: Lizzie, Fringes, and calf FRN4, less than a month old.

Use of overhead imaging for body condition assessment

Rachel Cassoff, Duke University

The body or nutritional condition of dolphins can significantly affect individual survival and reproductive success. In addition, it can be a sensitive indicator of prey abundance, feeding success, and the general health of an individual. Thus, assessing the body condition of animals is critical for monitoring the health of dolphin populations. However, current methods of measuring body condition in free-ranging dolphins require capturing, restraining and sampling individuals directly through capture-release health assessments, which are expensive, logistically complex, and are not feasible in many situations.

With a grant from the Association of Zoos & Aquariums Conservation Endowment Fund (through funding from the Disney Worldwide Conservation Fund), and a fellowship grant from the Morris Animal Foundation, we designed and built a low-cost remote controlled unmanned aerial vehicle (UAV) to remotely measure the body condition of dolphins at sea. The six-rotor UAV, which has a digital camera mounted below it, is designed to be launched from a small boat and to hover precisely over individual animals to collect photographs for detailed measurements of body size and shape (a technique called aerial photogrammetry). Initial field testing of the UAV system was conducted in 2014 over dolphins being temporarily held in large net corrals during capture-release health assessments in Sarasota Bay.

R/V Challenger, outfitted with the pole cam, obtaining aerial photos of Riptorn. In addition to revealing insights in body condition, this imaging technique also uniquely documented the severity of Riptorn's scoliosis.

More recently, in response to FAA restrictions and uncertainties regarding deployment of UAVs, we have been using a pole-mounted camera system to collect overhead images of Sarasota Bay dolphins. The pole camera was constructed by engineers at Woods Hole Oceanographic Institution under the guidance of Michael Moore. It makes use of a long carbon fiber pole that was previously used to deploy tags on large whales. With the pole camera mounted on the SDRP's pontoon boat *R/V Challenger*, we collected overhead images of more than 60 dolphins this summer both during capture-release health assessments and during boat-based surveys while animals were free-swimming in the bay.

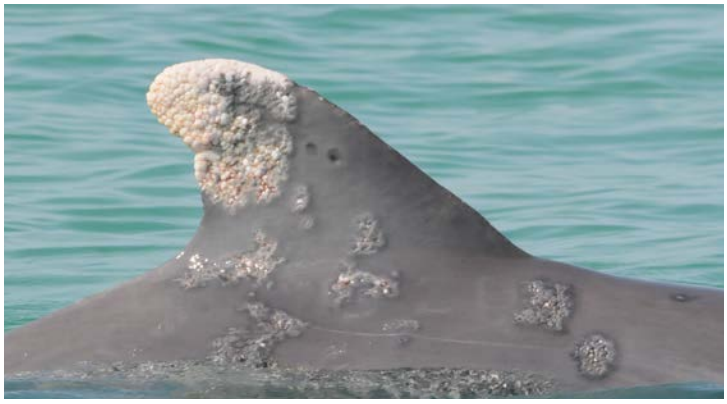
The images will enable us to compare body size and shape measurements (such as total body length and girth) obtained from the aerial photographs with those obtained directly from the animals being temporarily restrained during capture-release events, to assess the accuracy of our technique. The images will also allow us to compare measurements based on the animals' sex, age, and reproductive class, as well as between healthy and unhealthy individuals. Our novel health assessment technique could be used to help determine whether capture-release health evaluations of bottlenose dolphins are warranted in areas of concern, and it could be applied in the future to a wide variety of marine mammal species that have yet to be studied in this manner. This system was used to provide body condition data for treatment of a stranded bottlenose dolphin undergoing treatment at Mote's dolphin hospital.

Sarasota Bay dolphin community status

Jason Allen, Chicago Zoological Society

We keep track of the dolphins of Sarasota Bay through boat-based photographic identification (photo-ID) surveys that occur during 10 boat-days each month. One of the primary goals of our monitoring is to track additions and losses to the resident Sarasota Bay dolphin community. Twelve births were recorded this year in Sarasota Bay, up from only seven last year. All twelve are alive and doing well as of this writing. One other female, 12-year-old Petal, has apparently shifted her range northward to the St. Petersburg area, and was reported by researcher Ann Weaver this summer as being accompanied by her second calf.

One of the dolphin births reported this year was to a well-known resident 10-year-old female named Ginger who stranded on Siesta Key Beach in December 2008. She was rehabilitated at Mote Marine Laboratory's Dolphin and Whale Hospital before release back to Sarasota Bay the following February. We have monitored Ginger since release and were excited to see her with a new calf, believed to be her first, in August 2015.



The carcasses of Riptorn (top) and FB28 (bottom), two of Sarasota Bay's best-known residents, were recovered in October just one day apart. Both dolphins were widely recognized by their disfigured fins; Riptorn from his boat strike wounds and FB28 from his Lacaziosis infection, a fungus that causes the white lesions seen here.

Sadly, we have lost six members of the Sarasota Bay community this year, through October 2015. Three of our oldest males were lost, including 37-yr-old F108, 43-yr-old FB78 (Riptorn), and 50-yr-old FB28. In addition, the community lost 24-year-old female F175 and two calves, including the third calf of Aya, part of a five generation lineage of Sarasota Bay residents. Thankfully, our oldest male (age 52) and females (ages 62 and 65) have been observed recently and appear to be doing well.

Our monthly surveys represent the core effort of our program, supporting all other projects. More than 46,500 dolphin group sightings since 1970 have yielded more than 138,000 identifications of more than 5,400 individual dolphins. In support of these identifications, more than 650,000 dolphin photographs are currently archived by the Sarasota Dolphin Research Program. Data from monthly monitoring surveys and all of our photo-ID efforts are archived in a relational Access database (FinBase) designed specifically for bottlenose dolphin photo-ID data and images. Work has begun to integrate this database with our focal animal behavioral follow database, which contains 2,262 follows on 165 individual dolphins from 19 projects during 1990 to 2015. This database now also includes current and historic opportunistic respiration data taken on potentially compromised individuals. We will begin integrating our dolphin health database in the near future as well. Many thanks to NOAA's Jeff Adams for his continued support as our database guru!

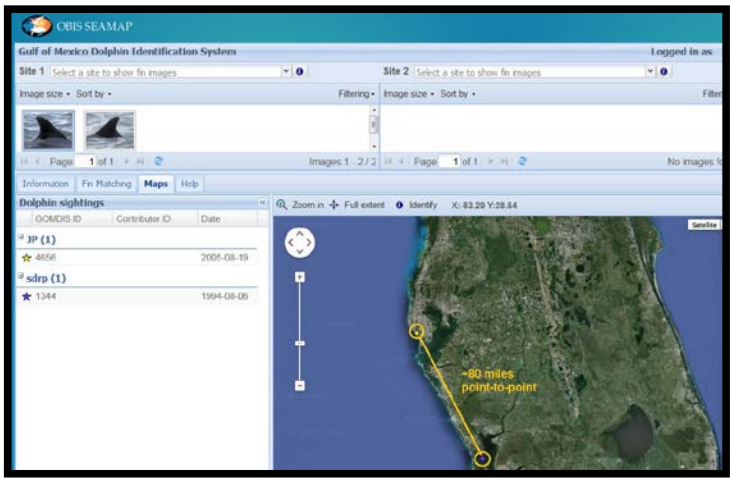
We have been able to continue our year-round, monthly monitoring of the Sarasota bottlenose dolphin community thanks largely to support from the Batchelor Foundation, as well as the continued dedication of our core volunteers and undergraduate interns. Thanks to these efforts, this community remains one of the most-thoroughly-studied wild dolphin populations in the world.

A glimpse into the potential power of GoMDIS-Gulf of Mexico Dolphin Identification System

Carolyn Cush, Chicago Zoological Society

GoMDIS continues to serve as a standardized and centralized catalog for bottlenose dolphins throughout the Gulf of Mexico. With continued funding assistance through NOAA and the Disney Worldwide Conservation Fund, this repository integrates data submitted from collaborating groups around the Gulf which have location-specific photo-identification catalogs.

We currently have 23 collaborating groups with 32 potential catalogs from around the Gulf, including Mexico and Cuba. We have also begun incorporating non-photo-ID programs into GoMDIS. This includes rehabilitated/released animals and deceased (but identifiable) animals. Thirteen catalogs from the possible 32 have been submitted to GoMDIS. This has yielded a repository of 9,462 individuals and 15,462 images. These data are maintained by the



GoMDIS interface on OBIS-SEAMAP website (Halpin et al. 2009) (http://seamap.env.duke.edu) using the map application to show the longest distance (~80 miles) between a matched animal from two contributor catalogs. Sightings are approximately ten years apart.

curator in the offline GoMDIS database and are periodically uploaded to the OBIS-SEAMAP website, facilitating data-sharing and providing our colleagues with a secure, online fin-matching interface. Quick searches on many of these project animals have yielded several interesting preliminary findings.

A match between two catalogs was found where a probable female dolphin was seen ten years later more than 80 miles away. Other matches found between catalogs are anywhere from a few miles, to 20 miles away. By using the OBIS-SEAMAP database mapping tool, we used the location points of animals seen in the late 1980's- early 1990's by SDRP outside of our normal survey area to make several extreme changed fin matches to animals from a project closer to the location of those surveys, albeit many years later. These have been circulated to the catalog owners for their approval. If approved, this will extend the sighting history of these animals from a few years to more than twenty years in some cases. The longest duration between sightings from two catalogs is 24 years apart.

The submission of non-photo-ID program catalogs has also provided interesting collaborative data. In positive news for rehabilitation programs, two dolphins which had been successfully rehabilitated have been sighted by another program over a year post-release with continued sightings approximately 19 miles from their release site and 13 miles from their stranding site. By incorporating deceased but identifiable bottlenose dolphins, we have matched numerous animals to surrounding photo-ID programs, giving a final sighting and providing valuable data by completing their life history.

Further investigation will occur on these matches between the collaborating organizations involved by comparing sighting histories. This will allow us to better determine the ranging patterns of these animals, which in turn will help management agencies to better define stock structure and obtain more accurate abundance estimates.

Pensacola Bay bottlenose dolphins: Updates and new developments

Christina Toms, University of Central Florida

Our last year of photo-ID surveys in Pensacola Bay is complete and our remote biopsy sampling begins! This year marks the beginning of the second half of my dissertation research assessing genetic population structure and connectivity between inshore and coastal bottlenose dolphins in the Florida Panhandle.

Sampling for the first half of my dissertation project has come to a close, with our last photo ID season that finished up in May of this year. Sampling over the past two years has resulted in seven seasons of mark-recapture photo-ID data that will allow us to determine seasonal abundance, obtain an estimate of the number of year-round residents in the area, and provide us with baseline estimates of vital population information, such as reproductive rates and success, and survival estimates. While most of the data processing and analyzing are ongoing, the data from our first summer season (2013) have been analyzed to give us an initial average abundance estimate of 195 dolphins (with a standard error of 45) in Pensacola Bay. We don't yet know how many of these may be long-term residents or dolphins that simply pass through, however the data from subsequent seasons will help answer these questions.

Last year we reported on a historical flood that occurred in Pensacola in the spring of 2014, resulting in an outbreak of dolphin skin lesions. With the help of undergraduate student volunteers, we've characterized the types of lesions seen and measured the prevalence (proportion of the population with skin lesions) and extent (proportion of the dorsal fin covered with lesion(s) per individual) of those lesions over the subsequent seven months. Prevalence of lesions in the population increased from 27% to 40% by late fall 2014, but the average extent of lesions on individual animals decreased from 20% to 12% coverage over the same time period. It's possible that lesions were caused by multiple factors and the initial outbreak reduced over time but left dolphins with a compromised immune system vulnerable to accumulating lesions from bacteria and/or toxins still present in the bay system. Since our data were based purely on visual observations, it is impossible to know the cause of lesions and how they might have affected individual health.

We documented that at least one calf did not survive the flood and three more are presumed dead. Of the 21 calves that were born in 2014, eight are known to have survived their first six months of life and 12 remain unknown since their mothers have not yet been seen again. This year, the first calving season since the flood, only five calves were born, which is a drastic difference from the 21 seen last year. Without historical trends on reproductive rates for this population, we can't conclude that this is a direct result of the flood, since rates vary naturally from year to year. It is, however, an important cautionary note and we aim to conduct additional surveys next spring to monitor this trend over time.

Finally, this year marks the onset of the second half of my dissertation project which is aimed at determining genetic population structure and connectivity between inshore and coastal areas in the Florida Panhandle. We conducted our first week of sampling in July of this year, using well established remote biopsy sampling techniques and collected a total of 23 skin samples from the inshore Pensacola Bay population. Additional sampling is planned for next year to increase the number of samples we have and to start sampling the coastal area.

This research has been supported by funding from the UCF Physiological Ecology and Bioenergetics Lab, the UCF Arnold Haverlee Exploration Endowed Scholarship, and a charitable donation from Frank Toms. Thank you to the numerous interns and volunteers that have helped over the past couple years and to Steve Shippee, Reny Tyson, Jeremy Kiszka for volunteering their time to help me sample this summer!

The dolphins of Galveston Bay

Kristi Fazioli, University of Houston Clear Lake and Vanessa Mintzer, The Galveston Bay Foundation

Galveston Bay (GB), Texas is one of the most industrialized estuaries in the United States. The western portion of upper Galveston Bay, in particular, is heavily affected by an urban watershed supporting more than 4 million people, the second largest petro-chemical complex in the world, and heavy maritime traffic traversing the Houston Ship Channel.

Photographic-identification surveys conducted by the Environmental Institute of Houston at University of Houston Clear Lake (EIH) in 2013-2015 suggest that a bottlenose dolphin population regularly uses this region. Prior studies by Texas A&M University - Galveston's Marine Mammal Behavioral Ecology Group detailed heavy use of lower GB channels by bottlenose dolphins, but indicated little to no activity in the upper portion of the bay. Increased dolphin activity in this area may reflect the success of efforts to protect GB over the past 30 years; however, little is known about habitat use, site fidelity, stock structure or other factors that may contribute to abundance trends in this population.

EIH has partnered with the Galveston Bay Foundation to conduct research on this understudied population and establish the Galveston Bay Dolphin Research and Conservation Program (GDRCP). Through long-term photo-ID monitoring, mark-recapture techniques and remote biopsy darting, this program aims to tackle fundamental questions pertaining to the population's ecology, health and behavior. As of March 2015, we conducted 16 boat-based surveys resulting in the observation of 364 dolphins in 56 groups. In total, 196 dolphins have been uniquely identified through photo-identification, and this research continues. Observations suggest that dolphins in upper GB forage frequently behind commercial shrimp trawlers and in the Houston Ship Channel, the region most influenced by toxic pollutants. Elevated exposure to contaminants, combined with habitat loss, noise pollution and human and fisheries interactions, place dolphins here at high risk, as evidenced by documented instances of skin disorders, fishing gear entanglements, and propeller strike injuries.

In the summer of 2015, with the help of the SDRP's remote biopsy training team, we began sampling dolphin tissue in upper GB. Former SDRP intern and University of Houston Clear Lake graduate student, Sherah Loe, will be analyzing stable isotope markers as part of a foraging study. Analyses for concentrations of persistent organic pollutants and mercury, genetic profiles, and gene expression in relation to contaminant exposure will occur in cooperation with several research groups including NOAA/NMFS. Considering the exceptionally high levels of human activity in GB, it is imperative to continue monitoring this population, with focuses on understanding residency and habitat use patterns, as well as the impact of anthropogenic threats.

A glimpse of the heavy industrialization that shapes the habitat available to the dolphins of Galveston Bay, Texas.

Puerto Rico Dolphin Project

Grisel Rodriguez, University of Puerto Rico

Bottlenose dolphins are commonly found around Puerto Rico. Population estimates from photographic-identification surveys for the southwest coast of Puerto Rico determined a population of about 314 individuals. Since 2001, no additional population assessment has been done in Puerto Rico. To understand the dynamics of this population, I began my dissertation project, "Genetic structure and diversity of the bottlenose dolphin, *Tursiops truncatus*, population off Puerto Rico." Population genetic analyses provide valuable information regarding population identity, social structure, gene flow and demographic history of any species. Molecular genetic markers are an increasingly important tool in the study of animal behaviors and ecology. DNA analysis of parentage and relatedness allows for testing specific hypotheses relevant to parental care, and dispersal. To determine the extent and interaction of the two ecotypes, we

are studying group behavior and distribution in combination with population genetics and fecal metagenomics. These data will be combined with GIS and remote sensing to determine group home range, sex distribution and parental relatedness.

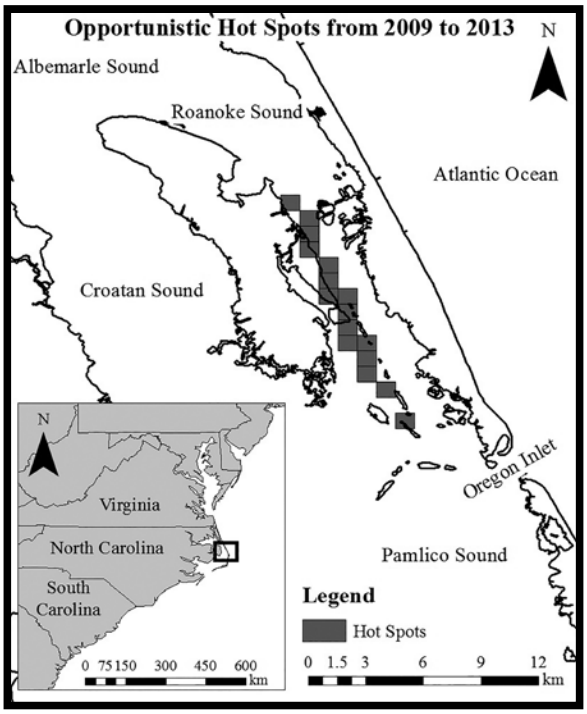
In April 2015, the SDRP invited me to Sarasota for a week-long biopsy darting sampling training session. This training is instrumental for the permit requirements by local and federal agencies for the research on cetaceans. To continue this collaboration, Aaron Barleycorn traveled to Puerto Rico during the second half of October to collect samples off the West Coast. This type of research is the first of its kind in Puerto Rico, and the expertise of the SDRP personnel is crucial for the project and its development.

Supervised by Aaron Barleycorn, Marilyn Mazzoil processes a biopsy sample as Grisel Rodriguez and David Kilpatrick observe.

Habitat use by bottlenose dolphins in Roanoke Sound, North Carolina

Shauna McBride, Chicago Zoological Society and Jessica Taylor, Outer Banks Center for Dolphin Research

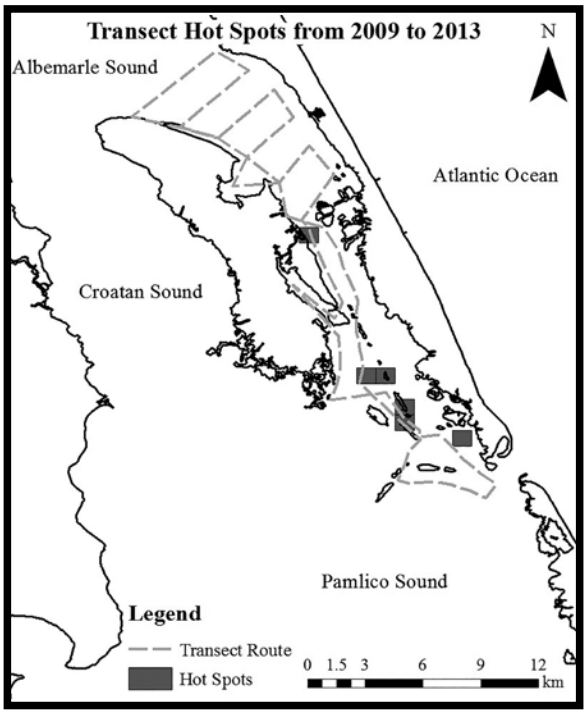
Roanoke Sound is located in the northern Outer Banks of North Carolina and is inhabited by a seasonal population of bottlenose dolphins, from the late spring to early fall. It is important to understand how dolphins are using this seasonal habitat for specific behaviors to determine the significance of this seasonal habitat, such as whether it provides a feeding ground, nursery area for calves, or a traveling route to other inshore estuaries. The objectives of this dissertation project are to: 1) identify areas that are frequently used by dolphins, known as hot spots; 2) determine how these hot spots are used for certain behaviors; and 3) compare hot spot results between transect and opportunistic survey methods to assess reliability.



Preliminary opportunistic hot spots of dolphin groups observed on the Nags Head Dolphin Watch between 2009 and 2013.

Through collaboration with the Outer Banks Center for Dolphin Research, photo-identification data from 2009 to 2014 are being analyzed. Researchers and interns conduct transect surveys using a standardized route (see figure below) and collect opportunistic data on board a local dolphin ecotour, the Nags Head Dolphin Watch. The spatial distribution of dolphin groups is examined using a Hot Spot Analysis (Getis-Ord Gi*) within ArcGIS to identify frequently used areas in the habitat and determine what behaviors occur most often in these hot spots. Transect data and opportunistic data are analyzed separately and hot spots are compared between these two survey methods to assess the reliability of the results.

Preliminary results show that several hot spots are found across transect data and opportunistic data (see figures). These hot spots are located in the middle and lower channel close to Oregon Inlet, which provides a pass between the inshore estuaries and the Atlantic Ocean. Feed and travel behaviors are often observed in these areas. Some hot spots overlap between transect data and opportunistic data, but opportunistic data detected more hot spots distributed throughout the channel.



Transect route and preliminary transect hot spots of dolphin groups between 2009 and 2013.

These results will help scientists to better understand how dolphins are using Roanoke Sound as a seasonal habitat and whether hot spot results are reliable between transect and opportunistic survey methods. Future directions for this project are to include more transect data to increase sample size and examine dolphin distribution in relation to environmental variables, such as depth, salinity, water temperature and seagrass coverage.

Dolphin feeding on a crevalle jack. Dolphins often swallow their prey whole, but fish as large as this one are first broken into pieces.

This project is a collaboration with Jessica Taylor from the Outer Banks Center for Dolphin Research, which is a non-profit organization based in Kill Devil Hills, NC. Funding for research is provided through private donations, fundraisers, and local grants. We would like to thank past and present researchers, interns and volunteers for their assistance in data collection and data processing. We would also like to thank the Nags Head Dolphin Watch, which has been collaborating with the Outer Banks Center for Dolphin Research since 2008, for providing a platform to collect opportunistic data.

Status of fish populations in Sarasota Bay

Elizabeth Berens McCabe and Sunnie Brenneman, Chicago Zoological Society

To explore the relationship between wild dolphins and their prey, the SDRP monitors seasonal fish abundance, distribution, and body condition in Sarasota Bay, Florida. Data from this multispecies fish survey have allowed us to investigate fine-scale habitat and prey selection in wild dolphins, and to explore the effects of *Karenia brevis* red tides on different fish species and community structure.

This ongoing project has facilitated a variety of novel research, including studies on the diet of wild dolphins (Sam Rossman, Michigan State Univ.), mercury content in dolphin prey (Yongseok Hong, Johns Hopkins Univ.), modeling work involving human interactions with dolphins (Katie McHugh, Sarasota Dolphin Research Program), dolphin population modeling (Bob Lacy, Chicago Zoological Society), and comparisons between iron (Melissa Zabojnik, Chicago Zoological Society) and nutrient content (Amanda Ardente, Univ. of Florida) of fish consumed by wild dolphins versus dolphins under human care.

Our standardized multi-species fish survey consists of a winter and summer fishing season (January-March, June-September, respectively), during which we catch, measure, count and release fish from the *R/V Flip* using a 183 m purse seine. This summer we completed 40 seine sets in seagrass habitat. Preliminary data indicate that we had a very good year! We caught a total of 34,110 individuals of 60 different species through September 2015. Our 30 seine sets this past winter yielded a total of 4,805 fish and 56 different species. After limiting for the influence of small schooling fishes on the mean number of fish caught per seine set (CPUE, or catch-per-unit-effort) by excluding clupeids, our preliminary 2015 summer CPUE was 620. Our final winter CPUE was 109.

After severe red tides in 2003, 2005 and 2006 and subsequent spikes in summer fish abundance, CPUEs remained fairly steady since 2009. However this year fish abundance spiked to our third highest CPUE on record. Pinfish, scaled sardine, Atlantic threadfin herring, silver perch, mojarra, and mangrove snapper were particularly abundant compared to past years. For the second year in

a row, summer mullet abundance was negligible. Last year we caught two individuals, while this year we did not catch a single mullet. Despite our findings in Sarasota Bay, the Florida Fish and Wildlife Conservation Commission reports that commercial landings on the west coast of Florida have remained stable since 2008 and the mullet stock is neither overfished nor undergoing overfishing. Winter fish abundance has varied little since our survey began (range=81-211), despite sampling through three distinct red tide periods (2004-2005, 2006-2007, and 2012-2013). Additional analyses are needed to determine trends in species-specific abundances and body condition.

We thank the many interns and dedicated volunteers who have worked on this project over the years since its inception in 2004. This work would not be possible without them! The Batchelor Foundation, Disney Worldwide Conservation Fund, NOAA's Fisheries Service, Harbor Branch Oceanographic Institution's Protect Wild Dolphins Program, and Florida's Fish and Wildlife Research Institute have provided funding for this work. This research was authorized by the Florida Fish and Wildlife Conservation Commission (13-0809-SR, current Special Activity License).

Shark-dolphin interactions in Sarasota Bay

Krystan Wilkinson, University of Florida and Chicago Zoological Society

This summer, Mote's Stranding Investigations Program (SIP), received a call regarding a free-swimming dolphin bearing fresh shark bite wounds. The dolphin was identified as 1593, the third calf of Sarasota Bay resident female, F159 ("Aya"). Unfortunately, 1593 did not survive. The animal was recovered by SIP, and while the cause of death has not yet been determined, the extensive shark bite wounds certainly didn't help the dolphin's situation. When and where did this interaction between the dolphin and the shark occur? What implications do such interactions have for the resident dolphin community?

There are still many questions to be asked of shark-dolphin interactions in Sarasota Bay, which is the continued focus of my graduate research. My Masters research found that 37% of the members of the Sarasota Bay dolphin community had at least one shark bite scar. Additionally, I found that dolphins bearing a shark bite scar exhibited different habitat use than dolphins without a shark bite scar. In particular, open bay and mangrove habitats stood out as areas where we were more likely to find a dolphin with a shark bite scar. But what is the spatial overlap between sharks and dolphins? My Ph.D. research is focusing on aspects of dolphin survival and behavior, respective to shark encounters, in addition to movement patterns of shark predators. Specifically I am investigating dolphin survival after a shark encounter, and dolphin maternal care, to determine if dolphin mothers change their habitat use with young-of-the-year calves and if mothers with prior shark encounters use habitat differently than those without such prior experience.

Little is known about large shark use of Sarasota Bay and habitat overlap between sharks and dolphins. I am aiming to address this knowledge gap by tagging large sharks with acoustic tags. Working collaboratively with researchers at Mote Marine Laboratory, New College of Florida, and Loggerhead Instruments, we will set up a series of receivers, or underwater "listening stations," that will detect acoustically tagged marine life and record sounds in the surrounding environment, such as dolphin signature whistles, fish sounds, and boat traffic.

Classifying the interactions between sharks and dolphins and understanding the resources that they share are important because both species are top predators in many coastal areas. The knowledge that we gain from such research provides insight into the complex species interactions and spatial distributions which help structure marine ecosystems. The case of 1593 is a prime example of the types of species interactions we observe in Sarasota Bay and highlights our need to understand the drivers and implications of shark-dolphin interactions.

This project has been made possible by a series of anonymous donations to the Chicago Zoological Society and by the University of Florida, School of Natural Resources and Environment. I would like to thank all past and present SDRP staff and volunteers for collecting decades of capture-release project photos and data and for their participation in SDRP population monitoring surveys. I would also like to extend a special thanks to Mote Scientific Foundation for providing funding support for field materials and shark tagging efforts, and to Bob Hueter, Randy Wells, Michael Scott, Jack Morris, Aaron Barleycorn, Dean Dougherty, Pete Hull, and Greg Byrd for their amazing assistance with shark tagging pilot projects.

1593 free swimming with a fresh shark bite wound the same day his carcass was recovered by Mote Stranding Investigations Program. Photo credit: Captain Kathe

Dolphin Rescues

Aaron Barleycorn, Chicago Zoological Society

In November 2014, the SDRP participated in a disentanglement of two different bottlenose dolphins in the Mosquito Lagoon, on the east coast of Florida. A dolphin calf had been seen with monofilament line wrapped around, and cutting into, its flukes and dorsal fin, and a dolphin known as TORN had an apparent deep entanglement around his lower jaw, causing severe deformation. The calf was quickly found, temporarily restrained, and rescuers were able to remove all of the line. TORN was a little harder to locate, but once found, he was also temporarily restrained. It turned out that there was no line wrapped around TORN's jaw, but the deformation of the jaw could have been caused by a previous entanglement. After a veterinary exam, TORN was released. The rescue included participants from NOAA, Harbor Branch Oceanographic Institute, Hubbs-Sea World, and FWC.

On April 7th, during a monthly photo-ID survey, we received a call from the Mote Marine Laboratory Stranding Investigations Program that there might be a mass stranding occurring near Venice Inlet. We were close, so we headed down to find Mote staff and the Venice lifeguards doing what they could to keep a group of 9-10 pygmy killer whales from beaching themselves. They seemed to be able to keep the animals off the beach and the pygmy killer whales appeared to be in good body condition, so we decided to use boats from SDRP, Mote, FWC, and the Venice Police Department to try to herd them back offshore. We kept 2 boats behind the group to drive them, and one on each side of the group to direct them, and we were able to guide them slowly offshore. We left the group continuing to head west, about 11 miles off the coast. They were not reported stranded or close to shore again, so there is a good chance they were able to find their way back to deep water, where they are usually found.

Pygmy killer whale, Feresa attenuata, spyhopping as enforcement and research vessels gently herded the group back out to deeper waters.

Dolphin calf near Clearwater with packing strap entanglement around its head. Without intervention, this entanglement likely would have proven fatal in time. Photo Credit: Clearwater Marine Aquarium

On 17 September 2015, MM72, a dolphin known by SDRP staff since 1988, stranded on a mud flat in Tampa Bay. He was rescued by FWC and Clearwater Marine Aquarium, and transported to Mote Marine Laboratory for treatment. SDRP staff members assisted with the rehabilitation of MM72, nicknamed "Feeny." Unfortunately, the conditions from which Feeny suffered could not be successfully treated, and he died within several weeks of arriving at Mote.

On 6 October 2015, boaters near Clearwater, Florida reported a dolphin calf with a plastic packing strap wrapped around its head and chest. NOAA officials determined that the entanglement was a threat to the calf's life, so a rescue was planned. On 15 October, SDRP staff led the rescue effort that included members from Clearwater Marine Aquarium, NOAA Fisheries, Florida Fish and Wildlife Conservation Commission, Sea World, Mote Marine Lab, and the University of Florida. The team was able to catch the calf, remove the strap and associated fishing lines, and tag it for follow-up monitoring. The calf was quickly released and was seen swimming away next to its mother. They were seen again five days later, doing well (see p.35 for recent photo). Clearwater Marine Aquarium staff will keep track of the calf over the coming months.

The SDRP has rescued many dolphins over the years. These rescues vary from remote disentanglement of fishing line, to treatment and release in the field, to transport for rehabilitation at Mote's dolphin and whale hospital. An important part of any intervention is post-release monitoring in order to learn what works and what does not in each situation. This information has been vital to managers when creating guidelines for rehabilitation and release, and for focusing limited resources. Previously rescued dolphins: Skipper (2014), 1231 (2014), Lizzie (2013), Vidalia (2011), Nellie (2010), Ginger (2008), FB28 (2007), and Scrappy (2006) were all observed in 2015, although FB28 died in October. Ginger was even recently seen with a newborn calf, believed to be her first, which is a big milestone indicating long-term success as she contributes to the next generation in Sarasota Bay!

25 year anniversary of Misha and Echo's return to the wild

Kim Bassos-Hull, Chicago Zoological Society and Mote Marine Laboratory

Twenty-five years ago, on October 6th 1990, bottlenose dolphins Misha and Echo were successfully returned to their native waters of Tampa Bay after two years under human care. Part of a unique two-part scientific experiment, they were initially collected in Tampa Bay in July 1988 and spent two years at the University of California Santa Cruz's Long Marine Laboratory where researchers studied their echolocation processing abilities and behavior patterns. Then, as planned prior to collection, they were released back into Tampa Bay after a transition process in a seapen at Mote Marine Laboratory.

During intensive monitoring over the first year following their release, both Echo and Misha were observed feeding, interacting with other local dolphins, and in general displaying typical behavioral, ranging, and social association patterns, as well as excellent body condition. Echo and Misha split up after the first few months back in the wild but researchers continued to observe both dolphins through opportunistic sightings. Misha had been sighted on 70 days since release along the southeast coastline of Tampa Bay. The last sighting of Misha by SDRP before his carcass was recovered in 2006 was on August 16th, 2005 in the Manatee River, where he was observed with longtime associate, KATT.

Echo's most recent sighting by the Eckerd College Dolphin Research Program on July 15th, 2015 in the Boca Ciega Bay region of Tampa Bay marks his 60th sighting since release in 1990. The Eckerd research team has observed Echo with many associates since 1997 but one dolphin, DUCK, has been in several repeat sightings since 2002 and was with Echo during his last two sightings in 2014 and 2015. Together the SDRP and ECDP will continue to document Echo's likely pair-bonding with DUCK, a typical behavior observed in adult male dolphins in the region. If you want to learn more about the details of this successful release see Wells, Bassos-Hull, and Norris 1998 article in Marine Mammal Science, "Experimental Return to the Wild of Two Bottlenose Dolphins". If you want a more in detailed look at the human side of this release check out Carol Howard's book "Dolphin Chronicles."

Top: Misha just prior to being released back into Tampa Bay, FL, in 1990. Photo credit: Flip Nicklin

Left: Echo and Misha at UC Santa Cruz's Long Marine Laboratory.

Education, Outreach, and Training

Education continues to be a major component of our program's activities, directed toward the general public, students, colleagues in the United States and abroad, and wildlife management agencies. The Sarasota Dolphin Research Program is a component of the Chicago Zoological Society's Conservation Education and Training group.

Public Education and Outreach: We work to educate the general public regarding bottlenose dolphins and conservation issues through public presentations at the Chicago Zoological Society's Brookfield Zoo, Mote Marine Laboratory and Aquarium, and elsewhere, articles and interviews, and through volunteering opportunities. We also produce books for the general public and students. For more information on our program's books and publications, please visit www.sarasotadolphin.org.

In response to an increase in dolphins taking bait, catch and discarded fish from anglers, we worked with NOAA Fisheries Service, Hubbs-Sea World Research Institute, and fishing guides and anglers to develop an educational card displaying 10 tips intended to improve the experience of the angler or boater while enhancing protection for dolphins. By making these cards available to boaters, anglers, and the general public, we hope that more individuals will become aware of the risks and legal issues involved when interacting with wild dolphins and choose to engage in responsible viewing and fishing practices when dolphins are present. These *"Dolphin-friendly fishing and viewing tips"* cards were initially developed through the support of the Disney Worldwide Conservation Fund, with additional funding for re-printings coming from Marineland: Dolphin Conservation Center, Harbor Branch Oceanographic Institution, and Fish Florida. We coordinate distribution of the cards, and we will continue to make them available at no cost to those who can effectively distribute them to people likely to come into contact with wild dolphins. The cards are available in English and Spanish as downloads at: www.sarasotadolphin.org.

As a complement to the cards, we helped to develop a 30-second public service announcement (PSA), *"Don't Feed Wild Dolphins."* This animated PSA highlights the dangers of feeding wildlife along with ways that members of the public can interact with wild dolphins in a more responsible manner. This PSA, along with more information on issues surrounding people feeding wildlife, is available online at: www.dontfeedwilddolphins.org.

We have produced brief (2-4 min) educational videos about dolphin conservation and biology, through support from the Disney Worldwide Conservation Fund. These videos are available through the SDRP website, www.sarasotadolphin.org.

Sharing Scientific Findings and Participation on International and Government Panels: Our efforts to provide information to our colleagues and wildlife management agencies continues, through publication of numerous peer-reviewed scientific articles, through invited presentations at various scientific conferences and through participation in national/international panels such as the NOAA/USFWS Atlantic Scientific Review Group, the NOAA/NMFS Bottlenose Dolphin Take Reduction Team, the U.S. Marine Mammal Commission Committee of Scientific Advisors on Marine Mammals, and the IUCN Cetacean Specialist Group.

Winter 2015 intern, Ruma Chatterji, obtaining dorsal fin photos during a monthly population monitoring survey in Sarasota Bay.

International Training Opportunities: As a component of the Chicago Zoological Society's Conservation Education and Training group, we provide training opportunities for scientists and students from outside of the United States. These training opportunities allow foreign scientists to participate in SDRP field and laboratory research activities and discuss with staff how such activities might be applied to their own situations at home. Standardized research methodologies facilitate comparisons across research sites.

Graduate Students: As described throughout this newsletter, graduate students from a variety of institutions, especially the University of California Santa Cruz, the University of North Carolina-Wilmington, Michigan State University, Duke University, the University of Florida, and the University of Central Florida involve the resources of our program as they conduct their thesis or dissertation research. To date, 32 doctoral dissertation and 33 master's thesis projects have benefited from association with our program, through field research opportunities or access

to data, samples, or guidance. During 2015, one doctoral student with our program (and previous SDRP intern), Kate Sprogis (Murdoch University, Australia), successfully defended her dissertation, and one master's student, Eilidh Siegal (University of Aberdeen, Scotland), successfully defended her thesis. Currently, six doctoral students and two master's student are making use of resources provided by our program.

Undergraduate College Internships and Post-Graduate Trainees: At the college level and beyond, 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 2-3 months at a time (for more information on internships, please contact Katie McHugh, SDRP Intern Coordinator, at: kmchugh@mote.org). During 2015, 14 interns and the post-graduate trainees provided approximately 7,000 hours of assistance to the program. We provided training to five interns from outside the USA, including Canada, India, Italy, Mauritius, and Scotland. Many of our undergraduate interns apply their training with the SDRP towards advanced study in the areas of marine animal conservation, research, and management. In addition, we provided training opportunities to 9 students/researchers from Brazil, Denmark, Mexico, and Scotland during our May health assessment session.

Elementary School Curriculum: Wild dolphin conservation is being introduced into Sarasota, FL elementary schools. Students are presented with videos focused on the dolphin's underwater perspective around boats and fishing lines, and on the problems caused by humans feeding dolphins. An experiential activity helps students understand what it's like for wild dolphins to swim through multiple fishing lines. The curriculum was developed by long-time Sarasota County K-5 Science Lab Instructor Chip Phillips, who worked with the SDRP staff to develop the course content. Chip also wrote a teacher's guide, and he made the course available to teachers throughout the District. During the 2014-15 school year, 17 elementary schools used the curriculum and corresponding videos, and one school had ALL students in grades 2-5 watch and discuss the videos and participate in the hands-on activities. In addition, the videos were used during summer session at one school for their Exceptional Student Education students, grades K-5. According to Chip, "It's never too early to start learning about what we can do to conserve and protect our area's natural resources!" The curriculum is available as a download at www.sarasotadolphin.org.

Aaron Barleycorn hamming it up in the classroom: this ham proved a useful tool for teaching proper sample processing technique without risking the integrity of an actual priceless dolphin biopsy sample.

Conservation research capacity building: Biopsy sampling training

Aaron Barleycorn, Chicago Zoological Society

Biopsy dart sampling is an important field technique that involves obtaining a small skin and blubber sample without needing to physically handle or restrain an animal. This allows researchers to get precious samples from wild free-swimming dolphins. The tissue obtained can be used to look at the animals' genetics, contaminants, stable isotopes, presence of disease, reproductive hormones, stress hormones, and lipid content. The information learned is invaluable to dolphin research and conservation. There is a need to increase capacity of this technique in the southeastern United States and other areas for management purposes. Thanks to a grant from Harbor Branch Oceanographic Institute/Florida Atlantic University, SDRP staff members have been able to conduct biopsy dart sampling training sessions for qualified researchers.

The training begins in Sarasota Bay, where a team of trainees is taught the basic skills needed to safely dart a dolphin, collect associated data, and process tissue samples for analysis, as well as get a chance to watch an experienced team collect samples. After trainees demonstrate the ability to safely and accurately hit a target as well as show an understanding of dolphin behavior, they are allowed to take samples under the watchful eyes of the trainers. When possible, a follow-up week of training is performed in the researchers' own study areas. As they demonstrate the ability to safely collect samples, the trainees are allowed to take on more responsibility and try to lead the team.

To date, we have finished two rounds of biopsy training, having trained 10 researchers. As well as building capacity, the training has resulted in the collection of needed samples from Sarasota Bay, Pensacola Bay, the Indian River Lagoon, Galveston Bay, and Puerto Rico. These samples and the ability to collect more will greatly increase our ability to understand dolphins in the southeastern United States and elsewhere.

Graduate Student and Intern Updates
Where are they now?

Understanding the effects of harmful algal blooms

Spencer Fire, Florida Institute of Technology

I joined SDRP in 2003 as a University of California Santa Cruz PhD student with interests in the effects of harmful algal blooms (HABs) on marine wildlife. My research experience prior to joining SDRP was primarily focused on fisheries and human health, and as a true lab nerd, I had never seen a dolphin or spent much time on a boat. During my time with SDRP, I learned a variety of valuable field research skills that allowed me to successfully complete a dissertation investigating the effects of HAB toxins on the Sarasota bottlenose dolphin population. I also became conversant with important issues in marine mammal conservation biology that have served me well and shaped my research interests ever since.

After completing my graduate studies and leaving SDRP in 2006, I was fortunate to land a position with the National Oceanic and Atmospheric Administration (NOAA) due to my experience combining the study of HAB toxins and marine mammals. At the NOAA lab in Charleston, South Carolina, I led a team of scientists who responded to, and provided analytical services for, HAB-related events, most of which involved marine mammal strandings. During this time I continued my fruitful collaboration with my SDRP friends and colleagues, who allowed me back every year for health assessments despite my supernatural ability to disable boat electronics simply by being near them. One highlight of this collaboration was when we jointly published the first case of multiple HAB toxin exposure in live dolphins sampled during the SDRP health assessments.

Spencer Fire using a small plankton net to collect water samples for analyses during health assessments.

In 2014, I moved from my role as a federal research scientist into a faculty position at Florida Institute of Technology in Melbourne, Florida. During this past year, I have been able to start my own research program and advise graduate students as we continue to investigate the role of natural toxins in marine mammal food webs. The research we are beginning through FIT focuses on the nearby Indian River Lagoon Estuarine System, a critical habitat along Florida's Atlantic coast, where HABs and bottlenose dolphins also overlap. Fortunately, our fledgling research program continues to benefit from support, training and collaboration with SDRP staff. With time, we hope our research makes as positive an impact on the Indian River Lagoon dolphins as SDRP has had on their Sarasota Bay counterparts.

The devil is in the detail

Andrew Wright

I was still relatively fresh out of my Bachelor's Degree when I got my internship with SDRP around the turn of the millennium. Being from London, spending time studying dolphins on the water in Florida was, of course, an appealing choice for me to hone my skills in marine mammal field work. However, the placement was so much more than that. I came to have the opportunity to work in a lab with an extensive long-term data set (even back then) and well-established data-collection procedures because I wanted to learn what was involved in running a research program. However, anyone who has had the opportunity to work at SDRP under Randy Wells knows that the lessons do not stop there: it was at SDRP that I learned about the unparalleled importance of quality controls in data collection, entry and analysis.

Of course, any intern keen to cut their teeth in the field finds this side of the job tedious. However, this lesson supported my natural tendencies as a perfectionist and it has stayed with me throughout my subsequent career. In my Master's research I painstakingly listened to hours of sperm whale recordings to make certain the automatic detection algorithms were doing what they were supposed to do. I also manually confirmed hundreds of dives that were automatically categorized in my PhD research on harbor porpoise behavior and bioacoustics. (Neither automatic process did a good enough job for me, but at least I knew what the limitations actually were.) Moreover, equipment used for collecting my PhD data was carefully calibrated both in terms of confirming the accuracy of the measurements and also in terms of the correct interpretation of related animal behavior. The processing scripts were tested, revised and tested again until I was happy with them.

This focus on the detail has been very useful in a career that has spanned both science and policy, where people who do not like your conclusions often look very closely for a reason to ignore them. My results have largely stood up

to the scrutiny, supporting my career path from project to project. Currently I am contracting with the New Zealand Department of Conservation in Wellington, leading the review and revision of the Seismic Survey Code of Conduct. However, I still have one foot firmly in research. I am involved in a collaborative project to develop a non-invasive tool for assessing stress levels in cetaceans using sloughed skin. Elsewhere, I am also part of an effort to look more closely at sleeping behavior in wild bottlenose dolphins, with a view to determining relative disturbance from human activities. Finally, one of my graduate students (I am an affiliate professor at George Mason University in Virginia) and I developed a new method for collecting and analyzing behavioral data in cetaceans. Much like my own view of the data protocols at SDRP, I believe my student also took a little time to grow an appreciation for my attention to detail too.

Collecting behavioral data for dolphins in large social groups can be challenging. Photo credit: Angela Ziltener, Dolphin Watch Alliance

2015 Intern Perspectives

Developing skills for application to dolphin conservation in Mauritius

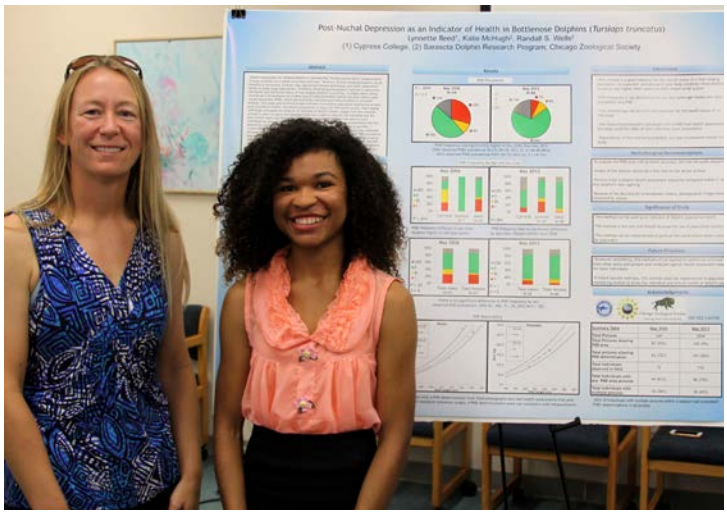
Roshni Mangar, College of the Atlantic

My desire to study to marine mammals started at the age of five. In college, I have had the opportunity to augment my knowledge on this topic. As a human ecologist, I see science strongly intertwined with humans – in both a positive and negative way. My interest with the effects of human interactions on marine mammals began with my days on the water in Mauritius, an island south-east of Madagascar. Tourism brings a substantial amount of income for the island community. Spinner and Indo-Pacific bottlenose dolphins

Summer 2015 intern, Roshni Mangar, practicing field skills for application at home in Mauritius.

are commonly observed in Mauritius and are subjected to the anthropogenic disturbances. The spinner dolphins come into the bay early in the mornings to rest; however, during this critical moment for the dolphins they are accompanied by multiple tour boats and swimmers. In Mauritius, we are still fully unaware about how much of an impact it is having on the dolphin population. I want to be part of the process that is capable of understanding these effects and find ways to improve it. My interest also revolves about policies and regulation. Due to the lack of resources in Mauritius, the presence of enforcement is minimal. I am interested in understanding the perspectives of tour operators, tourist, and researchers.

I applied for this 13-week internship at the SDRP to be able to gain more skills and tools in this field. At SDRP, I have picked up skills in photo-ID, data collection, data analysis using ArcGIS, driving boats, and methods to assess prey-predator interactions. I am currently conducting my undergraduate senior thesis involving both Sarasota and Mauritius. My project focuses on the impacts of human interactions on dolphins in both locations and ways to assess these impacts. Dr. Katie McHugh and Dr. Randall Wells have been of valuable help in aiding in developing my project and teaching me methods to approach data and to analyze it. I also would like to thank Shauna McBride for being unbelievably helpful and patient in teaching me multiple ArcGIS methods and analyses. Even though the primary purpose of this internship was to gain more skills, I ended up gaining something else of extreme value. My daily tasks at SDRP and the multiple conversations with the staff have developed a sense of independence and happiness for me, so thank you Sunnie Brenneman, Jason Allen, Aaron Barleycorn, Shauna McBride, Elizabeth Berens McCabe, Kim Bassos-Hull, Katie McHugh, and Randall Wells for this amazing opportunity.



Lynnette with mentor Katie McHugh during the 2015 Mote National Science Foundation REU poster session.

From California to Sarasota, Florida: A community college student and marine mammal research

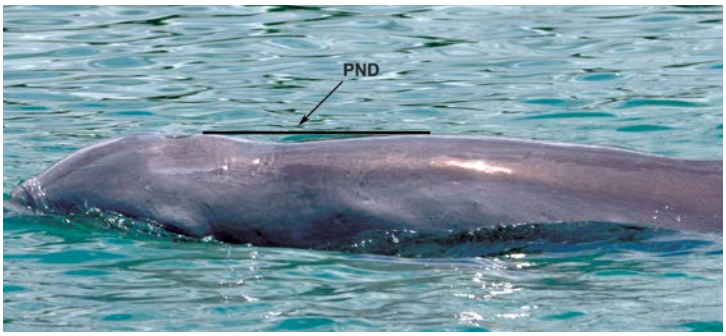
Lynnette Reed, Cypress College

I am a Marine Biology major and come from a non-research based community college in Southern California. Under mentorship of my former marine biology professor, I was fortunate to have the opportunity to conduct environmental research at California State University, Long Beach. This prepared me both physically and mentally to participate in this intellectually challenging 10-week National Science Foundation-sponsored Research Experience for Undergraduates with the SDRP for summer 2015.

My research project was focused on the area of fat behind the skull of the dolphin that helps to provide a dolphin with positive buoyancy and metabolic energy and nutritional storage. When in poor health, this sensitive post-nuchal fat pad reduces to form a post-nuchal depression (PND). I compared PND prevalence in a year with poor resources and scarce prey with a year of excellent resources and excellent prey. I hypothesized that PND prevalence would be higher in the year of poor resources and scarce prey and tested the replicability and accuracy of this method applied to live, free-ranging dolphins. To test this hypothesis, I analyzed over 4,000 photographs with a method developed by Mary Gryzbek that involved drawing a line across the dolphin's dorsal surface to see if a space existed between the line and body. Individuals were coded: 0 (no PND), 1 (PND), BL (borderline PND). In addition, I compared individuals with a PND from field photographs with measurements from their health assessment to determine the accuracy of a PND as an indicator of health condition. The results of this photographic method proved to be statistically significant when applied to the overall population, but inconsistent when applied to individuals who had a health assessment. Therefore, additional testing with a larger data set should be considered; and if successful, could replace the need for direct handling and increase population studies in all parts of the world.

My experience with the SDRP was enriching, educational, and intellectually challenging. I learned how to take photographs of dorsal fins in the field during dolphin population monitoring surveys and ID them into a catalogue database in the lab. I assisted with dolphin prey abundance surveys where I identified, weighed, and measured various species of fish. I was introduced to ArcView GIS software for the first time and frequently entered data from dolphin population monitoring and synoptic surveys. Under the guidance of Dr. Katie McHugh, I constructed a research proposal, poster presentation, and manuscript of my research project, all for the first time. I even learned how to drive a research vessel for the first time thanks to the SDRP staff! My REU experience involved weekly seminars with distinguished researchers who shared their expertise to aspiring researchers like myself. Not to mention, the exciting field trips and marine-related activities such as visiting the U.S. Geological Survey, Florida Fish and Wildlife Commission, kayaking through the mangroves, and touring Mote's Bone Lab and Sea Turtle Hospital! This experience has truly defined life as a researcher for me and I am honored to have acquired new skills and refined existing ones at this world-renowned research program. With a special thank you to the SDRP, my research was selected to be presented at the 2015 SACNAS National Conference in Washington, D.C. targeted towards the advancement of Hispanics and Native Americans in Science. As a minority myself, I plan to inspire and educate those of similar backgrounds by presenting my research entitled: "Post-Nuchal Depression as an Indicator of Health in Bottlenose Dolphins (*Tursiops truncatus*)" to a diverse scientific community.

I would like to thank Katie McHugh for selecting me to work with the SDRP for summer 2015 and the following staff and graduate students: Randall Wells, Jason Allen, Aaron Barleycorn, Sunnie Brenneman, Shauna McBride, and Rachel Cassoff for an exciting and enriching experience.



The concave space seen beneath the black line is what is known as a post-nuchal depression. In a robust animal, this area is filled in.

Professional Activities 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 annual report, including the relevant work of our collaborators from partner institutions. Copies of specific papers can be obtained upon request, as electronic pdf files.

Theses and Dissertations

Siegal, E. 2015. Identifying the causes of human-dolphin interactions using spatially explicit capture-recapture methods. Master's thesis, Applied Marine and Fisheries Ecology, University of Aberdeen. 53 pages.

Sprogis, K. R. 2015. Sex-specific patterns in abundance, home ranges and habitat use of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in south-western Australia. Doctoral dissertation. Murdoch University, Australia. 168 pages.

Published Peer-Reviewed Journal Articles, Book Chapters

Aksenov, A., L. Yeates, A. Pasamontes, C. Siebe, Y. Zrodnikov, J. Simmons, M. McCartney, J-P. Delplanque, R. Wells and C. Davis. 2014. Metabolite content profiling of bottlenose dolphin exhaled breath. Analytical Chemistry 2014; 140925142838003 DOI: 10.1021/ac5024217

Au, W., J. Ford, L. M. Herman, P. Nachtigall, S. Ridgway, J. Thomas, R. Wells, H. Whitehead, C. M. Johnson and D. L. Herzing. 2015. Visions of the future. Pp. 271-298 *in*: D. L. Herzing and C. M. Johnson, eds., Dolphin Communication and Cognition: Past, Present, and Future. Cambridge, MA: The MIT Press.

Balmer, B.C., G. M. Ylitalo, L. E. McGeorge, K. L. Baugh, D. Boyd, K. D. Mullin, P. E. Rosel, C. Sinclair, R. S. Wells, E. S. Zolman and L. H. Schwacke. 2015. Persistent organic pollutants (POPs) in blubber of common bottlenose dolphins (*Tursiops truncatus*) along the northern Gulf of Mexico coast, USA. Science of the Total Environment Volumes 527–528, 15 September 2015, Pages 306-312, ISSN 0048-9697.

Bouveroux, T. H., R. B. Tyson and D. P. Nowacek. 2014. Abundance and site fidelity of bottlenose dolphins in coastal waters near Panama City, Florida. Journal of Cetacean Research and Management. 14: 37-42.

Cammen, K. M., P. E. Rosel, R. S. Wells, and A. J. Read. 2014. Lack of variation in voltage-gated sodium channels of common bottlenose dolphins exposed to neurotoxic algal blooms. Aquatic Toxicology 157:150-158.

Cammen, K. M., L. A. Wilcox, P. E. Rosel, R. S. Wells and A. J. Read. 2015. From genome-wide to candidate gene: An investigation of variation at the major histocompatibility complex in common bottlenose dolphins exposed to harmful algal blooms. Immunogenetics 67 (2):125-133. DOI 10.1007/s00251-014-0818-x

Fahlman, A., S.H. Loring, G. Levine, J. Rocho-Levine, M. Brodsky. 2015. Lung mechanics and lung function testing in cetaceans. Journal of Experimental Biology. 218: 2030-2038.

Hart, L. B., R. S. Wells, N. Kellar, B. C. Balmer, A. A. Hohn, S. V. Lamb, T. Rowles, E. Zolman and L. H. Schwacke. 2015. Adrenal hormones in common bottlenose dolphins (*Tursiops truncatus*): Influential factors and reference intervals. PLoS ONE 10(5): e0127432.

Helm, R. C., D. P. Costa, T. D. DeBruyn, T. J. O'Shea, R. S. Wells and T. M. Williams. 2015. Overview of effects of oil spills on marine mammals. Pp. 455-475 *In*: Handbook of Oil Spill Science and Technology, First Edition. M. F. Fingas, ed. Hoboken, NJ: John Wiley & Sons, Inc.

Janik, V. M. 2014. Cetacean vocal learning and communication. Current Opinion in Neurobiology 28: 60-65.

Janik, V. M. 2015. Play in dolphins. Current Biology 25: R7-R8.

Mallette, S. D., W. A. McLellan, F. S. Scharf, H. N. Koopman, S. G. Barco, R. S. Wells and D. A. Pabst. 2015. Ontogenetic allometry and body composition of the common bottlenose dolphin (*Tursiops truncatus*) from the U.S. mid-Atlantic. Marine Mammal Science. DOI: 10.1111/mms.12253

Miller, L. J., R. S. Wells, R. Stacey, F. W. Zeigler, J. C. Whitham and M. Adkesson. 2015. Animal welfare management of bottlenose dolphins at the Chicago Zoological Society's Brookfield Zoo. World Association of Zoos and Aquariums Magazine 16:14-17.

Rossman, S., M. Stolen, N.B. Barrros, H. Gandhi, P.H. Ostrom, C.A. Stricker and R.S. Wells. 2015. Individual specialization in the foraging habits of female bottlenose dolphins living in a trophically diverse and habitat rich estuary. Oecologia. DOI 10.1007/s00442-015-3241-6

Venn-Watson, S. K., C. Parry, M. Baird, S. Stevenson, K. Carlin, R. Daniels, C. R. Smith, R. Jones, R. S. Wells, S. Ridgway and E. Jensen. 2015. Increased dietary intake of saturated fatty acid heptadecanoic acid (C17:0) associated with decreasing ferritin and alleviated metabolic syndrome in dolphins. PLOS One 10(7):e0132117. Doi:10.1371/journal.pone0132117.

Wells, R.S., J.B. Allen, G.N. Lovewell, J. Gorzelany, R.E. DeLynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Marine Mammal Science 31:355-368. DOI: 10.1111/mms.12142

Manuscripts In Press or Accepted for Publication

Cammen, K. M., T. S. Schultz, P. E. Rosel, R. S. Wells and A. J. Read. Accepted. Genome-wide investigation of adaptation to harmful algal blooms in bottlenose dolphins. Molecular Ecology.

Lane, S. M., C. R. Smith, B. C. Balmer, K. P. Barry, T. McDonald, J. Mitchell, C. S. Mori, P. E. Rosel, T. K. Rowles, T. R. Speakman, F. I. Townsend, M. C. Tumlin, R. S. Wells, E. S. Zolman and L. H. Schwacke. Accepted. Survival and reproductive outcome of bottlenose dolphins sampled in Barataria Bay, Louisiana, USA following the *Deepwater Horizon* oil spill. Proceedings of the Royal Society B.

Quintana-Rizzo, E. and R. S. Wells. Accepted. Behavior of an adult female bottlenose dolphin (*Tursiops truncatus*) toward an unrelated dead calf. Aquatic Mammals.

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

Simard, P., C.C. Wall, J.B. Allen, R.S. Wells, S. Gowans, E. Forys, B. Wursig and D.A. Mann. Accepted. Dolphin distribution on the West Florida Shelf using visual surveys and passive acoustic monitoring. Aquatic Mammals.

Manuscripts Submitted: In Review/Revision

Cook, M., R. Wells and D. Mann. In revision. Auditory evoked potential hearing measurements of free-ranging bottlenose dolphins (*Tursiops truncatus*). J. of the Acoustical Society of America.

Fleishman, E., D. P. Costa, J. Harwood, S. Kraus, D. Moretti, L. F. New, R. S. Schick, L. K. Schwarz, S. E. Simmons, L. Thomas and R. S. Wells. In review. Monitoring population-level responses of marine mammals to disturbance. Marine Policy.

Friedlaender, A. S., D. W. Johnston, R. B. Tyson, A. Katlenberg, J. A. Goldbogen, A. K. Stimpert, C. Curtice, C. Ware, E. L. Hazen, P. N. Halpin, A. J. Read and D. P. Nowacek. In revision. Two-step decisions in a central-place forager. Royal Society Open Science.

Mancia, A., L. Abelli, J. R. Kucklick, T. K. Rowles, R. S. Wells, B. C. Balmer, A. A. Hohn, J. E. Batz and J. C. Ryan. In review. Microarray applications to understand the impact of exposure to environmental contaminants in wild dolphins (*Tursiops truncatus*). Marine Genomics.

Relman, D., E. Bik, E. Costello, A. Switzer, B. Callahan, S. Holmes, R. Wells, K. Carlin, E. Jensen and S. Venn-Watson. In review. Marine mammals harbor novel microbiotas shaped by, yet distinct from the sea. Nature Communications.

Russo, C., M. Torralba, K. E. Nelson, D. Revie, J. Badger, R. S. Wells and D. J. Grimes. In review. A viromic study of serum collected from free ranging *Tursiops truncatus* (bottlenose dolphin) and report of the first marine system lentivirus with high relatedness to HIV-1. Microbial Ecology.

Tyson, R. B., A. S. Friedlaender and D. P. Nowacek. In review. Does optimal foraging theory predict the foraging performance of a large air-breathing marine predator? Animal Behaviour.

Education, Outreach, and Training

The dolphin calf near Clearwater that was entangled in a packing strap is seen here, 13 days post-rescue (see p.27). Despite its ordeal, the calf appears to be doing very well! Photo Credit: Clearwater Marine Aquarium

Contract and Other Reports

Barleycorn, A.B., R.S. Wells and K. Wilkinson. 2014. Post-Release Monitoring of "Speedy" Bottlenose Dolphin near Everglades City, Florida: Tracking Summary, 23 December 2014. Report for NOAA Prescott Grant No. NA12NMF4390152. 4 pp.

Wells, R.S., A. Barleycorn and K. Wilkinson. 2014. 2014 Barataria Bay Dolphin Tracking – Final Report Order No: AB133C-11-CQ-0050; Title: Deepwater Horizon; Activity: A3i MMST170 - Estuarine Dolphins. 21 pp.

Popular Books and Articles

Tyson, R. B. 2015. A Whale's Tale. Wyatt's Antarctic Adventure: Tagged by Scientists. Illustrations by G. Tyson. Blue STEAM, LLC. 30 pg.

Presentations at Professional Meetings

Bassos-Hull, K. 2015. Marine megafauna research off Florida's southwest coast: From dolphins to rays. Florida Marine Science Educators Association Conference, Tampa, FL. 2 May 2015.

Brodsky, M., S. Loring, M. Piscitelli, J. van der Hoop, J. Rocho-Levine, G. Levine, D. Garcia-Parraga, M. Moore, C. Smith, R. Wells, M. Haulena, C. Camarena, L. Ibarra, V. Fravel and A. Fahlman. 2015. Pulmonary function testing in cetaceans: What can we do it with? Annual Meeting of the International Association of Aquatic Animal Medicine, April 6-11, 2015, Chicago, IL.

Cush, C. C. and R. S. Wells. 2015. Gulf of Mexico Dolphin Identification System (GoMDIS) – a collaborative tool for bottlenose dolphin conservation and monitoring. Gulf of Mexico Marine Mammal Research and Monitoring Meeting, April 7-8, 2015, New Orleans (poster).

S. Emmert, J. M. van der Hoop, Y. Bernaldo de Quiros, A. Fahlman, R. Wells, J. Rocho-Levine, M. Brodsky, M. J. Moore. 2014. Characterizing bottlenose dolphin (*Tursiops truncatus*) breath sounds. American Cetacean Society. Newport Beach, CA, U.S.A. 7-9 Nov 2014 (poster).

Hart, L. B., C. R. Smith, T. K. Rowles, F. I. Townsend, R. S. Wells, R.S., B. C. Balmer, M. M. Fry, M. Ivancic, M. C. Tumlin, E. S. Zolman, and L.S. Schwacke. 2015. Health assessment of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, LA following *Deepwater Horizon*. Gulf of Mexico Oil Spill and Ecosystem Science Conference. February 16-19, Houston, TX.

Janik, V. M. 2015. Form and function in marine mammal communication. Plenary lecture at the Watkins Memorial Marine Mammal Bioacoustics Symposium, New Bedford, USA. 27-29 March 2015.

Janik, V. M. 2015. How does vocal learning affect marine mammal communication? Plenary at the 25th International Bioacoustics Congress, Murnau, Germany, Sep 2015.

Leon-Lopez, B., L. Sayigh, R. Wells, and V. Janik. 2015. Bottlenose dolphin signature whistles: do sex, age and size matter? Spoken presentation at the Watkins Memorial Marine Mammal Bioacoustics Symposium, New Bedford, USA. 27-29 March 2015.

McHugh, K. 2015. Recreational interactions: Growing threats to Gulf marine mammals. Gulf of Mexico Marine Mammal Research and Monitoring Meeting, 7-8 April 2015, New Orleans, LA (spoken presentation).

Moore, M., S. Thom, A. Trites, D. Rosen, T. Neale, N. Waller, R. Wells, B. Sharp, S. Dennison-Gibby and A. Fahlman. 2014. Markers of decompression stress of mass stranded/live-caught and released vs. single stranded marine mammals. ONR 2014 Marine Mammal and Biology Program Review, October 20-22, 2014, Arlington, VA.

Powell, J. W. B., G. M. Luo, and J. J. Kaufman. 2015. Ultrasonic bone assessment in *Tursiops truncatus*: A proposed means for monitoring marine ecosystem health. European Symposium for the Ultrasonic Characterization of Bone, Corfu, Greece, 9-12 June 2015.

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Van der Hoop, J. M., A. Fahlman, S. Emmert [10 Authors]. 2014. Acoustic parameters as indicators of metabolic rate in Bottlenose Dolphins. 5th Biologging Science Symposium. Strasbourg, France. 22-26 Sept 2014.

Van der Hoop, J. M., A. Fahlman, M. Brodsky [20 Authors]. 2014. Cetacean lung mechanics and metabolics from a portable pneumotachometer. Aarhus University Diving Physiology Workshop. Aarhus, Denmark. 18-19 Sept 2014.

Wells, R. S. 2015. Applying dolphin population health assessment to conservation. 5th Florida Marine Mammal Health Conference, 2-4 June 2015, Gainesville, FL.

Wells, R. S. 2015. Reproductive success of bottlenose dolphins. 5th Florida Marine Mammal Health Conference, 2-4 June 2015, Gainesville, FL.

Wells, R. S. 2015. Bottlenose dolphin health assessment and monitoring in Sarasota Bay, Florida: Integrating research on health, ecology, and behavior to understand factors affecting survival and reproduction. Southern Resident Killer Whale Health Workshop, 28-30 April, Seattle, WA (invited presentation).

Wells, R. S. 2015. Bottlenose dolphin research on Florida's west coast: 4 decades of research, 5 generations of dolphins, and 3 generations of scientists. Gulf of Mexico Marine Mammal Research and Monitoring Meeting, April 7-8, 2015, New Orleans.

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Invited Public, University, School Lectures

Staff and collaborators with the Chicago Zoological Society's Sarasota Dolphin Research Program delivered more than 22 lectures at public and educational institutions both locally and abroad.

Program Operations

Chicago Zoological Society Staff

Jason Allen, BS, Lab Manager
Aaron Barleycorn, BS, Field Coordinator
Elizabeth Berens McCabe, MS, Research Associate
Sunnie Brenneman, BS, Research Assistant
Carolyn Cush, BS, Research Assistant
Allison Honaker, MPS, Research Assistant
Shauna McBride, MA, Research Assistant
Katie McHugh, PhD, Staff Scientist
Reny Tyson, PhD, Postdoctoral Fellow
Randall Wells, PhD, Program Director

Mote Marine Laboratory Staff

Kim Bassos-Hull, MS, Research Associate
Paul Hillbrand, BS, Research Assistant (temp.)

Dolphin Biology Research Institute Officers

Blair Irvine, PhD, President
Michael Scott, PhD, Secretary
Randall Wells, PhD, Treasurer

Doctoral Students

Amanda Ardente, University of Florida
Rachel Cassoff, Duke University
Goldie Phillips, Duke University
James Powell, Portland State University
Kate Sprogis, Murdoch University (grad. 2015)
Christina Toms, University of Central Florida
Krystan Wilkinson, University of Florida

Master's Students

Fernando Noriega, University of Florida
Maria Robles, University of Florida
Eilidh Siegal, University of Aberdeen (grad. 2015)

Interns and Post-Graduate Trainees

Kara Andres
Fabrizio Ceneri (Italy)
Ruma Chatterji
Brooke Davis
Rebecca Hamilton (Scotland)
Roshni Mangar (Mauritius)
Leah Montsion (Canada)
Remy Phillips
Andrew Ploski
Lynnette Reed
Jessica Richter
Debashree Sinha (India)
Zachary Smith
Kristyn Waterwash

Local and Returning Volunteers

Stacy Albin
Austin Allen
Dee Allen
Ralph Arden
Perfecto Barba
Ed Blair, Jr.
René Byrskov (Denmark)
Michael Duranko
Zach Emberts
Kristi Fazioli
Sondra Fox
Ramsey Frangie
John Hamilton
Jeff Hollway
Billy Hurley
Charlie Key
Jamie Klaus
Cathy Marine
Charlie Mericle
George Morgan
Nigel Mould
Norma Pennington
Chip Phillips
Ralph Piland
Bryan Spaulding
Frank Szydlowski
Jeff Stover
James Thorson
Bill Tiffan
Laura Torelli
Martha Wells

Chicago Zoological Society staff members take a celebratory photo to commemorate the conclusion of another successful round of health assessments.

As the lab turns...

Sunnie Brenneman, Chicago Zoological Society

2015 has been a year of growth for the SDRP and its staff. January ushered in the arrival of baby Mason, first born to Elizabeth McCabe and her husband, Mike. Welcome to the world, Mason!

Elizabeth's maternity leave coincided with the start of our winter fishing season and, as head of the prey monitoring project, the absence of her skilled experience was sorely felt! Running a purse seining boat is no small task. I did my best to man her post at the helm of the *R/V Flip*, and Paul Hillbrand, in addition to his other professional responsibilities as a Mote Animal Hospital staff member, graciously stepped in to fill my role as deck boss. Although his employ via the Chicago Zoological Society was a temporary arrangement, we are deeply appreciative of the four months he committed to our program operations!

Shauna McBride joined our ranks in February. She came to us from the University of Southern Mississippi, where she had been working on the Mississippi Sound Wild Dolphin Project, processing photo-ID survey data and managing their FinBase database. She had completed her MA and is now in progress on her PhD dissertation, examining habitat use by bottlenose dolphins in Roanoke Sound, NC. Shauna's role with the SDRP is focused on processing photo-ID data for both our catalog as well as the many GoMDIS catalogs. Shauna has proved to be a valuable addition to our SDRP family, bringing with her a familiarity with FinBase, the photo-ID process and several years of experience managing the related data.

Hot on her heels, Reny Tyson accepted a postdoctoral research position with our program in March. Reny received her PhD in marine science and conservation in 2014 from Duke University, where she used high-resolution multi-sensor bio-logging tools to examine the fine-scale foraging behaviors of humpback whales in Antarctica. Reny brings experience in marine mammal tagging and tracking, photo-ID, behavioral ecology, bioacoustics, conservation science, and quantitative ecology to the SDRP, and we are very excited to have her as part of our team.

In addition to celebrating 45 years of dolphin research, 2015 also marks the 5-year Chicago Zoological Society employment anniversaries for both myself and Katie McHugh. I was hired as a full-time research assistant in 2010, just a few short weeks following completion of my internship. When I reflect on my time here with the SDRP, I am blown away by how much I have learned and grown professionally under the mentorship and instruction of some of the finest marine scientists in the world. I'm so grateful for this team!

For Katie, her dedicated contribution to this program far surpasses five years. She has been involved with the SDRP since 2000, progressing from intern to graduate student to postdoc and now to staff scientist. She is an invaluable asset, providing this program with a tremendous wealth of knowledge, experience, and skill.

Elizabeth McCabe with her very first young-of-year, Mason.

The R/V Martha Jane is delivered to the SDRP by George Morgan.

SDRP welcomes the donation of the *R/V Martha Jane*

Randall Wells, Chicago Zoological Society

September, 1971 - George Morgan and Randy Wells move into the Alpha 3 East dorm floor at the University of South Florida, in Tampa. This floor houses the male freshmen with an interest in biology, zoology, or pre-med. Fast-forward to the 2000's, as George and Randy reconnect when they discover they live on the same street on Siesta Key (and that they have the same birthdays, as do their wives and pets). George expresses his interest in dolphins, and Randy adds him to the SDRP's local rescue and health assessment team (it doesn't hurt that George is tall!). George proves to be a tremendous asset to the team during field efforts. In 2014, George and his wife, Jane, decide to move inland, and in November they make a donation of their essentially new 21 foot Parker center console boat to the SDRP. This vessel, in superb condition, is a (much nicer) sister-ship to one of our current primary research vessels, *R/V Fregata*, and it quickly finds a home in the fleet and becomes the survey-vessel-of-choice for staff members. George insists on naming it after our wives, so it is christened the *R/V Martha Jane*. And there continues to be much appreciation and rejoicing! Thank you, George and Jane, for your generosity!

Show Your Support for the Chicago Zoological Society's Sarasota Dolphin Research Program

Your gift to the Sarasota Dolphin Research Program will ensure the future of the important research and continued development of an unparalleled base of knowledge about wild dolphin populations. Each year, it costs almost $1.0 million to fund our scientists and our internationally recognized research. Your donation will ensure that we can continue to learn about some of the world's most majestic creatures.

For more information on how you can help, please contact Chris Jabin, senior vice president of development, at 708-688-8379.

Special Thanks

The Chicago Zoological Society is honored to recognize the following donors and funding organizations for their generous contributions to its Dolphin Research Program through donations, research grants and/or contracts.

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