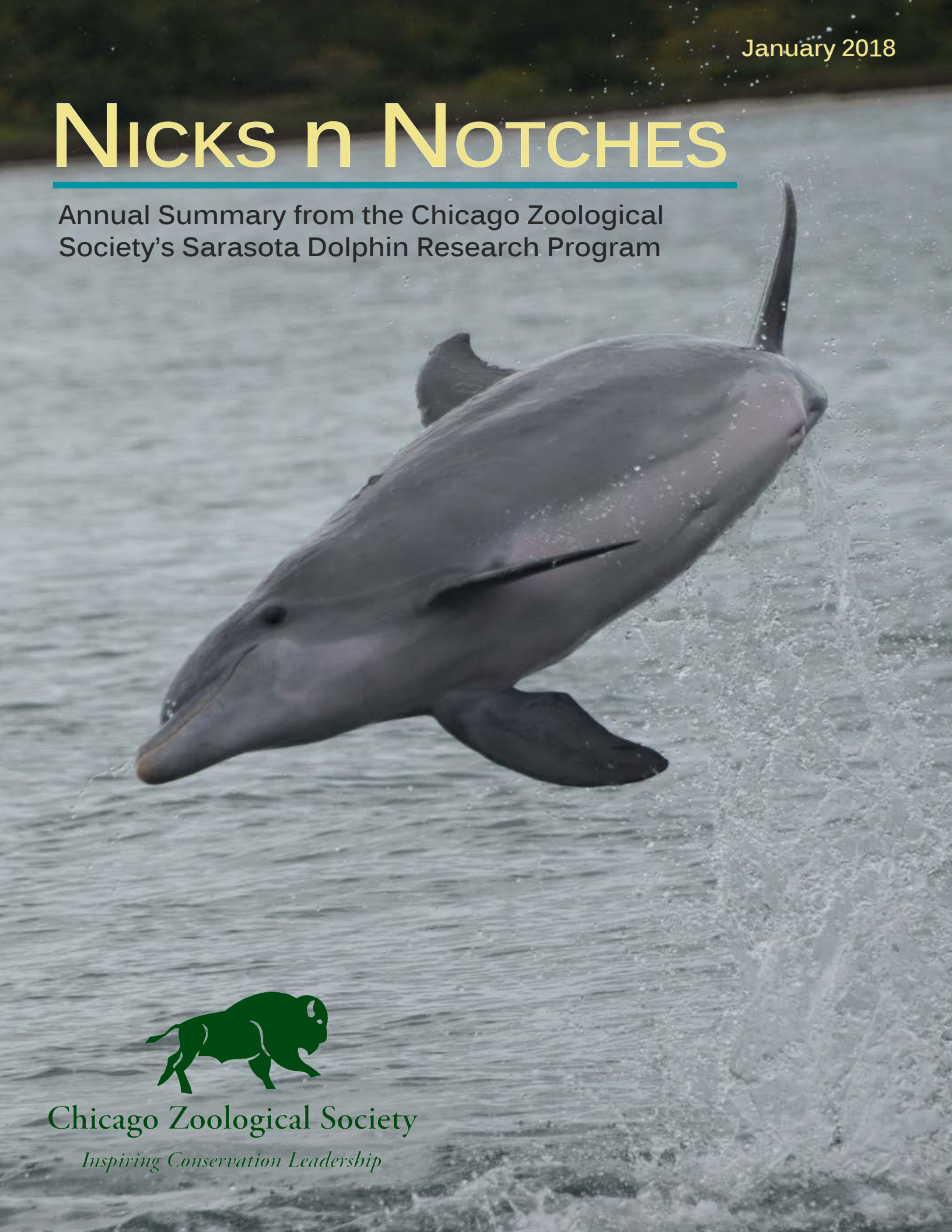
January 2018

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

Sarasota dolphins as sentinels of ecosystem health, thanks to the Barancik Foundation

The Sarasota Dolphin Research Program (SDRP), now in its 48th year, is the world's longest-running study of a wild dolphin population. The unique long-term datasets of the SDRP make the program ideal for studies of ecosystem health. Changes in coastal environments are often gradual and may be subtle to human perception. It is challenging to find meaningful signals within a complex ecosystem, but identifying appropriate indicator species for which we have the needed historical information can be a very effective approach for detecting and monitoring trends.

Bottlenose dolphins, as top predators and long-term residents in localized coastal regions, are excellent environmental indicators for areas such as Sarasota Bay. Our research has shown that these animals live for decades, generation after generation, within the same community home range including Sarasota Bay and surrounding waters. These large mammals breathe the same air we do, catch and eat the same fish we do, and swim through the same waters as we do. Changes to the local marine environment are likely to impact the local dolphins before they impact the human residents of the region. Being able to detect such changes early, when it might be possible to make a positive difference for the animals, the humans, and the environment, is highly desirable.

The continued and consistent study of Sarasota Bay and its resident dolphins over the decades establishes the dolphins as an important resource for monitoring the local environment. Continuing this study into the future and building on the incredible body of information we have compiled is crucial. We are very fortunate that the Charles and Margery Barancik Foundation recognized the importance of the resident Sarasota dolphins as sentinels of ecosystem health by awarding a 5-year, $1 million grant this year. These funds support both our monthly photographic identification surveys to monitor the dolphins and our seasonal dolphin prey fish surveys, which are the foundation of our research and the efforts of dozens of collaborating scientists from around the world. The ability to monitor who is doing what, and where in Sarasota Bay, and to relate this to ecological conditions including availability of prey fish, makes our program uniquely valuable to conservation work in Sarasota, the Gulf of Mexico and globally. Additionally, the comprehensive long-term study positions the Sarasota dolphins as a reference population for evaluating conservation issues and understanding threats to bottlenose dolphin populations elsewhere, as was the case for the investigation of the impacts of the *Deepwater Horizon* oil spill. The value of the SDRP to environmental and species conservation grows over time.

Thank you for being a part
of our program!

Director, Sarasota Dolphin Research Program

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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 insure 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, vehicles, computers, cameras, field equipment, etc. Since 1992, the program has been based at Mote Marine Laboratory, with office, lab, storage and dock space within the resident Sarasota Bay dolphins' home range. The SDRP maintains academic connections including graduate student opportunities primarily through the University of Florida, the University of California at Santa Cruz, and Duke University.

All of our dolphin research in the United States is conducted under NOAA Fisheries Service Scientific Research Permit No. 20455 and Institutional Animal Care and Use Committee approvals through the appropriate institutions.

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Investigation of mechanisms for reproductive failure in the aftermath of the *Deepwater Horizon* oil spill to understand population recovery scenarios for cetaceans

Lori Schwacke, National Marine Mammal Foundation

In the aftermath of the *Deepwater Horizon* (DWH) catastrophe, impacts to common bottlenose dolphins in heavily oiled coastal areas of the northern Gulf of Mexico were well documented by the Natural Resource Damage Assessment (NRDA). Among other health issues, a high incidence of reproductive failure was detected, although specific causes of the failures could not be determined during the NRDA studies. In Barataria Bay, Louisiana, which was heavily oiled, only 20% of pregnancies diagnosed via ultrasound during health assessments following the spill were observed subsequently to result in live calves, as compared to 83% for the Sarasota Bay reference population. The overall goal of this project, funded by the Gulf of Mexico Research Initiative (GoMRI), is to expand on the previous NRDA studies of dolphins in heavily oiled areas of the Gulf to understand the underlying factors involved in the observed reproductive failures.

We are using enhanced ultrasound techniques recently developed by NMMF veterinarians and employed for the care of dolphins managed by the U.S. Navy. We are employing the new ultrasound techniques to identify fetal and placental abnormalities in bottlenose dolphins in Barataria Bay. Over the past 2 years, we have evaluated 28 female dolphins in Barataria Bay and we are in the process of analyzing the diagnostic data and conducting photo-monitoring surveys to document the reproductive outcome of 11 pregnant dolphins. In addition to the enhanced ultrasound evaluation, we are using capnography to assess oxygenation, and collecting blood for hematological and serum biochemical analyses, as well as analysis for an extended suite of hormones. To add to the dataset, blood data from female dolphins previously sampled (2010-2014) in Barataria Bay, Mississippi Sound, MS and Sarasota Bay, FL with known pregnancy outcome were compiled, and banked serum samples have been analyzed for the extended suite of hormones. Analysis of the blood data from prior years shows that pregnant dolphins not seen subsequently with a live calf often have significantly elevated white blood cell counts and lower hemoglobin as compared to dolphins with successful outcomes. Our findings to date suggest that poor maternal health may be predictive of reproductive failure. Additional information on the project can be found on the GoMRI website: http://research.gulfresearchinitiative.org/research-awards/projects/?pid=274.

Dr. Cynthia Smith performs an in-water ultrasound exam. Enhanced ultrasound techniques are being used to investigate reproductive failure in Barataria Bay dolphins.

Linking health with survival and reproduction

Lisa Schwarz, University of California, Santa Cruz

Are there particular health measures that can be used to predict how well a dolphin population is doing? Are some health values tightly linked to survival and reproduction? Do easy-to-measure health values correspond to other health values that are difficult to measure? The answers to these questions have far-reaching implications for many dolphin populations because they can help researchers target specific health data, which may allow them to predict if a population is growing or declining, and if they should be concerned about its future. Using extensive datasets on Sarasota Bay dolphins, we looked at 47 different health measurements and their relationship with population-level survival and reproduction. We also explored the relationship between a measure of body condition, post-nuchal depression (also called “peanut head” because there is a divot behind the blowhole that makes an animal’s head peanut-shaped), and other health measurements. Post-nuchal depressions can be readily identified from photographs, so there is no need to handle the animal. Therefore, it has the potential to be a very useful measure of health in areas where animals cannot be captured.

The body-mass index (BMI, a value showing how far an animal is from the average mass for its length) is linked with survival. In other words, animals that are too skinny or too fat for their length have lower survival. The relationship was found using health samples from live, rescued, and dead animals as well as the long-term photo-ID data. Mother-calf separation was more likely when adult aldosterone levels where high. Unlike terrestrial animals, aldosterone may be an indicator of longer-term stress in marine mammals, indicating mothers and calves are more likely to separate after prolonged stress. Preliminary results show post-nuchal depression is not reliably related to poor health or body condition. Results emphasize the importance of collecting photo-ID data as well as data from dead and rescued animals.

Community engagement for dolphin conservation

Katie McHugh, Chicago Zoological Society

Dolphins and other coastal wildlife face increasing threats from interactions with boating, fishing, and wildlife viewing activities. We know that close encounters with boats or fishing gear can injure or kill dolphins, and repeated human disturbance disrupts key natural behaviors including feeding, nursing, or resting. Exposure to human sources of food worsens the problem by encouraging risky abnormal behaviors such as begging, scavenging, and taking bait or catch directly from active fishing gear, which put dolphins and their dependent young in harm's way.

In Sarasota Bay, more than 40% of resident dolphins have exhibited behaviors of concern and ~20% have suffered from human-related injuries such as boat strikes and entanglements. Many more individuals face frequent harassment from recreational boaters and tour operators. To improve this situation, the SDRP works to understand and alleviate adverse human interactions (HI) by conducting research in the long-term "natural laboratory" of Sarasota Bay including monitoring HI trends and testing mitigation techniques, providing rescue and post-release monitoring support for injured animals, and participating in education and outreach efforts intended to reach a wide audience.

Stakeholder outreach promotes best practices for viewing and fishing near wildlife to prevent harassment and injuries. For example, boaters should give dolphins their space (at least 50 yards, as in top photo) and not pursue them at close range (bottom photo) to avoid disrupting their ability to feed, rest, and take care of their calves.

With support from the Disney Conservation Fund, we have spent much of the past year focused on expanding and improving our outreach activities to better engage key community stakeholders in dolphin conservation to reduce HI. These efforts have targeted local user groups who interact with dolphins in different ways (for example, anglers, recreational boaters, boat rental companies, ecotour operators) but whose activities can put dolphins at risk. We have provided informal town-hall style presentations tailored to the issues most relevant to each group, including information on best practices for boating and fishing near wildlife, reducing marine debris to prevent entanglement, and reporting injured animals to facilitate effective intervention. We have also attended stakeholder events to provide informal educational opportunities and distributed relevant outreach materials through a number of new venues, including partnering with Freedom Boat Club to provide dolphin conservation information to their members in Southwest Florida via their monthly e-newsletter. We have built on a partnership with Mote Marine Laboratory's High School Alumni Program to engage in student-led weekend monitoring of HI hotspots and marine debris clean-up activities. We also created a 'virtual' marine debris clean-up team using the Marine Debris Tracker app, and the team has removed more than 9,100 pieces of trash and discarded fishing gear from our local shorelines and waterways this year!

Through these efforts, we have reached thousands of people with whom we otherwise would not have had the opportunity to interact, and we think this approach shows promise for reducing negative human-dolphin interactions in our region. For example, in the two months after our first major ecotour operator town-hall, we observed fewer instances of dolphin harassment near a tourism hotspot within our study area, and we also had more direct engagement with captains who observed injured or abnormal dolphins and reported them to the stranding network. In addition, although still observed infrequently, we did not see an increase in dolphin unnatural foraging interactions with anglers after several months of red tide disturbance in our study area in contrast to what we have seen previously. We still have a long way to go towards fully addressing human-related risks to local dolphins, but we are hopeful that we are on the right track.

Population consequences of red tides and water temperature

Lisa Schwarz, University of California, Santa Cruz

Natural variation in multiple factors can make it difficult to understand links in large ecosystems like Sarasota Bay, particularly when changes are occurring over long periods. However, the unique suite of mark-recapture and dolphin

prey data collected by the Sarasota Dolphin Research Program provides us with an unprecedented ability to look at long-term trends in a bottlenose dolphin population with fluctuations in red tide and temperature. We are also able to begin to look at how red tide and temperature affect dolphin prey species. We have found that red tides are themselves connected with temperature. The duration of red tides declines with higher winter temperatures as competing non-toxic organisms flourish. Summer 2009 was the second warmest summer on record, followed by the coldest winter. While no red tide was present, dolphin survival was the lowest on record, suggesting dolphins may have been experiencing thermal stress during that year. Longer red tides are followed by lower dolphin survival the next year. Reproduction and mother-calf separation were not strongly connected to red tide. Longer red tides are also associated with lower prey availability and lower overall prey energy. The results indicate that longer-term loss of prey due to red tides may affect dolphins more than direct exposure to red tide toxins. Results also allow us to understand the link between lost foraging energy and survival. That link is a key component in quantifying the effects of human disturbance on dolphin populations when the disturbance reduces foraging.

VaquitaCPR - Unprecedented efforts to try to save the vaquita from extinction

Randall Wells, Chicago Zoological Society and Cynthia Smith, National Marine Mammal Foundation

The vaquita is a tiny (less than 2 m long) porpoise found only in the Upper Gulf of California (aka Sea of Cortez), Mexico. They were first described scientifically in 1958 by Ken Norris and Bill McFarland. Even early in the scientific investigation of this species, there were concerns about how few lived in this very limited area of the Sea of Cortez, and they were considered to be rare and elusive. A 1,960 km vaquita survey from the 8-m *R/V Nai'a*, conducted by Ken Norris, Randy Wells, and Bernd Würsig in 1979, resulted in only two sightings of small groups. Subsequent research by others over the ensuing decades confirmed that numbers of animals in the Upper Gulf were small and declining, due in large part to drowning in gillnets set for the large, endangered totoaba fish. Vaquita abundance has declined dramatically in recent years due to increased demand and high prices paid by Asian markets for totoaba swim bladders. In spite of increased efforts by the Mexican government to provide protection for the most endangered cetacean in the world, illegal totoaba netting has brought the numbers of remaining vaquitas to fewer than 30.

In an unprecedented effort to try to save the remaining animals from dying in illegal gillnets, in late 2016 the Government of Mexico accepted the recommendation of its international recovery team, the International Committee for the Recovery of the Vaquita (CIRVA), to create the Consortium for Vaquita Conservation, Protection, and Rescue (VaquitaCPR). Working closely with the Mexican government's Ministry of Environment and Natural Resources (SEMARNAT) in efforts led by Lorenzo Rojas-Bracho, VaquitaCPR has developed a plan to attempt to catch and move vaquitas to a sanctuary in the Gulf where they would be under human care until such time as the Upper Gulf was considered to be a safe environment for their return to the wild – when the Upper Gulf is free of gillnets, when alternative fishing gear has been developed, and when derelict fishing gear has been removed. The plan is being implemented in tandem with Mexico's ongoing efforts to end illegal fishing and remove gillnets from the Upper Gulf of California.

At the time of this writing, VaquitaCPR efforts to catch vaquitas have just begun. Efforts are based in San Felipe, in Baja California. Crucial funding has been received from a variety of sources, especially the Government of Mexico and AZA. The project is being managed by Cynthia Smith of the National Marine Mammal Foundation, and involves partners from many organizations, including the Chicago Zoological Society (see the project website, vaquitaCPR.org for a full list). A facility on shore has been constructed to provide medical care and emergency housing, and a sea pen is nearing completion that will provide longer-term housing until a multi-year facility can be constructed. Field efforts involve three search vessels equipped with high-power binoculars and a highly experienced observation team.

A dead vaquita caught in an illegal fishing net.

Trained dolphins are being used to help localize porpoises for capture. The catch team, led by Randy Wells, is made up of Danish scientists with extensive experience catching harbor porpoises for tagging off Denmark and Greenland, and porpoise and dolphin capture experts from Canada and the U.S. A team of highly skilled veterinarians and animal care personnel is distributed among all the catch and transport boats, and the shore-side facility.

This project is extremely challenging and high risk – very few animals remain, they are elusive, and they have never been caught and maintained alive – but we could not ask for a better, more dedicated team to give the project the best possible chance of succeeding.

Mekong river dolphins of Cambodia

Frances Gulland, The Marine Mammal Center

The Irrawaddy dolphin population in the Mekong River of Cambodia and Laos is redlisted by the IUCN as Critically Endangered. The population had declined over the past 10 years to below 100 individuals, with most mortality due to bycatch in gillnets. In addition, unexplained high calf mortality occurred in some years. The conservation of the Mekong River Dolphins (MRD) is a priority for the Royal Government of Cambodia, with on-ground actions to minimize mortality increasing after signature of the "*Kratie Declaration on the Conservation of the Mekong River Irrawaddy Dolphins*" in 2012, following a workshop in which Randy Wells was a participant. In January 2017, another international workshop to support these conservation activities was held in Kratie, Cambodia, convened by the World Wide Fund for Nature (WWF) Cambodia and the Cambodian Fisheries Administration (CFA), in collaboration with the IUCN Cetacean Specialist Group and the U.S. Marine Mammal Commission, with Wells again participating and engaging in training of Cambodian researchers. The good news at the workshop was that the number of dolphins appears to have increased with increased efforts by the River Guards to remove nets and stop netting.

A Mekong river dolphin surfaces with a calf in a pool near Kratie, Cambodia.

Since the workshop, WWF Cambodia and the CFA staff have continued to monitor the dolphin population through photo-ID of individuals allowing use of mark recapture techniques. Dr. Lindsay Porter of the Sea Mammal Research Unit based in Hong Kong accompanied the team on the March 2017 survey to assist with photo-ID techniques. The SDRP is currently seeking funding to bring Cambodian researchers to Sarasota for additional training in photographic identification techniques, including field efforts, photo-analyses, and data archiving and analyses.

To date since the workshop, informal reports from the field are of only two deaths and nine calves born. This good news likely results from continued efforts of the River Guard program and outreach by the MRD field team. Despite this good news, the status of the MRD population remains of high concern. Unfortunately, the threat of hydropower development is now a reality for this population. Since the start of construction of the Don Sahong dam near the Laos/ Cambodia border, the trans-boundary pool subpopulation of dolphins has declined from five to three dolphins. Two further hydropower dams at Sambor and Stung Treng are now proposed, and a Memorandum of Understanding was signed recently between the Cambodia government and a private company to carry out feasibility studies for these dams. If built, these dams will eliminate or transform most of the dolphins' remaining riverine habitat. A letter co-signed by the IUCN Director General and the Chair of the Species Survival Commission was sent to the Prime Minister of Cambodia in summer 2017. A second letter from the IWC Scientific Committee (Subcommittee on small cetaceans) emphasized the concern of the international conservation community about the impacts of dam construction on the Mekong dolphins and other biodiversity.

PREDIS- An update on the effort to save the Chinese White Dolphin

Carolyn Cush and Randall Wells, Chicago Zoological Society

The Chinese white dolphin, a variety of the Indo-Pacific humpbacked dolphin, lives in the Pearl River Estuary (PRE) which borders a portion of southern China and Hong Kong. These animals face many threats to their survival including gillnet entanglement, habitat degradation and pollution. There is a strong need to understand their ranging patterns to know what specific threats they face, so possible mitigation measures can be identified, and to define their life history, to better understand impacts.

A collaborative effort among PRE dolphin investigators and SDRP was initiated last year, known as PREDIS, the Pearl River Estuary Dolphin Identification System. Modeled after the Gulf of Mexico Dolphin Identification System (GoMDIS), PREDIS was designed to assist in characterizing the Chinese white dolphin population as the first step in evaluating the impacts and mitigation of the threats. Several of the collaborators have contributed their catalogs to this

on-going dataset. The PREDIS system allows the groups to search for individual animals using a combination of fin characterizations and coloration to conduct between-site matching utilizing the OBIS-SEAMAP photo-ID portal. This will also allow them to keep their research interests separate but share data necessary to define ranges and life history parameters, such as calving success. To date, we have compiled 1,094 images of 620 animals from four research groups, three conducting photo-ID and one stranding program. These groups mainly focus their efforts on the eastern side of the PRE and we are keen to incorporate additional data from the western side to see how much animal overlap exists between the different contributor catalogs. Although estimates exist for the number of animals in the PRE region (~1,200), data from PREDIS could help local researchers to refine this estimate.

The process of identifying these animals presents challenges, as over time the coloration of the animal changes, going from a solid gray color to spotted, and eventually becoming all white or pink. The spotting and scarring patterns on the body and dorsal fin in addition to the fin notches, however, do give further confirmation to the validity of the matches between catalogs by increasing the amount of evidence available to examine. To date, 188 matches have been circulated for contributor review.

A group of Chinese white dolphins surfaces near Hong Kong.

Behavioral response of sea turtles to acoustic deterrent devices

Reny Tyson Moore, Chicago Zoological Society

Sea turtle hearing can be a very important consideration for their conservation. They can hear sounds at very low frequencies (< 1 Khz), such as those produced by human activities including fishing, shipping, and dredging and marine construction. The loud sounds commonly produced from these activities can adversely impact marine animals, causing behavioral changes, physiological harm, and in some cases death. While studies of behavioral responses of dolphins and whales to anthropogenic (man-made) sound are being done in many parts of the world, no one has previously examined whether sea turtles react or respond to such noise, despite these sounds dominating their range of best hearing.

Due to my experience in animal tagging, I joined a team of international collaborators from institutions including Gettysburg College (USA), Duke University (USA), Van Oord (Netherlands), MarBrasil (Brazil), Karumbe (Uruguay), PRICTMA (Argentina), LEC-UFPR (Brazil), and TAMAR (Brazil) in Paranaguá, Brazil, to assess the health and movements of local juvenile green turtle populations and to investigate potential technological solutions for minimizing sea turtle interactions with hopper dredging and marine construction projects. This ground-breaking research, funded by Van Oord, was designed to examine behavioral responses of sea turtles to a device called the FaunaGuard, which has been built to deter marine fauna, including sea turtles, from construction activities. During the first phase of the project in 2016, we completed field tests in the Paranaguá Estuary Complex, Brazil of both the FaunaGuard and a newly developed acoustic-movement tag (ROTAG) designed to record the behaviors of free-ranging sea turtles. During this phase we tagged nine juvenile green turtles with ROTAGs and exposed seven of them to the FaunaGuard. The FaunaGuard signals proved to be too quiet to elicit behavioral responses in the tagged turtles, and warranted further testing after appropriate modifications could be made. Therefore, we are modifying the FaunaGuard signals and plan to expose additional juvenile green sea turtles in the estuary in the spring of 2018. We are very excited about this project because it involves the first assessment of wild sea turtle population behavioral responses to anthropogenic sound and because it led to the development of the ROTAG, the first tag of its kind designed to study sea turtles and their responses and/or interactions with sound.

Several collaborators on the turtle tagging project (including SDRP alum Douglas Nowacek from Duke University and former trainee Camila Domit) pose with a turtle wearing a satellite-linked tag in the Paranagua Estuary Complex, Brazil.

History of Trac-Pac and Dtag deployments in Sarasota

Peter Tyack and Mark Johnson, St. Andrews University; Forrest Townsend, Bayside Hospital for Animals; Frank Deckert, Trac Pac Inc.; Alex Shorter, Michigan State University; Frants Jensen, Aarhus University; Kara Buckstaff Moore, Sarasota Dolphin Research Program; Michael Moore, Woods Hole Oceanographic Institution; Doug Nowacek, Duke University; Michael Scott, InterAmerican Tropical Tuna Commission; and Randall Wells, Chicago Zoological Society

The Sarasota Dolphin Research Program has acted as a testbed for the development of many innovative methods to study marine mammals. The capture-release health assessments make it possible to attach gear to wild dolphins in a safe and controlled setting. This is not only true for medical and veterinary research, but also for studying animal behavior and communication. From the earliest health assessments in the 1980s, we have attached suction cup hydrophones to record the sounds made by each individual dolphin, which was critical for defining their signature whistles, but we soon wanted to be able to record sound and behavior from dolphins swimming freely in the wild.

By the late 1990s, Mark Johnson and Peter Tyack were developing a small tag that could record sound and behavior for a few hours, but how to attach the tag to a dolphin? Standing in the net corral in Sarasota Bay, Tyack brought up this problem with Forrest Townsend, a staff veterinarian with SDRP. Forrest had worked with orthotics specialist Frank Deckert to design and fabricate prosthetic hooves for an Arabian mare with a disease that could have been lethal without them. After succeeding in this challenge, Forrest and Frank were ready to make plaster molds of dolphin fins (Fig 1), using them to design and build plastic packs that could hold tags. The goal was to attach the tags non-invasively to the fin. But how? After testing different suction cups, Randy Wells suggested they use a rubber bathmat material, which worked beautifully with dolphins under human care (Fig 2).

Figure 3 shows one of these first Trac-Pacs attached to a dolphin during health assessments. The Trac-Pacs had magnesium links across the front, which are designed to corrode in salt water, releasing after about 6 hours. The first Trac-Pacs had a small housing to hold a radio transmitter so that they could be followed. Soon after, an additional tag was added to record the depth of dive.

Tyack's goal was to record sound and behavior, and some of the first Dtags were integrated into the Trac-Pac housing by 2000. These tags not only record sound from the dolphin but also from other sources such as boats passing nearby. We quickly recognized that this tag advancement enabled experiments to study the effects of vessels on dolphin behavior. During 2001 and 2003 Trac-Pac Dtags were used in field experiments conducted by Kara Buckstaff Moore to show that dolphins increase their fluking rate and dive deeper as the received sound level of passing boats increases.

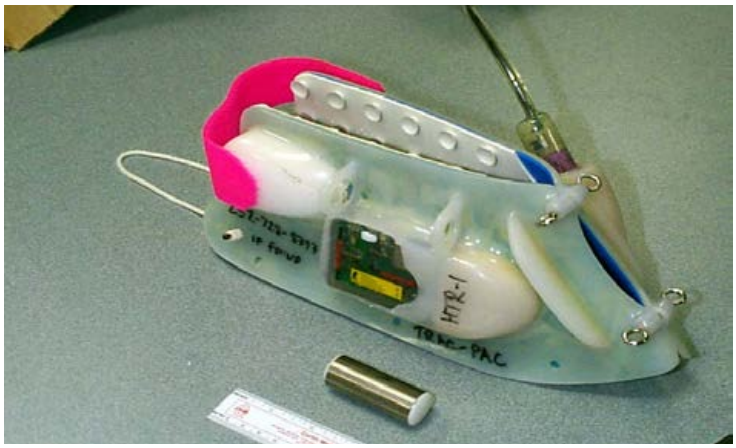


Fig 1 (top): Frank Deckert makes a mold from the dorsal fin of a dolphin carcass.
Fig 2 (bottom): Early Trac-Pac showing suction cups.

The classic Trac-Pac needed to be attached by hand to the dorsal fin of a dolphin. This was not a problem during health assessments in Sarasota, but what about attaching tags to free-swimming whales? Learning from Deckert how to form thermoplastic sheet around a mold, the Dtag team developed a Dtag for whales that could be attached with a pole.

The subsequent evolution of the Dtag has involved efforts to reduce the size and to make the shape more hydrodynamic. The next version of Dtag was potted in urethane, leading to a reduction in size. A team from WHOI and Duke used computers to model the hydrodynamic forces on Dtags, and used this information to refine the tag design, yielding the tag we now use in Sarasota Bay (Fig 4).

Currently we are simultaneously tagging several dolphins that are released together after health assessment. This method allows us to track the pattern of signal and response that makes up communication.

The ability to test new methods and gear during the health assessments of the Sarasota Dolphin Research Program have led to new ways to study these dolphins at sea, with continuously increasing refinement and level of detail in our studies of how these animals share the waters of Sarasota Bay with us.

Fig 3: F169 post-release on February 5, 2003 wearing an early Trac-Pac/ Dtag.

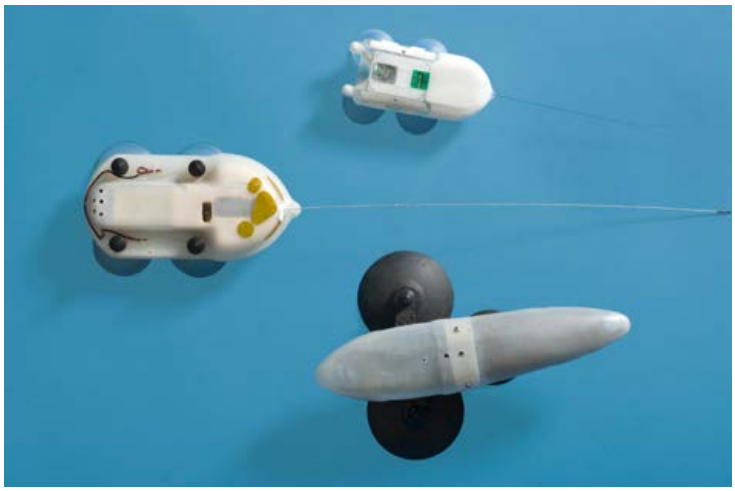


Fig 4: Current Dtags vary in size and shape, depending on whether they will be attached to dolphins or whales.

Dolphin communication studies

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

This year we published our study on voice recognition in bottlenose dolphins, in which we found that dolphins seem to rely exclusively on signature whistles and do not use voice cues to identify others. With this study finished, we had room to ask new questions in our playback experiments during capture/release sessions. During these sessions, we play back recorded sounds to dolphins being held gently in the water near our veterinary examination vessel, and we record their responses. Together with Dr. Julie Oswald, a new member of our group who came to the University of St. Andrews on a EU Marie Skłodowska-Curie Fellowship, we now want to find out how good dolphins are at recognizing whistles of other species. Previous work suggests that many dolphin species sound very much alike, and that it might be hard for a bottlenose dolphin to tell whistles of other bottlenose dolphins from those of spotted dolphins, for example. To investigate whether dolphins can make this distinction, we are using a so-called odd-ball paradigm. In this method, we play many different whistles of bottlenose dolphins, and every so often we put one spotted dolphin whistle into the sequence. The expectation is that if dolphins can tell the difference, there should be a change in behavior. The main changes we are looking for are in instantaneous heart rate and vocal behavior, which have been used in previous perception studies of this kind. The playback stimuli we used for these species recognition studies include whistles that dolphins in the Sarasota population have not heard before. Because of this, while we are looking for species recognition encoded in reactions to the whistles of spotted dolphins, we can also examine the vocal behavior of our target animals in response to unknown bottlenose dolphin whistles in the same experiment. This should give us further examples of stereotyped non-signature whistles, such as the “M” whistle that we described in our publication on voice recognition. M-whistles appear to be the first example of a stereotypic non-signature whistle that bottlenose dolphins use when encountering unknown animals of the same species.

Two more new projects are being conducted by our PhD student Brittany Jones, who is looking at vocal accommodation in dolphins. Many animals and humans adjust their vocalizations to be more similar to those of others when they interact. Humans, for example, tend to copy subtle aspects of the dialect of people they talk to. Brittany is analyzing acoustic parameters from whistles recorded when dolphins are engaged in counter-calling during capture-release sessions and comparing them to parameters from whistles outside of those interactions. She is looking for evidence that dolphins match the call parameters of others when interacting.

The other question in Brittany’s doctoral research is whether dolphins call altogether differently when they know others are listening. This is called the audience effect and often leads to animals, such as primates, calling a lot more when others are around, but staying quiet in the same contexts when others are not within ear shot. The audience effect is evidence that animals evaluate their environment and make informed decisions about communicating before calling. If present, it suggests that there is a certain level of planning and reflection on the animal’s own behavior instead of animals reacting automatically to a stimulus as in a reflex. Brittany found that dolphins have high call rates during their first capture no matter how many animals are around. In fact, females tended to call more when captured by themselves. In later captures when they have become more accustomed to the situation, dolphins call significantly more when an audience is present than when there are no other dolphins around. Thus, dolphins show a similar degree of planning of their communication calls as we see in primates.

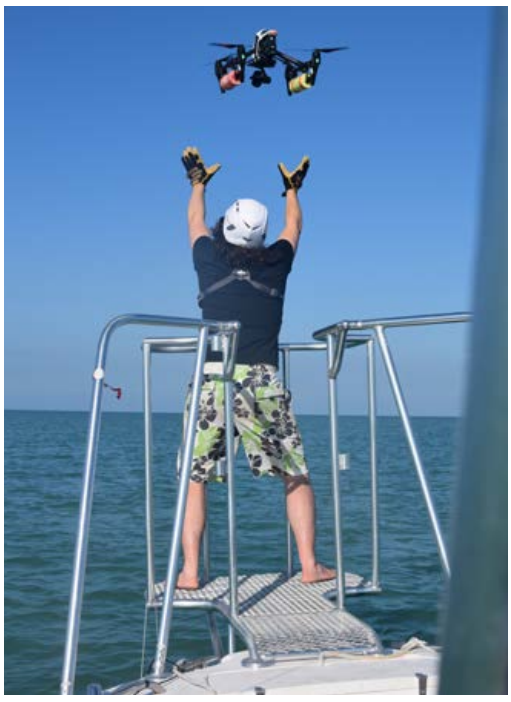
As in all other years, we also continued to add to our unique long-term database of whistles recorded during capture/release sessions over the past three decades.

Acoustic playback studies with drones

Laela Sayigh and Michael Moore, Woods Hole Oceanographic Institution; Vincent Janik, Peter Tyack and Marco Casoli, University of St. Andrews; and Katie McHugh and Randall Wells, Chicago Zoological Society

In 2017 we embarked on an exciting new approach to playback experiments (with support from the Woods Hole Oceanographic Institution's Ocean Life Institute), in which we used an unmanned aerial vehicle (UAV, or drone) to film responses of free-swimming dolphins to playbacks of recorded sounds through an underwater speaker. The goal of these experiments is ultimately to study the phenomenon known as "communication masking," where we look at how noise impacts the *function* of signals rather than just their *detectability* (the more traditional focus of masking studies). Sarasota is a uniquely positioned natural laboratory for these studies, since we have an extensive library of dolphin signature whistles from known individuals to use as playback stimuli. The first step in our studies was to establish robust responses to whistle playbacks, such that we have reliable predictions regarding how animals will respond to certain types of stimuli. Then, when we introduce varying levels of noise to interfere with these stimuli, we will be able to assess when the signals no longer function reliably.

Drone operators Michael Moore and Marco Casoli were able to keep the animals in view before, during and after the playbacks in most circumstances. We learned to focus our experiments in areas with good water clarity, which greatly facilitated the ability of the drone operators to keep the animals in view. Our experimental protocol involved playing back two signature whistle stimuli to each target dolphin: an unfamiliar whistle (recorded from another geographic area) and a familiar whistle (from a historically closely associated Sarasota dolphin). Based on preliminary results from an earlier study, we predicted that females would avoid unfamiliar whistles and approach familiar whistles, and that males would approach both types of stimuli. We carried out 14 paired trials and 7 single trials (where we lost track of the animal before doing the 2nd playback), for a total of 35 playbacks. Analysis is still under way, so it is too soon to determine whether our predictions were supported, but we saw clear responses to playback stimuli in the field, and are excited about the potential of this new methodology to learn more about dolphin communication and how it may be impacted by noise.



Marco Casoli releases a UAV to film free-swimming dolphins for playback studies.

Reproductive behavior in bottlenose dolphins

Marco Casoli and Peter Tyack, University of St. Andrews

Social behavior is notoriously hard to study in wide-ranging marine animals that are difficult to identify, observe and follow. By relying on the unprecedented details on communication and fine-scale movements of wild dolphins offered by Dtag data, in the last year we have started a research project aimed to investigate fine-scale reproductive behavior of the bottlenose dolphins in Sarasota Bay.

Reproductive interactions and mating strategies represent central components of behavioral ecology, and they are important for understanding aspects such as individual behavior, social structure and population dynamics. The reproductive system of bottlenose dolphins consists of brief associations between females and one or more males that occur during the breeding season and throughout the entire home range of individuals. Males associate in turns with different females in search of mating opportunities. During reproductive encounters, called "consortships," they sometimes use agonistic behaviors and physical aggression as ways to restrict the ability of females to choose a mate.

Although we know general features of the bottlenose dolphin mating system, many aspects remain poorly understood. For example, we do not know the function of some of the sounds used by males during consortships, whether females are able to choose their partners and possibly to refuse specific males, whether and how males compete with each other in order to gain access to females, and how males that form stable alliances manage to coordinate their movements during consortships and to share reproductive opportunities.

Our project aims to offer insights on some of these unsolved questions by analyzing Dtag data collected during periods of reproductive interactions. We have found that the full acoustic repertoire produced during these encounters is highly varied and more difficult to classify with discrete categories than previously thought. This is an important area of study in order to understand how male dolphins may communicate to females about their intentions, physical characteristics and even identity during consortship interactions. We hope that these Dtag data will help us understand the details of male sound use and female movement and behavioral responses during consortships, which could offer insights on how conflict situations between the sexes are mediated in this reproductive context. In

addition, we hope to clarify whether and how signature whistles function in male alliances during mating interactions with females, and if they are used for coordinating movements or facilitate reunions after periods of separations.

Socialization among a male alliance, an adult female and an independent juvenile of unknown sex, suggesting a likely consortship. Dtags deployed on allied males are helping decipher acoustic signals and finescale behavior during such reproductive interactions.

Paternity in the Sarasota Bay Dolphin Community

Debbie Duffield, Portland State University, and Randall Wells, Chicago Zoological Society

Knowledge of genetic relationships is key to understanding the social structure of the Sarasota Bay dolphins. We started our genetic analysis of relationships in the Sarasota Bay Dolphin Community (SBDC) in 1984.

We have used blood samples from the long-term capture/release health assessment program and, more recently, skin from the field biopsy studies. Paternity analysis was originally based on chromosomes and protein electrophoresis. With the advent of microsatellite DNA technology, this has become our analysis of choice. This report is an overview of the paternity results to date – the study is on-going.

Currently, we have completed 257 paternity analyses from mothers with single offspring to mothers with multiple offspring. One female has seven offspring for which we have determined paternity, three females have had five offspring tested, eight have each had four offspring tested, 10 have had three offspring tested, 19 have two and 38 have had one offspring tested. Often the mothers themselves were offspring of tested females, covering a span of four generations. There have been 45 different males in the SBDC that were sole paternity matches to offspring, with 13 more offspring for which we still have two or more possible sires in the community. Also, there are 50 offspring for which there were no matches among the SBDC males, supporting our earlier conclusion that, based on the movement of males between neighboring communities or coastal migrating populations, there is substantial gene flow among these groups.

FB60 was observed in Sarasota waters during 1970-1996. During his 26-year sighting history, he sired at least 7 calves by 6 different resident females, making him our most prolific male based on current data.

For paternities within the SBDC, one male has sired seven offspring, one has sired six offspring, one has five offspring, three have four offspring, six have three offspring, six have two offspring and 22 have sired a single offspring. The age of the sires at time of conception has ranged from 10 to more than 40 years, averaging 24 years old. Females with multiple offspring generally had multiple sires for these offspring, although given males were known to sire more than one calf of a particular female.

We are continuing to look among all the individually sampled animals for additional mother-calf relationships and paternities, using genetic profiles combined with the wealth of observational field data. This work represents the longest study of a dolphin community and is possible due to the tremendous efforts of the observers and the capture/release personnel that provide the samples and the behavioral context from which we can test genetic hypotheses about the structure of a resident dolphin community. This opportunity has been truly unique. Our heartfelt thanks to all of you that have made this possible.

Wiring Sarasota Bay for sound

Kim Hull, Katie McHugh, Reny Tyson Moore, Randall Wells, and Krystan Wilkinson, Chicago Zoological Society, and David Mann, Loggerhead Instruments

Acoustic monitoring of animals in aquatic environments is a useful method to help researchers understand animal movements and interactions with their habitat, others of their same species, and other species. In 2015, we initiated a collaborative study using active and passive underwater acoustic recording systems to better understand the movements of multiple marine species in Sarasota Bay.

This project has two primary components: (1) deploy and use a network of passive acoustic receiving stations

around Sarasota Bay and adjacent coastal waters to track the movements of tagged rays, sharks and other fish, and (2) develop a shore-based system for recording and remotely accessing sounds produced by fish, dolphins (for example, signature whistles), and human activities (for example, boat noise, dredging, marine construction), with these data coming to a central receiving system where they can be fully processed and disseminated to researchers, educators, and the public.

To address the first component, 37 passive acoustic receivers were deployed in all of the passes connecting Sarasota Bay to the Gulf of Mexico, in six creek mouths, and at three off-shore reefs. Additionally, collaborator Jayne Gardiner of New College of Florida has 11 acoustic receivers deployed in nearby Terra Ceia Bay and one off Long Bar Point in Sarasota Bay. These passive acoustic receivers act as listening stations - when the tagged animals swim by one of these receivers, their identity as well as the time and date are recorded. As passive receivers only record animal presence, the locations of the receivers were strategically placed to create "gates" in order to capture patterns of movements into and out of Sarasota Bay. Passive acoustic networks, such as the one in Sarasota Bay, are greatly enhanced by large-scale regional networks, such as iTag in the Gulf of Mexico or FACT along the Florida Atlantic

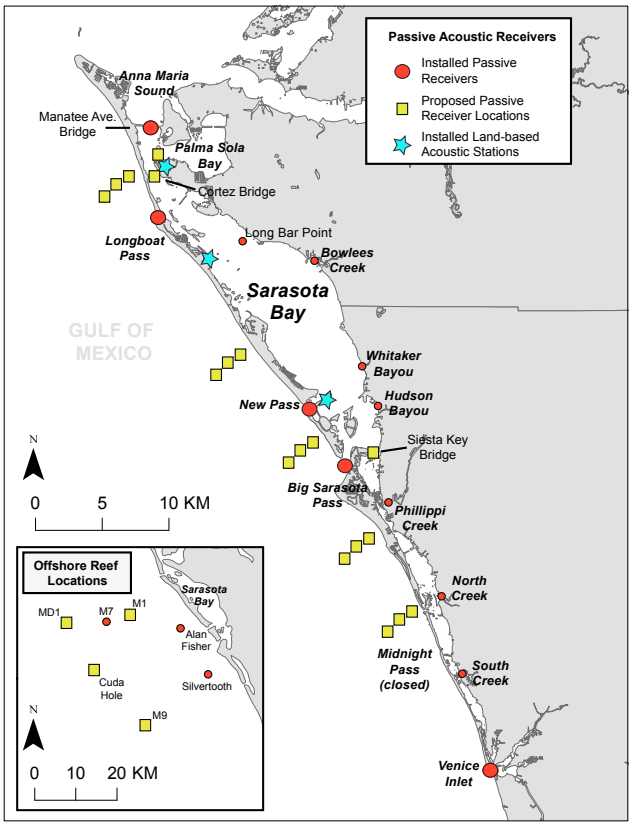


Fig. 1 Locations of installed acoustic and shore-based receivers. We hope to expand both components of this project to other locations in the near future.

Fig. 2 Solar-powered stand-alone receiving system on Longboat Key.

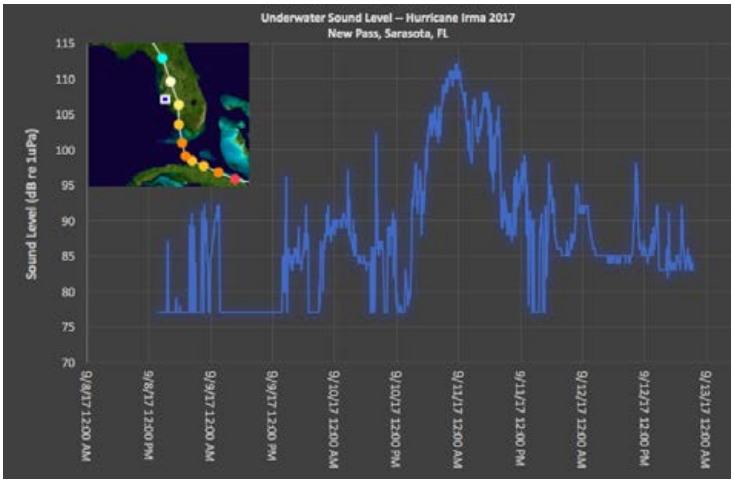


Fig. 3 Underwater sound levels recorded at our fixed acoustic station in New Pass during Hurricane Irma.

Coast, so that researchers can share tag detections between multiple arrays. Kim and Krystan are members of the iTag network and have attended the annual conference for the past two years as representatives of the Sarasota Bay acoustic array, and Randy serves on the Steering Committee of the national Animal Tracking Network that works to coordinate these regional networks. In the near future, we hope to expand the passive receiver array to include more off-shore reefs and additional locations throughout the Bay and coastal area (Fig 1).

To address the second component, David Mann is developing and testing shore-based acoustic stations including near-real time automated dolphin whistle detectors at three sites: a fixed station on New Pass at Mote Marine Lab, and solar-powered stand-alone systems on Longboat Key and near the entrance of Palma Sola Bay (Fig 2). These systems record continuous audio, with automated cloud reporting of sound levels at five different frequency bands and number of whistles detected at 5 minute intervals (see Fig 3

for an example of underwater sound levels recorded at New Pass during Hurricane Irma!). Our 2017 NSF REU intern, Carmen Camp, worked with the first of these two systems over the summer to evaluate aspects of the soundscape in Sarasota Bay, verify whistle detections, and determine some preliminary contributing factors to detection errors. She will continue working with her advisor at Vanderbilt University to investigate new methods, including machine learning, that have the potential to improve accuracy of the whistle detector in the future. These systems will be very useful for monitoring dolphin activity and anthropogenic noise throughout the bay and we plan to expand the number of installation sites in the near future.

Participating researchers, organizations, and their species of interest include:

- Randy Wells, Katie McHugh, Reny Tyson Moore, & David Mann, CZS & Loggerhead Instruments – dolphin vocalizations and anthropogenic noise
- Krystan Wilkinson, Randy Wells, & Bob Hueter, CZS and Mote – bull sharks
- Jayne Gardiner, New College of Florida – small, coastal sharks
- Kim Hull & Krystan Wilkinson, Mote – spotted eagle rays
- Ken Leber, Ryan Schloesser, & Jim Locascio, Mote – snook and goliath grouper

We would like to thank Mote Scientific Foundation for providing funding for the receivers in Sarasota Bay acoustic array, animal tags, and initial funding to develop the shore-based listening stations. We thank Rick Moskovitz and Jim Holbrook for their generosity and enthusiasm in facilitating installation of the first solar-powered acoustic station, and Nanette Rankin and the Pointe at Mariner's Cove Board for enabling us to expand the acoustic network to Cortez.

Hearing abilities of bottlenose dolphins in Sarasota Bay

Mandy Cook, Portland State University

Bottlenose dolphins can hear from roughly 75 Hertz (Hz) to over 150,000 Hz, which is well above the range of human hearing (typically 20-20,000 Hz). Dolphins are exposed to a wide variety of both naturally-occurring and anthropogenic (human-caused) noises in their environment, and there is concern that these noises may have negative effects on their hearing. Because they rely primarily on sound production and reception to navigate through their environment, find food, and communicate with each other, hearing losses in these animals can be especially harmful.

We measure the hearing abilities of bottlenose dolphins in Sarasota Bay using an auditory evoked potential (AEP) technique based on methods used to assess hearing in human infants. Short duration tones of different frequencies and sound levels are played to the dolphins using a jawphone (a speaker embedded in a suction cup and attached to the lower jaw of the animal), which takes advantage of the lower-jaw sound conduction pathway in these animals. Sensors in other suction cups on the surface of the dolphin's head measure microvolt potentials produced by the brain in response to the tones. The brain's responses to the sounds are then analyzed to determine each dolphin's hearing abilities.

Data were collected from 8 bottlenose dolphins (3 females and 5 males, ages 4-33 years) during the May 2017 health assessments. Overall, our findings from conducting hearing tests over 10 years show that the bottlenose dolphins in Sarasota Bay do not exhibit increasing hearing losses with increasing age, and male dolphins are no more likely than female dolphins to have a hearing deficit. Also, these dolphins do not present substantial hearing losses due to daily exposure to environmental noises, including anthropogenic sources of noise. Continued testing in the years to come will allow us to evaluate whether the hearing abilities of individual dolphins change over time.

F173, showing placement of the jawphone on the lower left jaw and AEP sensors on the animal's dorsal surface. A recording hydrophone is located on the melon of the animal, and ECG sensors are located behind the pectoral fin.

Behavioral research on bottlenose dolphins in the Shannon Estuary, Ireland

Isabel Baker, Galway-Mayo Institute of Technology

The overall purpose of my doctoral research is to describe the reproductive parameters, behavior and social structure of bottlenose dolphins in the Shannon Estuary, Ireland, for the first time. The bottlenose dolphin population in the Shannon Estuary is composed of around 142 individuals, and appears to be stable and genetically discrete from other populations in Ireland. The 684 km^2 study site is one of two Special Areas of Conservation for bottlenose dolphins in Ireland. With the help of some great teams of research assistants over five summers, we gained insights into the behavior of the dolphins in the estuary by conducting boat-based photo-ID surveys from two dolphin-watching tour boats and a dedicated research vessel. Using our research vessel, we carried out the first behavioral observations of bottlenose dolphins in the estuary by collecting focal follow data on specific individuals. All together, we conducted 472 dolphin surveys between June 2012 and September 2016 (which marked the end of data collection for my PhD). During this time, we encountered 781 dolphin groups and catalogued 204 dolphins.

Drawing on my experience with the SDRP, I developed data collection and processing protocols. Using our data supplemented with data collected by the Shannon Dolphin and Wildlife Foundation between 2008 and 2011, I populated two large databases – a photographic database containing over 213,000 images, and a relational sightings database with information on every individual dolphin recorded in the population.

It has been fascinating getting to know all of the dolphins in the estuary, recognizing them visually by eye, and learning about their sighting and reproductive histories. The reproductive females in the estuary give birth to an average of seven calves each year, with inter-birth intervals of around three years in length, although some calves have stayed with their mothers until the age of six. The fission-fusion social structure of the population seems to relate to age and area use, with different individuals using the inner and outer parts of the estuary to different degrees.

Above and right: Detailed observational studies are providing new data on bottlenose dolphin behavior, social structure, and reproductive parameters in western Ireland.

Long-term research has helped to construct interesting histories. For example, in June 2012, a female bottlenose dolphin known as Sandy Salmon stranded briefly on the shores of the Shannon Estuary, and turned out to be nine months pregnant at the time. Since the birth of her calf (nicknamed Muddy Mackerel) in September 2012, we have followed their progress over the years. Muddy has since weaned and we welcomed the arrival of Sandy Salmon's new calf (Rocky Ray) in September 2016. Stories like this would be difficult to tell without researchers prepared to devote years of fieldwork and analysis to these long-lived and highly complex social mammals.

This research will provide baseline information on the life history, behavior and social structure of this distinct bottlenose dolphin population in Ireland for the first time, making data available for comparisons with similar studies elsewhere and enhancing our knowledge of the variations found among bottlenose dolphin populations globally.

Along with my supervisors in Ireland, SDRP Staff Scientist Katie McHugh is an advisor on my Research Advisory Panel and I am so grateful for her continued support of my project. Our research would not have been possible without the help of dedicated teams of research assistants and the kindness of the dolphin-watching operators who welcomed us on board their boats to use them as opportunistic platforms for research. Many thanks to the SDRP for giving me a great start in the field of dolphin research back in 2007 and 2009!

Health and Physiology

Sarasota Bay dolphin health assessment project summary: May 2017

Randall Wells, Chicago Zoological Society

The Sarasota Dolphin Research Program successfully completed a dolphin health assessment project during May 8-12 in Sarasota Bay. We fielded an international team of 147 researchers, veterinarians, handlers, and law enforcement agents, with ~95 on the water each day, in 12 boats. Primary funding was provided by Dolphin Quest, with supplemental funding for specific projects as described below. We conducted up to 43 research projects with each of the 15 dolphins we handled. Of these, 9 were first-time samplings.

In addition to our ongoing population health monitoring and life history research, among the primary purposes of this year's health assessment project were: 1) to examine, sample, mark residents not previously handled; 2) to continue studies of dolphin kidney disease, as funded by the National Marine Mammal Foundation; 3) to continue studies of lung function, and respiratory sounds, as funded by the Office of Naval Research through Andreas Fahlman and Julie van der Hoop; 4) to continue to provide training opportunities for our local dolphin rescue team, and additional opportunities for interactions with collaborating rescue groups around the region (FWC-MMPL, FWC-SWL, CMA, MML, HBOI); 5) to provide training opportunities for Florida Fish and Wildlife Conservation Commission law enforcement agents to better prepare them for stranding response (8 agents participated); 6) to continue to provide training opportunities to increase dolphin veterinary medicine capacity (20 vets participated); 7) to test new tools and techniques for sampling and data collection (for example, radiography, esophageal catheter, ultrasound, drone photogrammetry); and 8) to continue studies of dolphin whistle communication, social behavior, and responses to whistle playbacks. Initial findings from many of these studies can be found throughout this issue.

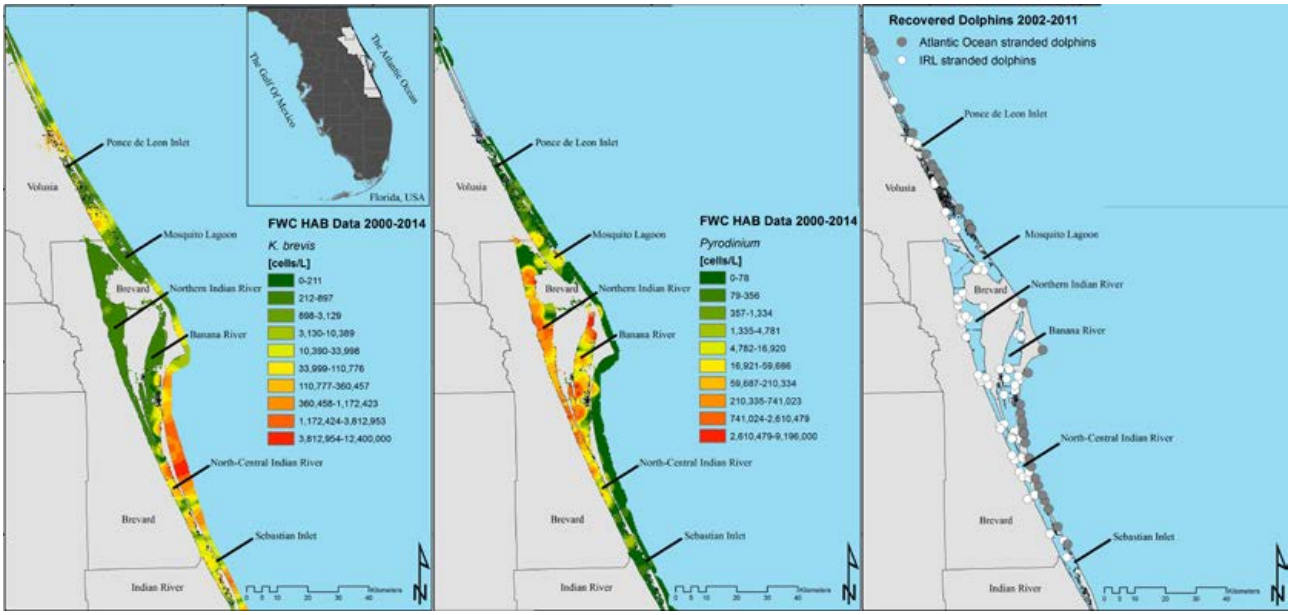
Food web dynamics of harmful algal toxins in Florida dolphins

Spencer Fire, Florida Institute of Technology

Natural toxins produced during blooms of marine phytoplankton ("red tides") are a serious health threat to marine mammals like bottlenose dolphins. Our current efforts aim to understand how, where, and in which fish species these toxins accumulate, and compare what we know from Sarasota Bay dolphins to their east-coast counterparts in Florida's Indian River Lagoon.

The Indian River Lagoon (IRL) has recently experienced several significant harmful algal bloom (HAB) events. These include the "brown tide" in the northern IRL, toxic blooms in the northern/central IRL, and an unusual cyanobacteria bloom that seriously impacted the St. Lucie Estuary. Since these blooms can be frequent occurrences, and produce potent toxins that threaten human and animal health, it is important to know how they move through the food web and which organisms are at risk.

We have recently begun a project that will measure the concentration of these toxins in several species of IRL fish that are important in the bottlenose dolphin diet. We are also in the process of collecting blubber samples from IRL dolphins to test for these same toxins to measure the concentrations in live, free-ranging animals. All of these tissue samples will be tested using an antibody-based detection method called ELISA (enzyme-linked immunosorbent assay), that has been useful for similar projects done in Sarasota Bay dolphins and fish. With tissue samples and training we have received from SDRP staff, we have an excellent start on understanding the impacts of HAB toxins in the IRL, and hope to use the knowledge gained from this effort to aid dolphin conservation efforts statewide. We are grateful for funding we have received from the John H. Prescott Marine Mammal Rescue Assistance Grant Program, and the FAU-Harbor Branch Oceanographic Institution Protect Wild Dolphins Specialty License Plate Fund.



Distribution of dolphin strandings in the Indian River Lagoon and nearby waters relative to harmful algal blooms.

Assessing differences in species susceptibility to dolphin morbillivirus

Andrea Bogomolni, Woods Hole Oceanographic Institution

It was only 25 years ago that morbilliviruses were recognized in marine mammals as the cause of an outbreak of infectious disease that rapidly killed more than half of the population of harbor seals in Northwest Europe. Soon after, cetaceans (dolphins, whales and porpoises) were found to be affected by a similar virus. The morbilliviruses infecting cetaceans are referred collectively as cetacean morbillivirus (CeMV). To date, six strains of CeMV have been identified in several species of cetaceans globally. In 1987-88, it was estimated that about half of the population of bottlenose dolphins along the U.S. East Coast died due to dolphin morbillivirus (DMV) and more than 1,600 bottlenose dolphins died in the 2013-2015 U.S. Mid-Atlantic bottlenose dolphin unusual mortality event (UME). Striped dolphins, pygmy sperm whales, fin whales, and humpback whales in the area have also tested positive for DMV during this event.

Mortality due to morbilliviruses can be devastating to susceptible populations. Bottlenose dolphins have historically been one of the most susceptible species to DMV. In order to understand cetacean interspecies variation in susceptibility to DMV, a 2013 Mid-Atlantic UME DMV isolate is being assessed using *in-vitro* infection of immune cells collected from several cetacean species. Blood was collected and peripheral blood mononuclear cells (PBMCs) isolated from four different cetacean species, including wild bottlenose dolphins from the Sarasota Dolphin Research Program in 2017. The amount of virus able to replicate in these isolated immune cells will be measured from several infection time points using quantitative RT-PCR. These data will help us to understand how some species may be affected by this virus more than others. Funding and support for this research was obtained through a Morris Animal Foundation Postdoctoral Traineeship, the NOAA Marine Mammal Health and Stranding Response Program and the Woods Hole Oceanographic Institution's Ocean Life Institute.

Animal welfare resesarch

Melinda Conners, Lance MIller, and Rita Stacey, Chicago Zoological Society

Animal welfare is a multifaceted concept that refers to an animal's collective physical, mental, and emotional state in relation to how well it copes with its environment. Wildlife researchers and managers have long valued physiological biomarkers as tools to measure health and welfare in animals from both free-ranging and professionally-managed populations. Historically, welfare studies have predominantly targeted biomarkers that reflect physiological stress (for example, cortisol). However, this approach requires caution since these biomarkers can respond to both positive and negative stimuli. Thus, the field of animal welfare is moving to understand and incorporate additional biomarkers that would provide complementary information on welfare, such as coping resilience and immune status. The Chicago Zoological Society's Brookfield Zoo, in partnership with its SDRP, is evaluating a suite of novel, minimally-invasive physiological biomarkers of welfare in common bottlenose dolphins.

While the concept of animal welfare is typically discussed and applied in zoo and aquaria settings, it is also relevant to wild populations. Different dolphin populations are exposed to varying levels of stressors, and this may manifest in differences in the health and welfare (and, ultimately, the sustainability) of populations. For example, coastal populations of Peruvian Burmeister's porpoise have some of the highest levels of infectious disease recorded. Some think that poorer health in this population is a consequence of immunosuppression driven by chronic stress induced from intense levels of fishery interactions. To better manage and conserve populations of dolphins from stressors, the community could particularly benefit from access to biomarkers that indicate population resilience. Thus, we are evaluating a hormone called dehydroepiandrosterone (DHEA) that has been shown to protect the brain against the damaging effects of circulating glucocorticoids released during a stress response. Individuals with higher DHEA to cortisol ratios displayed better coping resilience in both human and non-human animal studies. In addition to DHEA, the antibody immunoglobulin-A (IgA) has gained traction in recent years as a health and welfare indicator due to its crucial role in mucosal immunity and frontline disease prevention and can be used as a measurable outcome of the downstream consequences of stress.

These novel biomarkers (DHEA, IgA) can be detected in feces and saliva, offering a less invasive and potentially more feasible sampling method than blood for monitoring health in both free-ranging and professionally-managed animal populations. We have been collecting feces (more than 200

Samples from dolphins under human care at Brookfield Zoo and their free-ranging counterparts in Sarasota Bay are being used to investigate novel biomarkers of animal welfare.

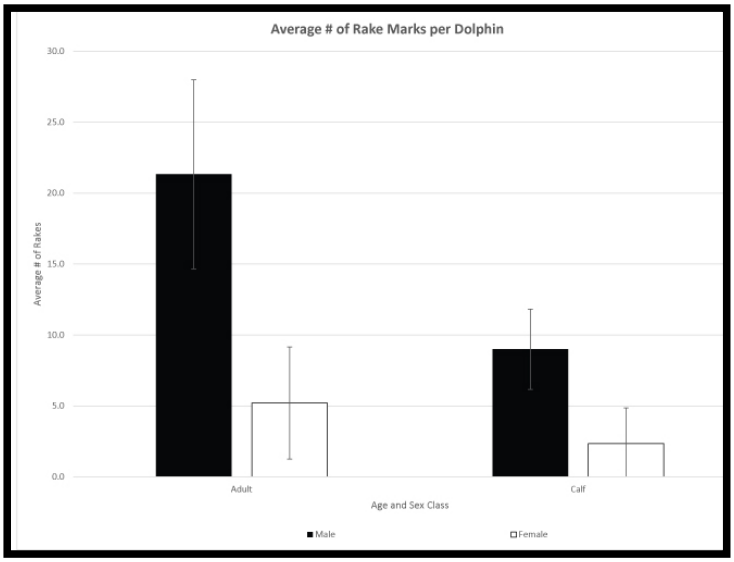
samples) and saliva from bottlenose dolphins in Sarasota Bay, FL, and from those under human care at Brookfield Zoo. Saliva appears to be a less tractable method for biomarker analysis than fecal samples, so current efforts are focused on developing methods to quantify hormones from dolphin feces. Assays were developed and validated during 2016-2017. We are currently working with an external lab to purify bottlenose dolphin IgA - the first step towards developing an assay to measure IgA in dolphin feces. Collaborations, such as those involving CZS staff at the Brookfield Zoo and the SDRP, are critical for obtaining information on animals that can ultimately be used to understand and improve the sustainability of populations in both free-ranging and professionally-managed environments.

The social marks of dolphins

Wendi Fellner, The Seas, Epcot, Walt Disney World Resort

Have you ever noticed that wild dolphins sometimes have lots of shallow cuts and scratches on their bodies? These marks, called “rake marks”, are groups of scratches arranged in parallel lines that look as if someone dragged a rake across their skin. These marks aren’t the work of some mad gardener, but rather come from the teeth of another dolphin. When dolphins interact with each other, they often tumble around and roughhouse. Without arms and hands with which to grasp each other, they use the next best thing – their mouths. We know from years of observation, both in the wild and in oceanariums, that dolphins receive rake marks from both friendly and aggressive interactions, and that having some rake marks is a result of normal social encounters. But how many is “normal” and how many is too many or too deep? The long-running work of the Sarasota Dolphin Research Program with the dolphins that reside in Sarasota Bay gives us a special opportunity to observe their natural behavior so we can make comparisons with aquarium-living dolphins. Not only can we determine how many rake marks a dolphin will naturally carry, but because the age, sex, and life histories of most of the Sarasota dolphins are known, we can also learn how a dolphin’s pattern of rakes may be expected to appear at different stages of life. For example, do males carry more rakes than females? Do juveniles carry more or fewer than adults?

During the May 2017 health assessment of the Sarasota dolphins, each dolphin that was temporarily captured was examined for the presence of rake marks. Each rake was counted, categorized by depth, and its location on the body was recorded. Preliminary analysis suggests that each dolphin carried an average of 10 rakes with males averaging more than females (male = 16, female = 4) and adults averaging more than calves (adult = 11, calf = 5). Superficial rakes that only broke the epidermis were much more common in adults than deeper rakes that go into the hypodermis/blubber for both males and females, and no calves had deep rakes. Having a better understanding of the pattern of rakes that a healthy individual at different stages of life will carry not only gives us a richer picture of their social interactions, but can help us interpret a stranded dolphin’s recent social situation prior to stranding.



Top and middle: These images reflect variations in rake mark severity, from the more superficial (top) to the deeper and more concentrated marks depicted in the second image.
Bottom: By counting the number of rakes each dolphin carries, we learned that there are differences between age and sex classes. Males receive more rakes than females, and dependent calves receive fewer than adults.

Respiratory sounds

Julie van der Hoop, Aarhus Institute of Advanced Studies

Respiratory sounds contain information on health and physiology – that's why stethoscopes are part of our routine medical examinations when we go to the doctor. Through the SDRP Sarasota Bay health assessments, we've learned a lot about the lung health of bottlenose dolphins at rest, but what about when they're free-swimming? We use digital acoustic recording tags (Dtag) to record breath sounds at the blowhole at rest, and then for hours after individuals are released. The variation in these respiratory sounds tells us about how much air dolphins are exchanging per-breath, and how their lungs might be functioning. As in humans, respiratory sounds can be used in wild dolphins to identify changes in energy expenditure or lung health. Dtag deployments in Sarasota Bay since 2014 have allowed us to quantify the differences in breathing sounds between resting and swimming. This alone has supported many of our current experiments and algorithm development to refine this relationship by using simultaneous measurements from the Dtag and a flow meter.

Measurement of respiratory physiology including respiratory volume and gas exchange in a bottlenose dolphin. The cone-shaped instrument measures the respiratory volume as well as oxygen and carbon dioxide concentration of each blow.

F164 freshly fitted with a Dtag by Julie van der Hoop prior to his release. The Dtag is recording the breath sounds at F164's blowhole to monitor his respiratory function. The suction cup on his melon is a hydrophone that records his vocalizations for communication studies.

Physiology and behavior of offshore bottlenose dolphins in Bermuda

Andreas Fahlman, L'Oceanografic Foundation; Randall Wells, Chicago Zoological Society; Michael Moore, Woods Hole Oceanographic Institution; Jay Sweeney and Rae Stone, Dolphin Quest; Peter Tyack, St. Andrews University; and Frants Jensen, Aarhus Institute of Advanced Studies

The physiology of a species limits the habitat they can explore and the ecological niches that they can exploit. Bottlenose dolphins are generally seen as shallow-water species capable of diving to a few hundred meters and over a handful of minutes. However, offshore ecotypes have adapted to a very different habitat than coastal bottlenose dolphins. These animals live in more open oceanic areas and regularly dive to depths of 3-500 m, with occasional dives beyond 1,000 m and lasting to more than 13 minutes. These animals defy our current understanding of the dive physiology of bottlenose dolphins and inspire further studies to understand the physiological differences between the coastal bottlenose dolphins in Sarasota and their deep diving offshore cousins in Bermuda.

In the fall of 2016, a multi-institutional team from the SDRP, Dolphin Quest, Woods Hole Oceanographic Institution, Aarhus University and Oceanografic Research Foundation set out to study offshore dolphins near Bermuda. Over a two-week period, four wild bottlenose dolphins were temporarily caught, sampled physiologically, and instrumented with tags to monitor position, dive behavior, and acoustic activity. On the study boat, the team conducted experiments to measure lung function, metabolic rate, and assess the use of a biomarker for stress associated with deep diving. While data processing is still underway, these experiments will help us understand the physiological adaptations that have taken place to help the species occupy this deep-water foraging niche.

In parallel with the physiological measurements, two tags (one acoustic and movement sensing Dtag, another a satellite-linked position and time-depth sensing tag) collected data on both fine-scale and long-term dive behavior. These two data streams are now being used to test physiological models of gas exchange during diving, and essentially investigate if the measured physiological changes are sufficient to achieve the dive capabilities of offshore dolphins, or if other factors that we have yet to measure are also in

play. Combining these traditional physiological experiments with data on dive performance of wild animals thus provides a tantalizing means of validating our understanding of the physiological adaptations of these deep-diving dolphins.

Field metabolic rates

Andreas Fahlman, L'Oceanografic Foundation; Randall Wells, Chicago Zoological Society; Michael Moore, Woods Hole Oceanographic Institution; and Micah Brodsky

For conservation, it is important to understand how energy flows among and between different species. For an animal like a dolphin, scientists need to understand the amount of energy that is required to maintain the basic functions of being alive. For example, the brain requires a certain amount of energy to function, the heart needs energy to continue pumping blood, and even staying warm requires energy. The amount of energy required depends on many variables, such as activity level (is the dolphin resting, sleeping, diving or is it swimming), and water temperature. In order to better understand how much energy is required for survival, physiologists separate energy requirements into different categories, such as the resting metabolic rate (the costs to stay warm, for the heart to pump blood, for the brain to function, when the animal is resting quietly), foraging costs (the additional energy required to capture and handle food), reproduction and nursing (the metabolic cost of raising a calf), predator avoidance, and migration. If we know the overall metabolic cost for an individual it is then possible to determine the amount of food that a dolphin will need to survive. We know from past studies in numerous species that the daily metabolic rate is about two to three times higher than the resting metabolic rate. By measuring the resting metabolic rate of dolphins in Sarasota Bay, we should have a good estimate of their daily metabolic requirements, allowing us to determine the amount of food (calories) a dolphin needs to find each day.

One way to measure metabolic rate is by measuring the amount of oxygen consumed over time, the oxygen consumption rate. Over the past four years we have collected data from 32 adult and juvenile dolphins in and around Sarasota Bay. In terrestrial mammals, experiments have shown that relative energy requirements (energy required per kilogram of body mass) get smaller as the animals get bigger. Our data indicate that the energy requirements of dolphins decrease even more rapidly with size than land mammals do. This may have important implications when estimating the amount of fish consumed by dolphins. The estimates of total biomass consumed by dolphins may be significantly less than previously estimated, thus competition for available resources (with humans and other animals) may be much less than currently estimated. These new data will be examined relative to metabolic rate data from recent doubly-labeled water studies in Sarasota Bay performed by scientists from the University of California, Santa Cruz, and the results of recently published models estimating food needs for dolphins, developed by Adriana Bejarano in collaboration with the SDRP.

F151 and calf, F267, post-release from their 2017 health assessments. F151 showed evidence of kidney stones in her ultrasound, contributing to the NMMF's research. Seen here, she and her calf sport Dtags that record sounds utilized for behavioral, metabolic, general health, and also communication studies.

Bottlenose dolphin kidney stone inhibitors

Jenny Meegan, National Marine Mammal Foundation

Kidney stones can occur in bottlenose dolphins, particularly older animals. For the past two years, we have been investigating potential differences between dolphins that form stones and those that don't form stones. We suspect that the presence of inhibitors and/or promoters of crystal growth in dolphin urine could be impacting the prevalence of kidney stone formation in different populations of animals. Dolphins living in Sarasota Bay rarely have kidney stones; therefore, they serve as a great control population. During the 2016 and 2017 health assessments, urine was collected from Sarasota Bay dolphins to identify specific inhibitors of stone formation. Laboratory studies are currently underway at the University of Texas to evaluate the urine with sophisticated chemical techniques to better understand how these dolphins are inhibiting stone formation. Additionally, ultrasound examination was performed to confirm the presence/absence of kidney stones. Interestingly, during the 2017 health assessment, one Sarasota Bay dolphin was found to have sonographic evidence of bilateral kidney stones. All the remaining wild dolphins examined in 2016 and 2017 had normal kidneys without evidence of stones. We plan to continue to utilize our collaboration with the SDRP to continue to investigate these important dolphin health questions in the coming years.

New collaborations launched from health assessments to advance bone density research on bottlenose dolphins

James Powell, Portland State University; Julie Rocho-Levine, Dolphin Quest; and Leslie Hart, College of Charleston

As a primary component of his doctoral research, James Powell has been assessing bone density in free-ranging bottlenose dolphins during capture-release health assessments in Sarasota Bay since 2014. Bone density is an established health parameter in human medicine and the addition of this technology to marine mammal health studies would be useful to more comprehensively understand the health of the individuals studied. The support of the SDRP not only fostered the environment necessary to develop and test the novel technology required to pursue this line of research, but also afforded opportunities to interact with, and establish partnerships and collaborations with, other researchers in the marine mammal research field.

Made possible through the long-standing partnership between SDRP and Dolphin Quest, the first comprehensive bone density assessments of a population of bottlenose dolphins managed under human care were performed in January 2017 at Dolphin Quest Oahu. In addition to obtaining preliminary bone density values for each dolphin, critical repeatability assays were performed to validate the accuracy and precision of both the technology and its clinical application. Preliminary findings from the dolphins studied suggest that these managed care dolphins have bone density values within the ranges observed in resident Sarasota Bay dolphins of similar age.

During the 2017 health assessment project, Dr. Leslie Hart was continuing a study on body mass indices (BMI) as a gauge of body condition in bottlenose dolphins. In humans, BMI is often used as an indicator of fitness, fatness/thinness, and risk for cardiovascular disease, diabetes, and stroke, based on comparison to reference intervals. Reference intervals specify what is expected for individuals in a healthy population given a particular sex and age, and can therefore be used to identify individuals with compromised health. There is general concern regarding the health of dolphins with low BMI, which could signal disease or malnutrition. In humans, poor body condition, or abnormal thinness, is an important risk factor for low bone mass and increased bone loss. As such, plans for a collaborative study to investigate linkages between dolphin body condition and bone density are underway.

James Powell trains Julie Rocho-Levine, Manager of Marine Mammals at Dolphin Quest Oahu, to perform ultrasound-based bone density assessments on the flipper of a bottlenose dolphin.

Bottlenose dolphins as gauges of environmental exposure to phthalates

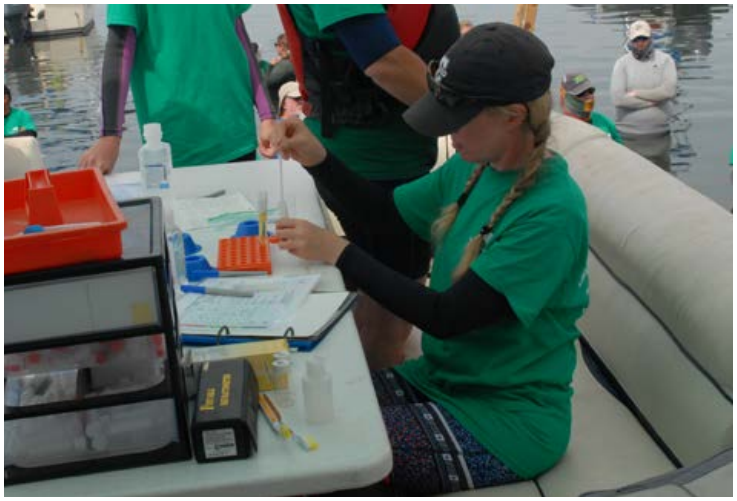
Leslie Hart and Barbara Beckingham, College of Charleston

Phthalates are a group of man-made chemicals commonly used in the manufacturing of plastic and other consumer goods (for example, cosmetics and personal care products), and they leach into the environment because they are not chemically bonded to these materials. Because of this, phthalates are readily available for human and wildlife exposure. Concern over phthalates stems from experimental laboratory animal and human epidemiologic studies demonstrating associations with endocrine disruption and reproductive impairment. Macro- and microplastics (particles < 5mm in diameter) are ubiquitous in the marine environment and quantities appear to be growing. In addition, there are potential sources of phthalates in stormwater and other effluents that reflect increased population pressures in coastal zones. This suggests that marine wildlife may be vulnerable to chronic chemical plasticizer exposure.

Once exposed, phthalates are rapidly broken down into metabolites that are usually excreted in feces and urine. Previous studies have detected phthalates in cetacean blubber; however, human studies suggest that urine may be more useful for detection and quantification of exposure. Prior to this project, urinary phthalate metabolites have not been reported in any marine mammal species. Our objective was to develop methods for the detection and quantification of urinary phthalate metabolite concentrations among Sarasota Bay bottlenose dolphins. Urine samples were collected from 17 individuals during the 2016 and 2017 health assessments. Urinary concentrations of metabolites were successfully detected using modified methods published by the Centers for Disease Control and Prevention, suggesting that dolphins are exposed to phthalates in Sarasota Bay and nearby waters; however, the sources of exposure remain undetermined. Moving forward, we will continue to screen for urinary phthalate metabolite concentrations to better understand and estimate the extent of exposure. Continued sampling of Sarasota Bay dolphins will help establish

baseline metabolite concentrations, to which we can compare the exposure of other dolphin stocks. Given the association between phthalates and the endocrine system, we ultimately hope that these methods will enable the identification of contaminated individuals and stocks that may be at risk of endocrine disruption and reproductive impairment.

Funding for this research and travel was provided by the College of Charleston's Faculty Research & Development Grant, the School of Education, Health, and Human Performance Research and Development Grant, the Department of Health and Human Performance Research and Development Grant, and the Department of Geology & Environmental Geosciences.



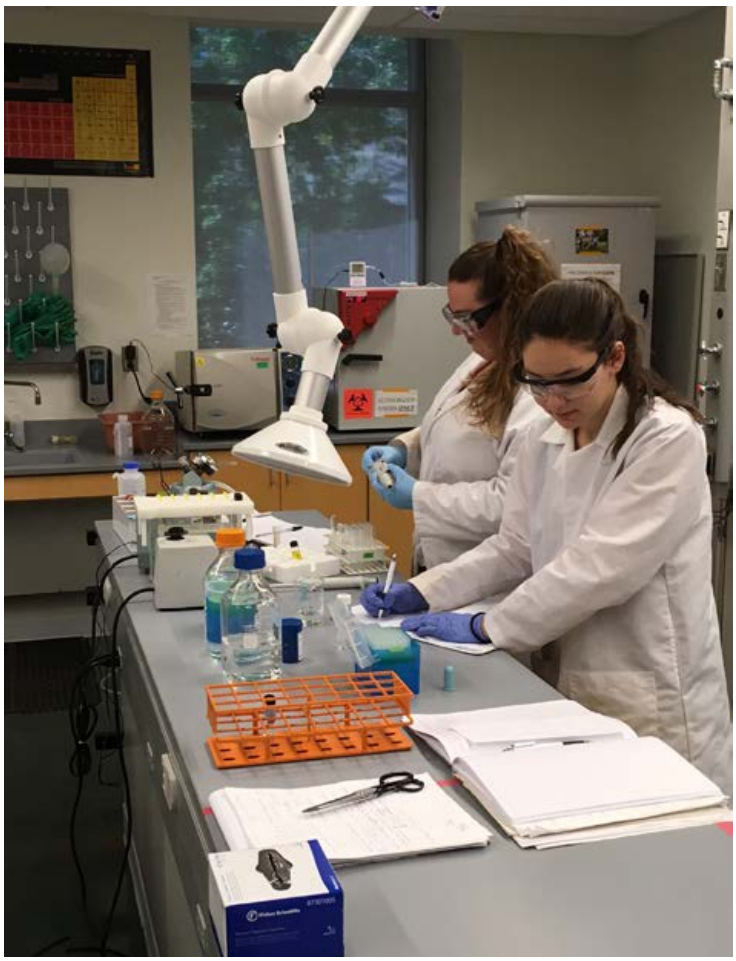
Urine has proved to be a successful test medium for the detection of phthalates, chemicals associated with plastic and cosmetic production. Here, Dr. Leslie Hart processes urine from a wild dolphin for testing during the Sarasota Bay dolphin health assessment project.

A new epigenetic tool to estimate the age of free-ranging bottlenose dolphins

Andria Beal, Jeremy Kiszka and Jose Eirin-Lope, Florida International University

Determining the age of free-ranging animals is critical to understand the demographic parameters within a given population, constituting a crucial piece of information for conservation and management purposes. Given the influence of age in development and health, this parameter constitutes a critical determinant of the ability of marine organisms to respond to environmental stress. Yet, the influence of age on behavior, ecology and environmental responses remains largely unknown in most cetaceans outside of well-known populations such as the dolphins of Sarasota Bay, due to scientists' inability to determine age in most free-living specimens.

Our research leverages our lab's experience in epigenetics and community ecology of marine mammals to develop a tool for efficiently and accurately estimating the age of free-ranging bottlenose dolphins and other small cetaceans by using small tissue biopsies. For that purpose, we target the analysis of a specific type of epigenetic mark (DNA methylation) at promoters of genes previously linked to aging in mammalian model organisms (humans and mice), as well as in humpback whales. The rationale of this approach is based on the well-known accumulation of DNA methylation changes at promoters of specific genes as organisms age. Therefore, by characterizing levels of DNA methylation at these genes in different control individuals of known age, we will be able to "calibrate" the aging method, facilitating age inference from experimental samples of unknown age. The present assay will be developed using archived bottlenose dolphin specimens from dolphins of known ages from Sarasota Bay for reference. Samples will be analyzed to generate a linear model using skin and blood samples, setting the basis for using this tool in other closely related species. In addition, given the non-invasive nature of the assay, the age of dolphin specimens could be easily incorporated into methods and datasets for all types of studies. Overall, the availability of this assay will greatly improve population assessment efforts.



Tissue samples from a biopsy are being processed by Andria Beal in order to determine levels of DNA methylation. Using this biomarker, researchers are developing a new tool for age determination that can more easily be applied to the study of wild cetacean population demographics.

Ecology, Population Structure and Dynamics

Sarasota Bay dolphin community status

Jason Allen, Chicago Zoological Society

We keep track of the dolphins of Sarasota Bay through photographic identification (photo-ID) surveys conducted on 10 boat-days each month. One of the primary goals of our monitoring is to track additions, losses, and condition of the resident Sarasota Bay dolphin community members. There were plenty of additions to track during the 2017 calving season, which marked the most births recorded in Sarasota Bay ever! Twenty dolphins have been observed with new offspring, including two moms who have benefited from rescue efforts (Nellie and Ginger), four first-time moms, and several seasoned pros like Murphy Brown who, as far as we know, is still living life as a single mother. Of these, 16 are still alive as of this writing, and all of the 2016 live-born calves are still alive. Three older males have died or disappeared over the past year or so: 35-yr-old Petey (FB10), 21-yr-old Jocko Bazinski (F148), and 7-yr-old F280.

The other major event that occurred in this area was Hurricane Irma, which passed to the east of Sarasota Bay on September 10th. In addition to concern for our staffs' well-being (we are doing great, thank you!), many have asked, "what do dolphins do during a hurricane?" While we obviously cannot observe them during the storm, we can infer quite a bit by comparing what we see directly after the storm to our long-term data sets. Thankfully, there was no damage to SDRP boats, trucks, or other equipment and we were able to get out on the water quickly after the storm, during September 13-15. We found the same numbers of individual resident dolphins that we would expect for this time of year, including the oldest and youngest.

Interestingly, we noticed that at first the resident dolphins were in larger groups and using the passes and nearshore Gulf of Mexico waters more, just as they normally would in the winter months. This could be a result of the significant reverse storm surge (or pushing of water out of the bay) by the hurricane, which happens to a lesser extent during the winter when we typically see larger group sizes and increased use of deeper waters. By the 15th they had returned to their typical summer pattern with smaller group sizes and distribution throughout the shallow waters of Sarasota and associated bays.

Our long-term, monthly photo-ID surveys are the core effort of our program, supporting all other projects. More than 49,200 dolphin group sightings since 1970 have yielded more than 147,700 identifications of more than 5,500 individually distinctive dolphins from the central west coast of Florida. In support of these identifications, more than 718,000 dolphin photographs are currently archived by the SDRP. 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 2,531 follows on 198 individual dolphins from 24 projects during 1989-2017. 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 Barancik Foundation and the Batchelor Foundation, as well as the continued dedication of our core local volunteers and undergraduate interns. Thanks to these efforts, this community remains one of the most thoroughly studied free-ranging dolphin populations in the world.

Top: Juveniles leap while they socialize.
Middle: Murphy Brown's seventh calf surfaces next to her.
Bottom: Nellie's first calf, the youngest dolphin in Sarasota Bay, pops its head up next to Nicklo, the oldest known bottlenose dolphin in the world, alive and well four days after Hurricane Irma.

Gulf of Mexico dolphin identification system (GoMDIS) as a tool for conservation

Carolyn Cush and Shauna McBride, Chicago Zoological Society

In the wake of several powerful hurricanes that have rocked the states and countries bordering the Gulf of Mexico in recent months, from a data management perspective it becomes clearer that having a central repository of data from around the Gulf of Mexico is a valuable step in the preservation of data for conservation purposes. The Gulf of Mexico Dolphin Identification System (GoMDIS) provides a unique venue to house bottlenose dolphin identification catalogs and associated data from our collaborators Gulf-wide, including Cuba and Mexico. By joining catalogs together into a single repository, we can gain better understanding of dolphin movements in the Gulf and have a standardized and centralized location for data. These data are stored both offline on our secure server at SDRP, and also on the OBIS-SEAMAP system which is accessible to our collaborators via an online portal (http://seamap.env.duke.edu/), facilitating data-sharing and providing our colleagues with a secure, fin-matching interface. In addition, we implemented a new arrangement in working with stranding partners around the Gulf to facilitate more real-time catalog searches in efforts to identify where stranded animals are coming from, based on photo-ID data.

The collaboration continues to grow steadily as contributors submit new catalogs and updates to catalogs. We added 8 projects, 1,731 animals, more than 3,000 images and 272 matches between projects, bringing the total number of animals to 15,723, the number of images in the repository to 27,219 and the number of matches between projects to 432. We have more than doubled the number of individual matches between projects over the past year! These numbers will continue to grow as contributors submit and update their catalogs. With their continued support, we will all gain a better understanding of dolphin ranging patterns in the Gulf which provides useful information for population management and conservation.

We have had many interesting matches to date. One of our most recent matches has been following the submission of University of Central Florida graduate student Christina Toms' Pensacola Bay catalog in the northern Gulf of Mexico. One animal has been sighted by four different projects, with the furthest two sightings more than 100 miles apart. This animal was originally seen in 2005 on the coast near St. Andrew Sound (Panama City, FL area), then in Pensacola in 2013 and back to St. Andrew Bay in 2016. Further investigation on the part of our contributors will have to occur to determine if these large scale movements are unique to certain animals or potentially indicative of some other type of natural or anthropogenic impetus.

GoMDIS map interface on OBIS-SEAMAP website using the map application to depict the partial sighting history of one animal's long-range movements in the northern Gulf of Mexico.

Another interesting match comes from the southwest Florida region. A stranded, deceased animal this year was recovered by Florida Fish and Wildlife Conservation Commission's stranding response team near Pine Island, FL. After an immediate search of the nearby catalogs, it was determined this animal not only matched an animal from the SDRP catalog but from an archival catalog collected from this area in the 1980's, giving this animal a sighting range between 1986-2004 and a minimum age of 31. Thanks to the recovery of this animal, we will know the cause of death and the specifications of this animal. Being able to link these types of data with photo-ID effort is and will continue to be an invaluable asset to better assess individual life histories and determine ranging patterns. Support for GoMDIS efforts with Florida dolphins was provided by FAU-Harbor Branch Oceanographic Institution Protect Wild Dolphins Specialty License Plate Fund.

Advances in automated dorsal fin matching - experimental evaluation of a new algorithm

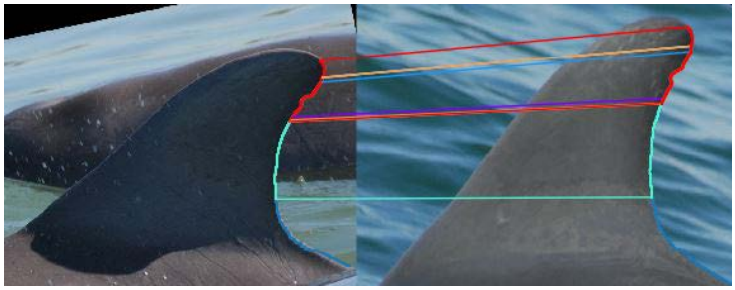
Reny Tyson Moore and Jason Allen, Chicago Zoological Society

Every year cetacean laboratories, such as the SDRP, spend hundreds of hours matching photographs of distinctive individuals taken in the field to catalogs of known individuals. This process can be even more time-consuming for large catalogs and/or infrequently surveyed populations. The development of an automated fin detection program for this purpose would be a game-changer in the field of photographic-identification methods for cetaceans, freeing up thousands of hours for researchers to spend on other important research and conservation tasks. While automatic detection algorithms for identifying animals such as zebras, whale sharks, manta-rays, and even humpback whales from photographs have been developed, many of the algorithms developed for use with cetacean dorsal fins have been limited by the lack of available features on an animal's dorsal fin such as patterns or colorations, and have had to rely solely on the nicks, notches, and scars of a trailing fin edge, the size and angles of which often vary depending on the fin angle, fin side (left or right) and/or fin distance from frame in an image.

Thanks to donations from friends of SDRP during last year's Sarasota Community Foundation 'Giving Challenge' and support from collaborating institutions such as Duke

University, Wild Me (www.Wildme.org), Cascadia Research Collective, and Massey University, this year, our lab helped to support a PhD student at the Rensselaer Polytechnic Institute who has developed and refined an algorithm for dorsal fin detection that can account for variations in fin angle, side, and distance from frame. The algorithm finds the fin in the image, and uses an integral curvature measure to represent the identifying pattern of nicks and notches along the trailing edge of the dorsal fin. This representation is then compared to a catalog of known individuals to generate a ranking based on dorsal fin similarity.

A total of 10,713 pre-identified, labeled, and cropped good-to-excellent-focused photographs of average and highly distinctive individuals from 5,520 group sightings of known resident dolphins in Sarasota Bay were used to test and refine the algorithm. The automated trailing edge extraction algorithm successfully found a usable trailing edge for 10,647 of the dorsal fin images (99.4%); failure to find a trailing edge was attributed to an extreme oblique angle or the presence of waves, boats, or other dolphins in the image. After ranking, the correct identification was in the top ten of the list 97% of the time, and was the first match 94% of the time! In the upcoming year we hope to include adding the dorsal fin leading edge, testing the algorithm with larger data sets, adding automated cropping, and developing an open-source user interface within Wildbook® that can be integrated into any workflow. This algorithm will substantially reduce the amount of time researchers like us spend matching unknown individuals, and will thus be an important tool for cetacean researchers worldwide interested in dorsal fin photo-ID.



Segments of a test fin (left) are compared to a catalog image (right). The notch at the top of the fin is the most distinctive feature and provided the strongest match.

Florida's river dolphins

Aaron Barleycorn and Katie McHugh, Chicago Zoological Society

With a large natural freshwater influx in Pensacola Bay, Forida, a planned freshwater diversion into Barataria Bay, Louisiana, and flood waters from the extreme rains of Hurricane Harvey in Texas, there has been increased interest in how bottlenose dolphins use freshwater systems. We have known for years that dolphins use the usually brackish waters near the mouth of the Manatee and Braden Rivers in our Sarasota study area, but we do not have a good understanding of the extent of their presence in this habitat. The SDRP decided to explore the Manatee/Braden river systems more thoroughly during our rainy season as part of a pilot study to better understand dolphins in fresh water.

During the month of August (in the middle of our rainy season) we conducted four surveys as far up the rivers as we could go. We had a total of seven sightings of five individuals. All five dolphins were seen more than once, suggesting possible residency in the area. Salinities ranged from 0.1-7.8 ppt; sea water is ~36 ppt. In fact, four of the dolphins were an adult female and 3 of her offspring. Most of their previous sightings have been near the rivers as well, and none of the dolphins showed any outward signs of poor health.

This pilot study was a beginning toward understanding the frequency with which dolphins in the Sarasota area use freshwater habitats. We know that dolphins that get stuck in freshwater lakes can develop skin lesions that can eventually kill them. How are these dolphins avoiding potentially debilitating skin conditions? Are they venturing back and forth between fresh and salt water to slough dead skin cells? How does dolphin occurrence relate to a gradient of salinities? Do they have any physiological differences that make them more suited to spending extended periods of time in fresh water? Hopefully, with further effort, we can address these questions.

Bottlenose dolphins in southwest Florida: ecology and conservation

Reny Tyson Moore, Chicago Zoological Society

The federal Marine Mammal Protection Act requires that population stocks of marine mammals be assessed regularly (at least every 8 years) and that estimates of cetacean abundance be reported in the U.S. Marine Mammal Stock Assessment Reports prepared by NOAA. The coastal and inshore waters near Naples and Marco Island, Florida are home to a stock of bottlenose dolphins for which estimates of abundance are lacking. In addition, we have engaged in three rescues of entangled dolphins in this region in recent years. Therefore, the SDRP is initiating a photographic-identification (photo-ID) capture-mark-recapture (CMR) project in this region to estimate bottlenose dolphin abundance and to build a catalog of identifiable individuals, which will be included in our Gulf-wide catalog, GoMDIS. Such work is important as it will establish a baseline for assessing how increases in human population and activities in southwest Florida may be impacting dolphins in this region. In addition, this area represents the ecological interface between the highly developed and populated Naples/Marco Island area and the sparsely populated adjacent Everglades, and therefore is of great interest to better understand how dolphins select habitat.

In January, 2017, SDRP staff in partnership with the Rookery Bay National Estuarine Research Reserve conducted pilot surveys in the proposed survey area to determine possible transect routes for these surveys

Photograph taken on 26 Jan 2017 of the dolphin Skipper, who was entangled and rescued by the SDRP near Marco Island in 2014.

and to begin collecting photographs of individuals in the region. During this time we photographically identified 37 dolphins, including Skipper, a young female dolphin that we disentangled in this region in September 2014. Unfortunately, we were unable to initiate any additional surveys in 2017 due to unforeseen extreme weather events in Florida (thanks, Hurricane Irma!), but we hope to resume the project in the spring of 2018. We are very grateful to the staff of the Rookery Bay National Estuarine Research Reserve's Shell Island Field Station for their help in the initial stages of this project and look forward to continuing this partnering as the project progresses. Our hope is that this work will form the basis of a long-term dolphin monitoring and outreach program that will aid in the successful conservation of dolphins in southwest Florida. This work will continue thanks to a grant from the Batchelor Foundation.

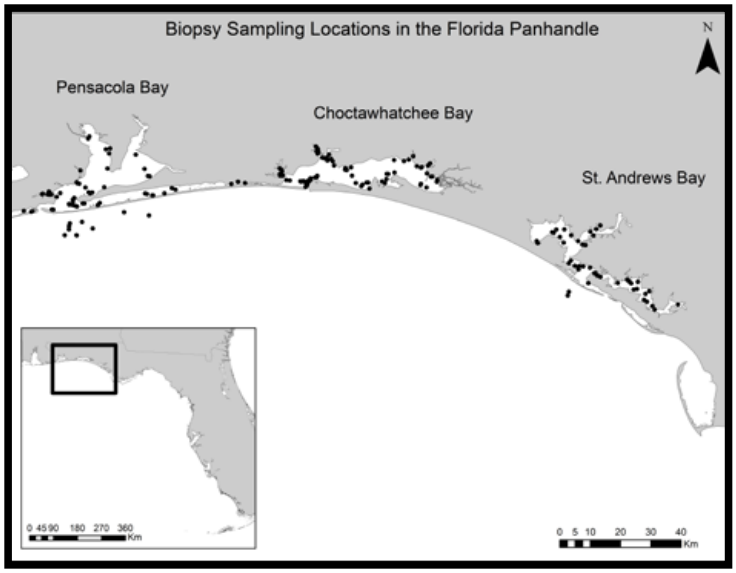
Pensacola Bay bottlenose dolphins

Christina Toms, University of Central Florida

The purpose of my PhD research is to (1) provide the first comprehensive assessment of population dynamics for bottlenose dolphins in the Pensacola Bay system and (2) to determine the degree of connectivity between populations in the Western Florida Panhandle. My field work is now complete and I have spent much of the past year processing genetic samples for one of my projects and working on preliminary data analyses.

Understanding population connectivity across habitats is critical for population management and conservation in the face of human-induced pressures and global climate change. For common bottlenose dolphins, 31 population management units, called stocks, have been delimited for bays, sounds and estuaries (BSEs) in the northern Gulf of Mexico. However, these units have often been assigned based on assumptions and geographic location, without the necessary biological data to better inform decisions. One of my dissertation projects is to evaluate, for the first time, population structure and genetic diversity of bottlenose dolphins in the BSEs found in the Florida Panhandle, which will provide valuable insight to demographic history and connectivity of animals across this area.

We finished remote biopsy sampling for this project in September 2016. These samples were combined with those previously collected and archived at NOAA Fisheries SEFSC to give us a total of 168 samples across Pensacola (*n* =42), Choctawhatchee (*n* =81) and St. Andrews (*n* = 45) Bays (see map). Sample processing was completed in collaboration with Toby Daly-Engel at the University of West Florida last fall and in collaboration with Patricia Rosel at NOAA Fisheries SEFSC, this past spring. Preliminary results show significant genetic differentiation across all three systems. This research has been supported by NOAA Fisheries SEFSC, the UCF Physiological Ecology and Bioenergetics Lab, the University of West Florida (UWF) Center for Environmental Diagnostics and Bioremediation, and the UWF Office for Undergraduate Research Scholarships.



Map of study area showing 168 biopsy sapmle locations in the Florida Panhandle. Preliminary results suggest these may be genetically distinct populations, aiding in evaluating stock structure.

Evaluating the impacts of Hurricane Harvey on the dolphins of Galveston Bay, Texas

Kristi Fazioli, Environmental Institute of Houston-UHCL, and Vanessa Mintzer, Galveston Bay Foundation

When Hurricane Harvey arrived in Texas in August 2017, it became the wettest hurricane ever recorded to have made landfall in the continental United States, as rain accumulation peaked at nearly 52 inches. Because the brunt of the rainfall took place on the Texas coast, Galveston Bay received an unprecedented volume of fresh water. This fresh water has not only changed the salinity of the Bay, but has likely contaminated the Bay with waterborne pathogens and toxic chemicals (including dioxins from a compromised Superfund

site and re-suspended channel sediments from legacy contamination in the bay). Consequently, the most pressing issues surrounding the dolphin's health and ecology is their ability to tolerate low salinity, exposure to contaminants in the water, and changes in prey availability.

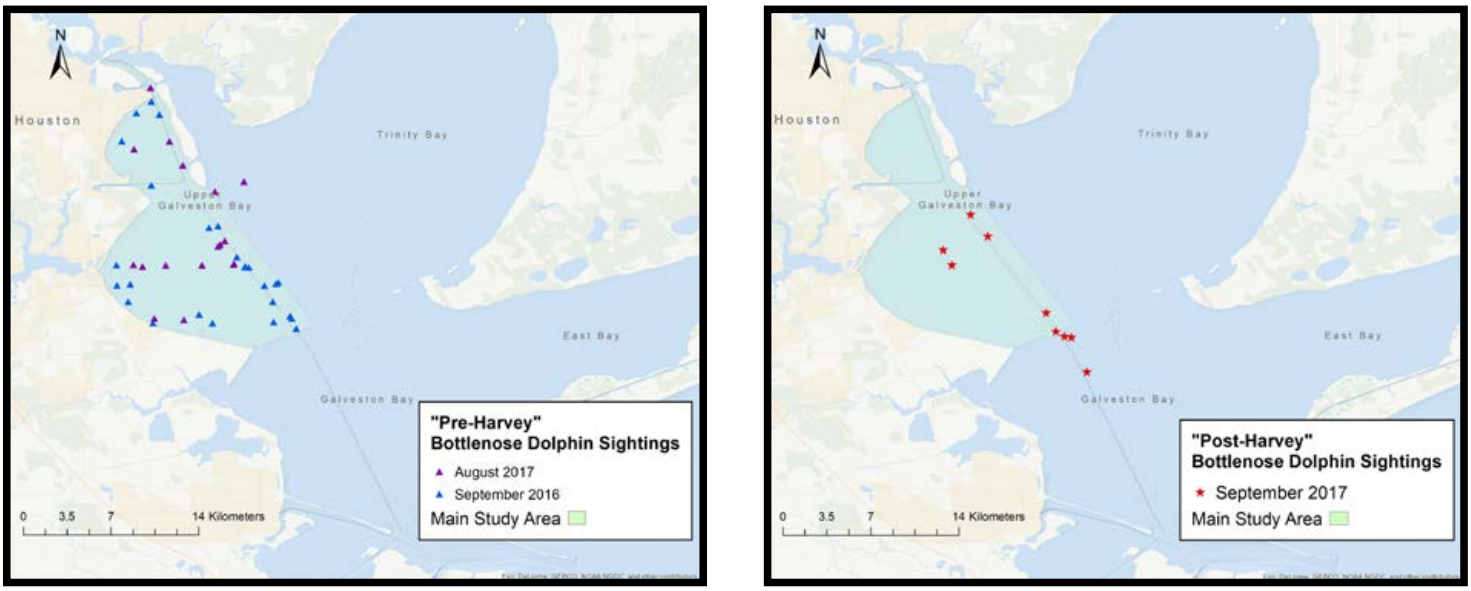
The Galveston Bay Dolphin Research and Conservation Program (GDRCP) is in a unique position to evaluate the effects of Hurricane Harvey on Galveston Bay bottlenose dolphins. The GDRCP has been monitoring the upper Galveston Bay dolphin population since 2013, allowing for multiple year comparisons of pre- and post-Harvey data. With over 550 cataloged dolphins, the GDRCP has the opportunity to evaluate Harvey's effects on both the population as a whole, and on its individuals. Additionally, the GDRCP has collected remote biopsy tissue samples from 2015-2017 in coordination with the SDRP, including samples collected during the week just prior to Harvey's arrival. These samples will prove valuable in comparisons of toxic exposure pre and post Harvey.

On September 5 (roughly 9 days after the rain from Harvey ceased), the GDRCP was able to conduct its first boat survey in Galveston Bay. The research crew found few dolphins in upper Bay, and traveled south in search for more. The absence of dolphins in most of the upper Bay region was in stark contrast to observations from previous years during the same time frame and to the weeks preceding Harvey, when dolphins were seen in high numbers throughout the study area (see maps below). The crew recorded salinity levels as low as 0.27 ppt in the upper Bay, so it is likely that dolphins traveled south and into the deep waters of the Houston Ship Channel (HSC) to seek saltier water. When the crew found dolphins in the channel near the middle of Galveston Bay, they were not engaged in commonly observed activities, like feeding, socializing and bow-riding, but were instead traveling slowly south. Additionally, many individuals were observed with skin lesions covering part or much of their body and a few were showing indications of poor body condition. The following week, the GDRCP surveyed the Bay again, finding a slight rise in salinity levels to 3-5ppt in the Bay and most dolphins still located in or near the HSC. Overall, the dolphins did not appear as lethargic and were engaged in more "normal" behaviors. However, the skin lesions were widespread and there were still signs of malnutrition and/or poor health.

The GDRCP will continue to monitor the dolphins of Galveston Bay to track if, when, and which dolphins return to upper Galveston Bay, the presence of calves, short and long-term changes in distribution, and the development of skin lesions and possibly other health conditions. With the predicted increase in the frequency of intense storms due to climate change, knowledge gained from this event is vital for the establishment of sound conservation plans for Galveston Bay dolphins, and could inform management of coastal populations of dolphins elsewhere.

The GDRCP is a collaboration between the Galveston Bay Foundation and the Environmental Institute of Houston at the University of Houston at Clear Lake. We appreciate support from The SeaWorld Busch Gardens Conservation Fund, The Trull Foundation, Restore America's Estuaries, The Houston Zoo, and private donors. The SDRP has been particularly helpful in the collection of crucial biopsy samples the past several years.

Bottlenose dolphin bearing skin lesions in Galveston Bay, TX exposed to freshwater runoff after Hurricane Harvey, September 5th, 2017.



Pre-Harvey (September 2016 and August 2017) and post-Harvey (September 2017) sightings of bottlenose dolphins in Galveston Bay.

The dolphins of Bermuda

Robyn Trainor, Dolphin Quest and Jason Allen, Chicago Zoological Society

The Bermuda Cetacean Sightings (BCS) project was established in 2015 to collect location, population and photographic-identification data for dolphins and other marine mammals to better understand and protect those animals living in Bermuda's waters. This is part of a broader effort supported by Dolphin Quest, the Bermuda Wild Dolphin Project (BWDP), which includes our ongoing dolphin health assessment project initiated in 2003 and continued in 2005 and 2016. During the 2015 and 2016 BWDP, a focus was placed on photographing the dolphins of Bermuda for identification purposes, and with the expertise, mentoring and long-standing dolphin photo-ID knowledge of the SDRP, the Bermuda dolphin catalog was established. The catalog includes data archived since 2003, as well as more recent data provided by a local researcher and a volunteer.

The dolphins of Bermuda have been sighted most months of the year, are typically seen in 2,000 to 3,000 feet of water, and are seen in groups as small as three and as large as 100. The photo-ID catalog includes 100 individuals. Forty-four unique individuals have been seen more than once, with 12 seen across multiple years since 2003. One dolphin was seen across a period of almost 12 years. Dolphin calves have been observed in multiple groups and dolphins have been regularly seen with intriguing skin markings, scarring and lesions. The scarring around the head are a probable association with squid and the lesions around the dorsal fin are likely from the attachment of remoras. The more we learn and understand about these dolphins, the better we can protect and conserve all marine life around Bermuda, including mitigating the pollution and entanglement issues these animals face.

Dolphin Tt0088 surfaces off Challenger Bank with a large remora on October 3, 2016. Many of the dolphins around Bermuda are seen with evidence of these parasites.

Continued photo-ID partnerships with Bermuda residents will enhance the Bermuda dolphin photo-ID catalog. Additionally, as beaked whales (of several species) have been seen frequently during dolphin assessments, a Bermuda beaked whale photo-ID catalog will be created along with other odontocetes photographed. Little is known about the beaked whales seen around Bermuda. Beaked whale photo-ID and sightings data would be valuable for learning more about the population in waters around Bermuda, and how they relate to beaked whales elsewhere.

Healthy dolphin prey populations in Sarasota Bay: Prey monitoring update

Elizabeth Berens McCabe and Sunnie Brenneman, Chicago Zoological Society

The SDRP continues to explore the relationship between wild dolphins and availability of their prey by conducting seasonal surveys to monitor fish abundance, distribution, and body condition in Sarasota Bay, Florida. Data from this project enable us to investigate fine-scale habitat and prey selection by local dolphins, and to explore the effects of red tides on different fish species and community structure. This project has facilitated a variety of novel research projects, including modeling work involving the consequences of disturbance on a dolphin population. Planned collaborations include the development and testing of a new low cost, portable electronic system for remotely monitoring cetacean bycatch and human-cetacean interactions in fisheries.

Our standardized multi-species fish survey consists of a winter and summer fishing season (10 sets per month; Jan-Mar; Jun-Sep), during which we catch, measure, count and release fish from the *R/V Flip* using a 183 m purse seine in seagrass habitats. This year our data indicate a large spike in fish abundance in Sarasota Bay! This winter we caught a total of 9,388 fish of 50 different species. This summer yielded 64,249 individuals of 65 different species, 13,639 more fish that we have ever caught in a single season! Taking into consideration the influence of small schooling fishes on the mean number of fish caught per seine set (CPUE, or catch-per-unit-effort), winter CPUE was 233 per set and summer CPUE was 856 fish per set, our highest winter and summer CPUEs since this study began in 2004! Pinfish, Atlantic threadfin herring, scaled sardine, mojarra, pigfish, and planehead filefish ranked highest in abundance, respectively, by species. The top three most abundant species totaled 51,338 individuals alone! Other notable abundances this summer include gag grouper, which ranked 17th highest, contrasting with past years in which their abundances were negligible. Mullet abundance remained high this summer, ranking 11th.

After severe red tides in 2003, 2005 and 2006 and subsequent spikes in summer fish abundance, CPUE remained fairly steady from 2009-2014. In 2015, summer fish abundance jumped to our third highest overall CPUE,

remained high in 2016, and spiked again this year. In contrast to summer fish abundances, winter fish abundance has varied little since our survey began in 2004 (range = 81-233), despite having sampled through four distinct winter red tide periods. Assessing trends in species-specific abundances and body condition in relation to year, red tide, and habitat has been problematic due to the large variability and non-normality of these data. We are working with Bill Pine and graduate students at the University of Florida to try to model these data. Funding for this project over the past year was provided by the Barancik Foundation and the Batchelor Foundation.

Pinfish are one of the most abundant dolphin prey species in Sarasota Bay. Here, a resident dolphin grabs a snack.

Acoustically tracking bull sharks near Sarasota Bay

Krystan Wilkinson, Chicago Zoological Society

In April 2017, five bull sharks (four females and one male, 172-200 cm long) were tagged with passive acoustic tags along Florida's Gulf coast, near Sarasota Bay. Acoustic receiver gates, located in passes connecting Sarasota Bay to the Gulf of Mexico, monitor if and when these sharks enter or exit the bay (See article "Wiring Sarasota Bay for sound" for more information on the acoustic receiver network). One of the five sharks, nicknamed Miss Lillie, was additionally fitted with a satellite-linked tag and has traveled extensively along the Florida Gulf coast. She spent most of May near Fort Myers, and then in June, she went north to the Big Bend area. We last heard from Miss Lillie on July 13th, a few kilometers offshore of Cedar Key, Florida. You can follow Miss Lillie and other tagged sharks on OCEARCH's webpage at www.ocearch.org/profile/miss_lillie, or you can download the free OCEARCH app to your iPhone or Android device.

Unfortunately, none of these sharks have been detected in the Sarasota Bay receiver array, nor have they been detected in the regional iTag network, a collaboration involving multiple organizations to share tag detections on passive acoustic receiver arrays. However, the last update by the iTag network was in July, so it may be possible these sharks were detected

This female bull shark was acoustically tagged to track her movements in-and-out of Sarasota Bay and along the Florida coast in April 2017.

in the regional array this summer, but these locations have not yet been added to the iTag network database. Collected bull shark movement data will be integrated with information on habitat use of the resident Sarasota Bay bottlenose dolphin community to better understand habitat-associated predation risk and its impact to the dolphin community.

This project is made possible by an anonymous donation to the Chicago Zoological Society and by the University of Florida. I would like to thank Jack Morris, Mote Marine Laboratory, and Dr. Jayne Gardner, New College of Florida, for assisting with tagging logistics. I would also like to thank the Guy Harvey Ocean Foundation for providing funding for the acoustic tags, and Dr. Jorge Brenner, The Nature Conservancy, for providing the SPOT tag.

Sarasota Bay resident dolphin F149 was seen in June 2017 with a new calf (1497) and with fresh shark bites. Sighting information from before and after she sustained this bite will be used to help determine if dolphins shift their habitat use following a shark encounter.

Dolphin Rescues, Releases, and Follow-up Monitoring

False killer whale mass stranding in the Everglades

Aaron Barleycorn, Chicago Zoological Society

On January 14th, we received word that a mass stranding of 70+ false killer whales (*Pseudorca crassidens*) occured south of Marco Island, Florida. Officials decided to push back some of the healthier animals, outfitting one with a satellite-linked tag in order to keep track of the group. We provided a time-depth-recording tag that FWC applied to a small beached calf. They walked it into deeper water, where it joined a group of five free-swimming *Pseudorcas* just before sunset. The tag transmitted until about 10:00 pm and showed that the tagged animal did not go far from the stranding site. I joined the response group the next day to potentially tag more animals.

We took a boat to Hog Key, just north of Lostmans River in Everglades National Park. When we arrived, three FWC personnel and the Mote Stranding Investigations Program intern were on scene. Of the 48 animals counted, 14 were still alive. The tide was very low and most of the animals were high and dry. Several acres of mudflat were exposed during low tide, strewn with *Pseudorcas* up into the mangroves. The tagged calf was alive, but had restranded overnight along with most of the other animals. All of the animals we had seen were either dead or in very poor condition, so the focus shifted to euthanasia and investigation. I joined a team helping to collect samples and count individuals. We were able to mark and sample many, but after several hours the tide started coming in and sharks were seen feeding on some of the now-floating carcasses. We continued to mark and sample animals by boat.

As more personnel arrived, 14 free-swimming animals in poor condition were seen a bit farther south, and another 33 were found across the bay from the original 48, for a total of 95 animals. Seventy-four skin/blubber samples and ~10 blood samples were collected from live animals. Five necropsies were done on recently deceased animals. NOAA staff indicated later that the data collected would contribute greatly to our understanding of *Pseudorcas* in the Gulf of Mexico, but the lack of histology and complete necropsies would make it very difficult to determine the cause of the stranding. Hopefully the information collected will help us to better understand this seldom-seen deepwater species, and with that understanding we can more effectively help in future mass stranding situations.

False killer whales stranded on the wide tidal flats of the Everglades.

Frasers dolphin mass stranding

Jason Allen, Chicago Zoological Society

On July 29th, SDRP staff assisted Mote Marine Laboratory's Stranding Investigations Program with a mass stranding of more than 20 Frasers dolphins (*Lagenodelphis hosei*) on south Siesta Key near Turtle Beach, FL. These dolphins are smaller and darker than bottlenose, and typically live their entire lives offshore in deep water. Many from the group stranded on the beach and were pushed back out to sea by beachgoers. One remained on the beach despite an attempt to release it towards the others. After veterinary examination and consultation with the National Marine Fisheries Service, it was determined that the odds of survival were extremely low and the dolphin was humanely euthanized by Mote staff.

Staff from Chicago Zoological Society and Mote Marine Laboratory attempting to release a stranded Frasers dolphin.

Tracking rescued and rehabilitated pilot whale "Gale"

Randall Wells, Chicago Zoological Society

On July 1st, a dispersed group of short-finned pilot whales stranded in the Big Bend region of the Gulf coast of Florida. One individual, a young female named Gale, was recovered alive and rehabilitated at SeaWorld-Orlando. As part of our NOAA Prescott grant, we attached a satellite-linked time-depth-recording tag to Gale's dorsal fin when she arrived in St. Petersburg prior to being lifted onto a Coast Guard cutter for release. She was released offshore of Tampa Bay, on the shelf edge, on August 8th. Tracks show she went to Cuba, and up to waters off the coast of North Carolina where pilot whales are frequently observed by the Duke University research team. Over 32 days of tracking, she made dives to >700 m, staying down for as long as ~16 min. Her behavior off North Carolina was comparable to that observed by the Duke University team for other pilot whales in the area.

2017 Rescues/disentanglements and updates on past rescues

Aaron Barleycorn, Chicago Zoological Society

Brunswick, GA

In early July 2017 a dolphin with line wrapped around its head and cutting into its fin was reported by Georgia DNR in the area of the Hampton River, north of Brunswick. Veterinarians deemed the entanglement as life-threatening, so NOAA assembled a rescue team.

On July 13th, participants from Georgia DNR, NOAA, Hubbs/Sea World, Harbor Branch, Georgia Aquarium, National Marine Mammal Foundation, Georgia Sea Turtle Center, and Chicago Zoological Society met at the Georgia DNR Brunswick field station to help with the rescue. The dolphin was found feeding with a group of 5-9 animals. The tidal current is very strong in the area, and it was still hours until slack tide. The target dolphin was consistently with another adult sized animal, possibly his male ally. The two dolphins would occasionally swim along shore, but mostly stayed in waters deeper than 30 feet. Even close to shore there was only a tiny 6-15 ft deep shelf before it quickly dropped off. After following the group for a few hours, they began to spread out. The current slowed dramatically as high tide approached. Finally the entangled dolphin and one other swam into 10-15 feet of water close to the edge. The dolphin was caught, placed on a floating mat, and unwrapped from the net. The entanglement, a loop of packaging twine, was easily removed and began falling off the dolphin even as it was extracted from the net. The loop of twine was secured to the dolphin only by his own forward momentum, but as we have seen in the past, entanglements like this do not often resolve themselves and can lead to serious damage. The veterinarians on site determined the dolphin was in good condition, so I applied a satellite-linked tag. Although in good body condition, he appeared to be an old dolphin: his flukes were bowed, his dorsal fin was heavily scarred, and his teeth were worn down to the gum. He was released after about a 50 minute workup, and was seen swimming back to the middle of the river.

A team representing several different agencies worked together to disentangle a dolphin from packing twine in Brunswick, Georgia.

The dolphin was tracked by the National Marine Mammal Foundation for 63 days before the tag failed. It remained in the brackish river system where it was initially sighted. Locals were able to obtain photos of it after its rescue, and it appeared to be in good shape. Thanks to this collaborative effort, this dolphin will be swimming a little easier.

Barataria Bay, Louisiana

In September 2017, CZS personnel joined a National Marine Mammal Foundation team in Barataria Bay, Louisiana for another round of post-oil-spill health assessments. During the project, we spotted a dolphin with a large open wound around its head. We were able to temporarily catch the dolphin and found that a piece of monofilament line had looped around its head and was slowly cutting a gouge deeper and deeper around its entire head. It is likely that left alone, the line would have eventually killed the dolphin. Veterinarians on hand were able to remove the line and treat the wound. The dolphin was released on site. Photos from previous projects in the area showed that the dolphin had been dealing with this entanglement for at least 7 years!

Updates

Previous rescues: Scrappy, Ginger, Nellie, Lizzie, Skipper, F286, and Bill were all seen in 2017. Both Ginger and Nellie have new babies this year! Unfortunately, Vidalia, who was rescued near St. Petersburg, FL in 2011, passed away in May. His death did not appear to be related to his previous entanglement. Follow-up data from these and other previous rescue cases are being analyzed with several collaborators to evaluate the long-term success of interventions in our region and the potential conservation benefits of pre-stranding interventions to local dolphin communities.

Dolphin in Barataria Bay, Louisiana found with a deeply embeded entanglement encircling its head. Historical photos suggest this animal had been dealing with this impediment for over 7 years. The odds of long-term survival in the absence of intervention for an entanglement this severe are low.

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, Disney Worldwide Conservation Fund, 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. The cards are available in English and Spanish as downloads through the SDRP website at: sarasotadolphin.org/sources-of-information/videos

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 brief (2-8 min) educational videos we have produced about dolphin conservation and biology, are available through the SDRP website, at sarasotadolphin.org/sources-of-information/videos and are also packaged in an interactive video kiosk format for display.

SDRP intern Grace Dodillet and Staff Scientist Reny Tyson Moore bring conservation and fun to Snooty's Birthday Bash, July 2017. Our new poster created with support from the Disney Conservation Fund is also on display.

Elementary students

Katie McHugh and Reny Tyson Moore, Chicago Zoological Society

In recent years, we have expanded our educational offerings to include local youth by collaborating with teachers and students to provide conservation-focused elementary school lessons online and within public school curricula, creating an inspirational dolphin conservation poster for local elementary science labs, hosting kid-friendly activities at festivals to connect dolphins and their habitats, and sponsoring an elementary science showcase award, giving 4th and 5th graders the chance to learn about what we do as conservation scientists.

Building from our existing entanglement lesson created by Sarasota County Schools science instructor Chip Phillips, this year we initiated more direct local science teacher engagement by publicizing the conservation-oriented lesson available online in the Elementary Instructional Focus Guides for Sarasota County and on our website and providing additional content and experiences as a springboard for future collaborations to create lessons and classroom activities. This has included inviting Sarasota County elementary science lab teachers to participate in dolphin surveys in Sarasota Bay to learn more about how we do our research and what we've learned about dolphins and sending copies of our new "*Dolphins Need You*" poster to all Sarasota and Manatee County elementary science classrooms. This poster highlights key conservation themes and how students can make a positive difference in the lives of dolphins and other wildlife.

In 2017, we also began participating in the Manatee County Science Showcase, presenting a special award at the 4th and 5th grade levels, which included student visits to Mote Aquarium with a chance to come 'backstage' to meet SDRP scientists and ask questions about science and conservation. We also worked with SDRP college interns and Mote high school interns to bring kid-friendly educational activities to family-centered festivals reaching broader area youth, including the Sarasota Seagrass Survey, World Oceans Day at Mote, and Snooty's Birthday Bash at the South Florida Museum. Mote high school alumni intern Lis Sundberg and her father, Bay Haven Elementary School science teacher Rolf Hanson, are even taking this to the next level by collaborating to create three new dolphin lessons this school year. Stay tuned as we continue to seek new opportunities to excite young students about science and wildlife conservation!

Early childhood science education at Mote Marine Laboratory

Miranda Herren, Mote Marine Laboratory

Young children are natural scientists, always filled with curiosity and a sense of exploration. At Mote Marine Laboratory and Aquarium, we offer early childhood education programs based on marine science for children ages 2-5 years old and their accompanying families. The goal of our program is to promote healthy development and relationships, school readiness, and an appreciation for science and the environment to promote prosocial behavior and values for our local communities.

The research conducted by the SDRP has been an integral part of our education programs, especially this summer during our "I Spy!" summer camp curriculum. This camp focused on the scientific process of observation to collect data. Using songs, stories, games, role plays, science tools, crafts, and special visits throughout the aquarium, I developed a variety of learning experiences to create an impactful connection to our local ecosystems. For one month, approximately 120 campers and their guardians learned about bottlenose dolphin biology, photo-ID to understand population dynamics, and conservation efforts including rescue and release. Not only did we have fun, but families developed a deeper understanding of our neighboring wildlife in Sarasota Bay and a closer connection to Mote Marine Laboratory.

Heddy Levine-Sabol wrote, "I have had the privilege of taking my grandson to a wide variety of programs. The Mote's "Mommy & Me" summer camp, ranks at the top of the list of programs. The staff are experts in marine life, early childhood education and in creating an environment that fosters learning and fun. The program integrates hands-on activities, songs, books and crafts/projects around a theme and encourages fun and a deeper knowledge of sea and plant life!"

Cela, age 3, compares and matches the correct dorsal fin to our bottlenose dolphin as her mom, Betty, watches.

Building the next generation of ocean scientists: Involving teenagers in research and outreach

Kim Bassos-Hull, SDRP, Mote Marine Laboratory

Through a collaborative partnership, Mote Marine Laboratory and the SDRP initiated a High School Intern Program in 2006 that engages students in marine research and outreach. This program runs the duration of the school year and allows educators and researchers to work together to build strong relationships with each student and foster interest in science and conservation. Students actively participate in mentored research, for example, helping scientists to collect behavioral and distributional data on wild bottlenose dolphins in relation to boat traffic during weekend days, or collecting marine debris and wildlife data at bridge and fishing pier hotspots. During this research component, students gain hands-on experience in the field and the lab collecting and analyzing scientific data relevant to conservation challenges facing local dolphins and other marine wildlife.

During 2017, trained high school interns collected and recorded several thousand pieces of trash and accumulated more than one kilometer of fishing line from Sarasota area bridges, piers and beaches. On a few weekends in 2017, these interns also helped SDRP research staff collect data on dolphin presence in relation to boat counts and distribution. A second important component of this teen program is communication of results and conservation messaging through the students' Community Awareness Projects (CAPs). Student CAPs are presented through a variety of modes such as public or scientific posters, games and activities at outreach festivals and peer mentoring of elementary-school children on relevant conservation topics. One example of a student generated outreach product is a "*Stow-it, Don't Throw-it*" personal-sized fishing line recycling container, which helps anglers to safely contain their unwanted fishing line until it can be recycled. Allowing students direct involvement in research opportunities during teenage years builds important capacity in this next generation of potential future ocean scientists and creates conservation-minded members of the public.

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, the national Animal Telemetry Network, the Florida Marine Debris Reduction Guidance Plan Working Group, and the IUCN Cetacean Specialist Group.

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 and students 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. During 2017, we had trainees, including interns and graduate students, from Denmark, France, Panama, and Spain.

Spanish researcher works with the SDRP

Joan Gonzalvo, Tethys Research Institute

I am the director of the Ionian Dolphin Project (IDP) run in western Greece since 1991 by Tethys Research Institute, an Italian NGO funded in 1986. During the late winter of 2017, I visited the SDRP, where I had the chance to observe from within how the research is conducted on a daily basis by the world's longest-running study of a wild dolphin population; a project of reference for me and many others worldwide dealing with dolphin research and conservation.

The IDP has two study areas, which are remarkably diverse in terms of environmental features and threats caused by human activities: The Inner Ionian Sea Archipelago and the Gulf of Ambracia. The latter, where the bottlenose dolphin is the only cetacean present, is an increasingly degraded coastal ecosystem hosting one of the highest observed densities of this species in the Mediterranean Sea. By visiting my colleagues at SDRP I strongly believe that there are not many areas that can be considered a "natural laboratory", but Sarasota Bay and the Gulf of Ambracia, where I am privileged to work, are certainly two of them. Despite having almost 20 years of experience studying bottlenose dolphins in the Mediterranean, during these two weeks I observed many dolphin behaviors that I had never seen before. This has been an eye-opening experience on how the same species in a relatively similar scenario (for example, high dolphin density in semi-enclosed waters suffering from several different anthropogenic pressures) can develop very different strategies in order to survive (or try to!). I aim at establishing a collaboration between both our projects in the near future, not only with the goal of setting up comparative studies to improve our knowledge on this species, but also to provide opportunities for researchers willing to develop their own research, which may help to define the most urgent dolphin conservation needs.

Joan Gonzalvo, director of the Ionian Dolphin Project in Greece, spent two weeks with the SDRP learning our data collection and processing methods. We look forward to a collaborative partnership between these programs.

Graduate Students

As described throughout this newsletter, graduate students from a variety of institutions, especially the University of California-Santa Cruz, 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, 40 doctoral dissertation and 36 master's thesis projects have benefited from association with our program, through field research opportunities or access to data, samples, or guidance. Currently, eight doctoral students are making use of resources provided by the SDRP:

Baker, I. Bottlenose dolphins of the Shannon Estuary, Ireland. Galway Mayo Institute of Technology.

Beal, A. Epigenetic estimation of age in bottlenose dolphins using DNA methylation. Florida International University.

Casoli, M. Mating strategies in bottlenose dolphins: fine-scale behaviour and acoustics during male-male and male-female interactions. University of St. Andrews, Scotland.

Jones, B. Vocal interactions of bottlenose dolphins. University of St. Andrews, Scotland.

Powell, J. Bone mineral density of the bottlenose dolphin: a proposed model for monitoring ecosystem health with respect to long-term and acute exposure to anthropogenic contaminants. Portland State University.

Toms, C. Bottlenose dolphin population structure in Pensacola Bay. University of Central Florida.

Weideman, H. Automated fin matching. Rensselaer Polytechnic Institute.

Wilkinson, K. Direct and indirect effects of shark-dolphin interactions in Sarasota Bay, FL. University of Florida.

Grad student update - Where is she now?

Ester Quintana, New England Aquarium

I am originally from Guatemala, where I examined the distribution and abundance of manatees for my Licenciatura degree in Biology. I came to the United States with a Fulbright/LASPAU fellowship to obtain a Master's degree in Zoology at the University of Florida. Later I did my dissertation studies at the University of South Florida. I have always been interested in animal behavior and

communication. I spent a lot of time reading about it when I first came to this country because access to this type of literature was lacking in Guatemala. It was thanks to this interest that I first met Randy Wells. I read many of his publications and specifically remember a 1987 book chapter that masterfully described the complex and intricate social lives of the Sarasota bottlenose dolphins. It inspired me to study their social behavior. Little did I know that I would soon do this and more under the direct mentorship of Randy, who became the co-adviser of my Master's and Ph.D.

With the training I received at SDRP, I developed, designed and conducted a Master's project examining the resighting and association patterns of bottlenose dolphins in the Cedar Keys, Florida. For my doctoral research, I studied the communication and group fission-fusion patterns of the Sarasota Bay bottlenose dolphins. Both research projects have been presented at local and international scientific conferences and parts of them have been published in peer-review journals. Although its been 10 years since I graduated, the skills I learned and developed during my time at SDRP and through mentorship with Randy have helped in every step of my professional career. I have also been able to influence other young scientists, some of whom have also worked with Randy and the SDRP.

I am currently the chief scientist of the marine mammal surveys of the Anderson Cabot Center for Ocean Life at the New England Aquarium. I work in the right whale program - similar to the SDRP in that it is one of the longest continuously running cetacean programs in the world. I coordinate and execute a project that examines the distribution, abundance and resighting patterns of North Atlantic right whales in the future wind energy areas offshore of Massachusetts and Rhode Island. The North Atlantic right whale is a critically endangered species with a population estimated to be around 450 individuals. The project also examines sightings of other large cetaceans including humpback, sei, fin and minke whales; small cetaceans such as common dolphins and bottlenose dolphins; and other marine fauna such as basking sharks and leatherback turtles.

Ester and Paul Nagelkirk conducting an aerial survey in the future wind energy area offshore of Massachusetts and Rhode Island.

In addition to my work in the United States, I continue studying manatees in Guatemala and have expanded my work to study humpback whales. I have been involved in several conservation and management efforts including the development of the Guatemalan management plan for manatees, and the regional management plan for the West Indian manatee for the entire Caribbean region, which was developed for the United Nations Environment Program. Studying marine mammals has been one of the most exciting experiences of my life. I am forever thankful to the SDRP, its staff and Randy for giving me the opportunity to learn from them and to contribute to our understanding of the complex lives of the Sarasota bottlenose dolphins.

Intern updates - Where are they now?

For this year's installment of former intern perspectives, we are highlighting several SDRP alumni who now work on marine mammal stranding response and associated research in the Gulf of Mexico region. All of the organizations represented also contribute images to GoMDIS, facilitating identification of dead animals from photo-ID research efforts.

Rebeccah Hazelkorn (2008)

Mote Marine Laboratory Stranding Investigations Program

I interned with SDRP in the summer of 2008 working under then Master's student Jessica Powell examining depredation and human interactions in Sarasota Bay. Since that time, a lot has happened. After interning, I went back to Georgia Southern University for my last year of undergrad, in which I conducted a senior thesis studying domestic horses. Specifically, I looked at overall aggressive behaviors, and the correlation between aggression and a horse's trychoglyph (or hair whorl).

After graduation, through a connection made while an intern at SDRP, I acquired a job for the Loggerhead Marinelife Center from 2009-2010 conducting night-time leatherback sea turtle research, as well as performing morning nesting surveys of sea turtles. I spent 2 seasons with the LMC before deciding it was time to go back to school for my Master's. I obtained a Master's of Marine Science with a focus in Marine Mammalogy at Savannah State University

under the mentorship of Dr. Tara Cox. My thesis and publication resulting from this study centered around long-term shifts in behavioral budgets from bottlenose dolphins known to interact with people.

During my time in school, I volunteered for two stranding networks. After finishing my MSMS, I was hired by, and am currently the senior biologist for the Stranding Investigations Program at Mote Marine Laboratory. I have now been with this team for almost five years, and have handled countless turtles, and many cetacean species. Without the chance being taken on me by SDRP almost 10 years ago, I am not sure I would've made it this far in my career. That experience definitely shaped my career by teaching me skills I would use in the field still to this day, how to communicate with other researchers and how to build and conduct a research project. Mentors and supervisors from my internship were there endlessly to help with how to navigate pursuing a career in the field, and what skills were of the most importance and how to market myself. Without being a part of the SDRP team, I would have never made the connections with people that have been able to speak to my work ethic and have helped me with references and putting in "good words" for graduate school and jobs. Without starting my career in SDRP, I'm not sure I would've been able to make it where I am today. Thanks SDRP!!!

Gina Lonati (2012)

Florida Fish and Wildlife Conservation Commission

I interned at the SDRP in the summer of 2012 after graduating with a B.A. in biology from Bowdoin College, Maine. Immediately after the internship, I began a Master of Science program at the University of North Carolina Wilmington. For my thesis, I investigated the composition and nitrogen solubility of toothed whale fats to better understand if whales are susceptible to decompression-related injuries like the bends (Lonati et al., 2015).

After graduate school, I spent a month aboard a NOAA research cruise that conducted marine mammal surveys in the northern Pacific Ocean. In October 2014, I began working for the Florida Fish and Wildlife Conservation Commission at the Marine Mammal Pathobiology Lab in St. Petersburg, which is where I still am today. At the FWC MMPL, my primary responsibility is responding to marine mammal strandings, which includes rescuing injured, sick or orphaned animals, and recovering and performing necropsies on dead animals. In addition, I manage the FWC's Florida manatee aging program, which involves collecting and processing earbones from deceased manatees to count growth layers (similar to tree rings). I value the time I spent at the SDRP, where I was able to network with experts in the field and learn skills (photo-ID, ArcGIS, data QA/QC, boat operation, and more) that are very relevant to my current job. I am honored to now have the opportunity to work alongside many of the knowledgeable SDRP and Mote staff, particularly during dolphin health assessments! Additionally, I still keep in touch with my intern cohorts, many of whom have also found jobs in biology around the country.

Lauren Albrittain (2013)

Gulf World Marine Institute

I have had what many would consider a very lucky career so far, and I have the SDRP internship to thank for that. As my first field experience after receiving my Bachelors, I completed four months of work with the SDRP during the summer of 2013.

After that, I jumped across to the next building and got my first experience with stranding response working with Mote Marine Lab's Stranding Investigations Program. I was hooked. A brief spring internship as a whale watch intern with the New England Aquarium was followed immediately by over a year as a Batten Fellow with the Virginia Aquarium Stranding Response Program. While continuing a long-distance project for the Virginia team as an independent contractor, my adventures temporarily took me to Anchorage, Alaska as a photo analyst with LGL.

Finally, I returned to the southeast, working for some time with the husbandry department at the Georgia Sea Turtle Center on Jekyll Island before coming to my current stop as the Stranding Coordinator for Gulf World Marine Institute, Inc. in Panama City Beach, Florida. As the only employee at Gulf World to dedicate my time solely to the stranding response program, this experience has been and continues to be one of constant growth and inspiration. I know that, had I not been asked by Katie McHugh towards the end of my time with SDRP whether I wanted to try out stranding response, I may not have had the great start in the stranding world that I did. The staff, interns, and volunteers who form the SDRP helped to springboard my post-undergraduate career, and I am very grateful for that.

Ruma Chatterji (2015)

Dauphin Island Sea Lab

During the winter-spring of 2015, I landed an internship with one of my dream research organizations: the SDRP at Mote Marine Laboratory. I remember feeling ecstatic about the opportunity of working with SDRP researchers, and can confidently state that I learned volumes from interning there. From learning techniques such as dolphin fin photo-ID to participating in exciting projects such as dolphin prey assessments, the attributes and experiences I gained at SDRP benefitted my development as a scientist. Upon completing the internship at SDRP, I pursued my master's degree at Texas A&M University-Corpus Christi (TAMU-CC), where I majored in biology and had a project focus in neuroscience. My thesis work examined the behavioral and neuronal plasticity in the marine mollusk, *Aplysia californica*. Upon graduation from TAMU-CC (Aug 2017), I relocated to Alabama where I am currently interning with the Alabama Marine Mammal Stranding Network and the Manatee Sighting Network at the Dauphin Island Sea Lab (DISL).

At DISL, I have thus far participated in marine mammal strandings, sightings, and necropsies. My experience with SDRP has provided enriching opportunities that have not only taught me tangible skills but left me with intangible lessons as well. The detail-oriented work and raw integrity that is demonstrated by researchers at SDRP is a perfect example of the type of effort I try to emulate in my own work as I plan to pursue a PhD in marine mammal acoustics, behavior and cognition. I am forever thankful for all the time that was spent training me and other interns in projects in the lab, on the water, and beyond.

Perspectives from a 2017 intern

Grace Dodillet

I have always felt inexplicably tied to the marine world. From the moment I first laid eyes on bottlenose dolphins from behind a thick layer of glass at the Brookfield Zoo to the time I first dipped my toes in the ocean, I knew I wanted to discover more about this underwater world. I tried to absorb as much information as possible that connected me to the sea throughout my childhood, even though I was geographically land-locked in the Midwest. I spent hours at the underwater viewing area of the "Seven Seas" at the Brookfield Zoo, watching the bottlenose dolphins swim by while listening to a short video loop explaining the research conducted by the SDRP. I remember thinking that researching dolphins sounded like my dream job, but deemed the idea impractical, as the closest ocean to me was hundreds of miles away.

Fast forward a few years: I decided to attend college at Northwestern University, an esteemed institution close to home. Although I loved my university, during my junior year I realized that no amount of environmental and biology classes could satiate my desire to immerse myself in the study of marine science. I subsequently secured an internship in Mossel Bay, South Africa, where I was able to gain hands-on experience contributing to Great White Shark and marine mammal research. When I was finally able to live out my passion for marine science, I was certain that I wanted to dedicate the rest of my career to this field.

The culmination of these experiences and my history with the Brookfield Zoo compelled me to apply for an internship with the SDRP after graduation. I was fortunate enough to work with the program from January through August. Throughout my internship, I was able to directly contribute to fieldwork and ongoing research, and also witness first-hand how humans impacted the behavior and health of the resident dolphin population. These experiences helped me hone my research interests while I was in the midst of applying to graduate schools; I am now a graduate student at Harbor Branch Oceanographic Institute investigating the impacts of pollutants on the health of juvenile green sea turtles in the Indian River Lagoon.

The hands-on fieldwork experience I received while working with the SDRP was invaluable. I was not only able to develop my photo-ID skills, but I also learned new data collection techniques, improved my GIS skills, and learned how to properly operate and maintain a research vessel. I learned numerous skills that simply cannot be taught in a classroom or learned from reading a textbook, skills like adapting to the unpredictable nature of fieldwork, how to be an effective team player both on the water and in the lab, and how to not pass out while assisting with a necropsy. I genuinely felt like I learned something new every day, and woke up every morning excited to come to work. I know I will always cherish the people I met and the friendships I made. I am excited to take the newfound skills I have learned to Harbor Branch and continue my career in marine science. I am confident that my internship with the SDRP was the first step in creating a solid foundation from which an impactful career can flourish; a career in which I can truly make a difference in protecting, preserving, and understanding marine life and the marine environment for years to come.

Program Operations

Development of tools for offshore research

Randall Wells, Chicago Zoological Society

We have been working for several years to develop our capacity for conducting health assessments and tagging of dolphins in deeper waters offshore in the Gulf of Mexico. This year, thanks to a grant from Dolphin Quest and several major donations, and building on our recent experience in Bermuda, we have made significant progress toward this goal. We are working with Woods Hole Oceanographic Institution to build and test a prototype tool for attaching satellite-linked tags to dolphins riding at the bow of the boat, without requiring capture. For health assessment purposes, we received guidance from our Australian colleague, Guy Bedford, on constructing and using hoop-nets for catching bow-riding dolphins, and we now have our own hoop-nets. In consultation with Guy during a practice field session in late winter 2017, we have worked through several iterations to modify our research vessel *Nai'a* with a bow pulpit that should place a tagger or hoop-netter in the appropriate position above bow-riding dolphins. Our new National Marine Fisheries Service Scientific Research Permit allows us to use the prototype tagging tool, and to engage in hoop-netting, with bottlenose and Atlantic spotted dolphins. Based on our experience with established hoop-netters, three members of our staff have been approved by the National Marine Fisheries Service to conduct the hoop-netting. We are looking forward to beginning to apply these new capabilities to learning more about dolphins over the West Florida Shelf and elsewhere around the world.

Nai'a sporting a new bow pulpit that facilitates hoop netting operations along the Gulf of Mexico coastal shelf. Our goal is to expand our knowledge and understanding of offshore dolphins.

Staff development workshops in Scotland

Krystan Wilkinson, Reny Tyson Moore, and Shauna McBride, Chicago Zoological Society

This summer several SDRP staff travelled to Scotland to attend professional development workshops in their areas of expertise. Reny Tyson Moore spent a week in St. Andrews at the Centre for Research into Ecological and Environmental Modelling where she attended the Analysis of Data from High-Resolution Animal-Borne Tags Workshop and the Hidden Markov Models for Animal Movement and other Ecological Data Workshop. These workshops delved into many of the statistical methods used to analyze data collected from the types of tags that SDRP commonly uses to study dolphin behaviour such as Dtags, Splash tags (Wildlife Computers), and OpenTags (Loggerhead Instruments). Reny also learned more about tag calibration, trouble-shooting tag sensor issues, and additional forms of data visualization, which she will put to good use in upcoming tagging projects.

Krystan Wilkinson and Shauna McBride spent a week at the University of Glasgow's Scottish Centre for Ecology and the Natural Environment (SCENE) where they participated in a PR Statistics course, Spatial Analysis of Ecological Data using R. They learned various spatial techniques, including deriving species distributions from point and transect data and determining environmental drivers of movement, to apply to their research and as well as a variety of collaborating SDRP projects.

These staff development efforts, as well as participation in professional conferences such as the Society for Marine Mammalogy biennial conference, were made possible from donations to Dolphin Biology Research Institute.

From left to right, Shauna McBride, Jason Mattiopoulos (course instructor), Krystan Wilkinson, and Luca Nelli (course instructor) after the completion of the Spatial Analysis of Ecological Data course.

As the lab turns...

Sunnie Brenneman, Chicago Zoological Society

For years this column has served to chronicle gradual progressions in the lives of our staff and associates. Like the gentle roll of the earth along her orbit, so too do our lives move forward. This year, however, felt more like a top spiraling rapidly towards an entropic finale. 2017 has produced a dizzying array of personal developments that has left all our heads spinning with emotions!

In January, Shauna McBride announced her engagement to fiancé Alan Kebert, whom she met during graduate school five years ago. Just two months later, Reny Tyson announced in March that she also got engaged! Jason Moore, her partner of eight years, popped the question and she said 'YES!' Soon after, like a cosmic sign from the universe that true love really does last, Kim and Pete Hull celebrated their 25th wedding anniversary... wed by our very own Randy Wells! Though a bit early in the year to make any broad-sweeping conclusions, it seemed that love would be a pervading theme for our lab.

Shauna McBride and Alan Kebert are looking forward to happily-ever-after.

Kim and Pete Hull: then and now. A stunning couple no doubt, but like the best things in life, this pair just gets better with time!! Congratulations on 25 fantastic years of marriage!

No sooner had we recovered from the engagement excitement than Katie McHugh and Aaron Barleycorn dropped a bomb in our April lab meeting – a BABY bomb! The couple announced they were expecting their first child. Friends, I kid you not. The very next morning Carolyn Cush publicly announced that she and her husband were also expecting a new baby; a little brother for Natalie!

In keeping with the theme, and because she was already on such a monumental-life-event-roll, Reny surprised us once again with an announcement in late June that she and Jason are ALSO expecting their first child! Holy cow. On a scale of zero to even, I just can't. But the momentum was strong with this one. Reny and Jason went on to tie the knot in early September – the Triple Crown! She punctuated this accomplishment with a major move to North Carolina in October after her husband landed a fantastic job. Fortunately, she remains on staff with the SDRP, working remotely from home and popping in as-available for field work.

Pause for breath

Newly-minted wife Reny and fellow mom-to-be, Katie, make a baby-bump sandwich of the soon-to-be Mrs. Wilkinson.

Reny Tyson Moore and husband Jason walking hand-in-hand towards 'forever'.

Little miss Natalie loving on her new baby brother, Matthew.

Just as Reny made her Sarasota exit, baby Cush made his grand entry! Matthew Allen arrived on October 13th, and Carolyn, Brian and Natalie couldn't be more pleased to welcome him. But that's not all, folks! Barely three weeks passed before Krystan Wilkinson and Joe Schuler said 'I do'. Their November 4th nuptials were performed in a beautiful beach side ceremony officiated, once again, by Randy! He has an excellent success rate.

About five deep breaths later and only narrowly missing dual citizenship with Canada, Aaron and Katie's baby girl will make her way into the world no later than November 27th, giving everyone (but especially Katie and Aaron) one more thing to be thankful for. My most sincere and heartfelt congratulations to everyone on an absolutely incredible year!

Alas, I cannot sign off without relaying one last little bit of news, albeit of a more bittersweet nature. After seven wonderful years with the SDRP, it is with both sadness and excitement that I will bid farewell to Florida in December and embark upon a new adventure. It has been a privilege to work with so many brilliant colleagues who have inspired and challenged me. More importantly, it is a team that embraced me not only as coworker and friend, but in many regards as surrogate family. Several of you will forever hold a special place in my heart, but the time has come for me to head west to reunite with my family once again. Oklahoma City, here I come!

Now, to the person who will fill my shoes in penning this little column next year… good luck topping 2017!

Sunnie trades in her flip-flops for cowgirl boots as she heads west to Oklahoma and family.

Krystan and Joe exchange their vows on St. Pete beach before Randy.

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, PhD, Research Assistant
Katie McHugh, PhD, Staff Scientist
Reny Tyson Moore, PhD, Staff Scientist
Randall Wells, PhD, Program Director
Krystan Wilkinson, MS, Research Assistant

Mote Marine Laboratory Staff

Kim Bassos-Hull, MS, Research Associate

Dolphin Biology Research Institute Officers

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

Doctoral Students (SDRP staff serve on committees)

Isabel Baker, Galway - Mayo Institute of Technology
James Powell, Portland State University
Christina Toms, University of Central Florida
Krystan Wilkinson, University of Florida

Undergraduate Senior Thesis Students

Michelle Greenfield, Princeton University

Interns and Post-Graduate Trainees

Kayla Arjasbi
Carmen Camp
Heather Daszkiewicz
Grace Dodillet
Joan Gonzalvo - Spain
Michelle Greenfield
Whitney Kwiers - Panama
Taylor Machette
Clayton Mazur
Juliet Stevenson
Theresa-Anne Tatom-Naeker
Kassey Trahanas

Katie with SDRP interns at the Mote Monda Intern Reception. Summer intern Juliet Stevenson was supported by a scholarship from the Monda family to enhance student scientific training.

Colleagues, co-workers, interns and volunteers celebrating science at the 2017 Society for Marine Mammalogy biennial conference in Halifax, Nova Scotia.

Local and Returning Volunteers

Austin Allen
Dee Allen
Ralph Arden
Perfecto Barba
Trevor Barleycorn
Ed Blair, Jr.
René Byrskov - Denmark
Leah Crafton
Michael Duranko
Kristi Fazioli
Mark Fishman
Sondra Fox
Ramsey Frangie
John Hamilton
Chris Hessell
Jeff Hollway
Renee Jones
Emilia Lindvall - Sweden
Clara Meechan
Cathy Marine
Charlie Mericle
Fran Mericle
Kara Moore
George Morgan
Cecilia Mould
Nigel Mould
Norma Pennington
Chip Phillips
Remy Phillips
Natalie Richard
Aya Robinson
Jamie Shelley
Bryan Spaulding
Frank Szydlowski
Jeff Stover
James Thorson
Bill Tiffan
Laura Torelli
Martha Wells

SDRP local staff feeling holly-jolly at the annual staff Christmas dinner.

Products

Professional Activities Summary: September 2017

Published Peer-Reviewed Journal Articles, Book Chapters

Ardente, A. J., R. S. Wells, C. R. Smith, M. T. Walsh, E. D. Jensen, T. L. Schmitt, J. Colee, B. J. Vagt and R. C. Hill. 2017. Dietary cation-anion difference may explain why ammonium urate nephrolithiasis occurs more frequently in common bottlenose dolphins (*Tursiops truncatus*) under human care than in free-ranging common bottlenose dolphins. Journal of Animal Science 95:1396-1406. DOI:10.2527/jas2016.1113.

Baker, I., J. O'Brien, K. McHugh and S. Berrow. 2017. An ethogram for bottlenose dolphins (*Tursiops truncatus*) in the Shannon Estuary, Ireland. Aquatic Mammals 43:594-613. DOI:10.1578/AM.43.6.2017.594.

Bejarano, A. C., R. S. Wells and D. P. Costa. 2017. Development of a bioenergetic model for estimating energy requirements and prey biomass consumption of the bottlenose dolphin *Tursiops truncatus*. Ecological Modelling 356:162-172. DOI:10.1016/j.ecolmodel.2017.05.001.

Christiansen, F., K. A. McHugh, L. Bejder, E. M. Siegal, D. Lusseau, E. Berens McCabe, G. Lovewell and R. S. Wells. 2016. Food provisioning increases the risk of injury in a long-lived marine top predator. Royal Society Open Science 3:160560. DOI:10.1098/rsos.160560.

Cremer, M. J., A. C. Holz, P. Bordino, R. S. Wells and P. C. Simões-Lopes. 2017. Social sounds produced by franciscana dolphins, *Pontoporia blainvillei* (*Cetartiodactyla, Pontoporiidae*). Journal of the Acoustical Society of America. 141(3): 2047-2054.

Davison, A. J., K. Subramaniam, K. Kerr, J. M. Jacob, N. Landrau-Giovannetti, M. T. Walsh, R. S. Wells and T. B. Waltzek. 2017. Genome sequence of a gammaherpesvirus from a common bottlenose dolphin (*Tursiops truncatus*). Genome Announcements 5:e00777-17. DOI:10.1128/genomeA.00777-17.

De Guise, S., M. Levin, E. Gebhard, L. Jasperse, L. Burdett Hart, C. R. Smith, S. Venn-Watson, F. Townsend, R. Wells, B. Balmer, E. Zolman, T. Rowles and L. Schwacke. 2017. Changes in immune functions in bottlenose dolphins in the northern Gulf of Mexico associated with the *Deepwater Horizon* oil spill. Endangered Species Research 33:291-303. DOI:10.3354/esr00814.

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Hornsby, F. E., T. L. McDonald, B. C. Balmer, T. R. Speakman, K. D. Mullin, P. E. Rosel, R. S. Wells, A. C. Telander, P. W. Marcy, K. C. Klaphake and L. H. Schwacke. 2017. Using salinity to identify common bottlenose dolphin habitat in Barataria Bay, Louisiana, USA. Endangered Species Research 33:181–192. DOI:10.3354/esr00807.

Kellar, N. M., T. R. Speakman, C. R. Smith, S. M. Lane, B. C. Balmer, M. L. Trego, K. N. Catelani, M. N. Robbins, C. D. Allen, R. S. Wells, E. S. Zolman, T. K. Rowles and L. H. Schwacke. 2017. Low reproductive success rates of common bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico following the *Deepwater Horizon* disaster (2010-2015). Endangered Species Research 33:143–158. DOI:10.3354/esr00775.

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Pack, A. A., E. Y. K. Herman, C. S. Baker, G. B. Bauer, P. J. Clapham, R. C. Connor, A. S. Craig, P. H. Forestell, A. S. Frankel, G. Notarbartolo di Sciara, M. Hoffmann-Kuhnt, E. Mercado III, J. Mobley, M. R. Shyan-Norwalt, S. S. Spitz, M. Solangi, R. K. R. Thompson, L. von Fersen, R. Uyeyama, R. Wells and J. P. Wolz. 2017. In Memoriam: Louis M. Herman (1930 - 2016). Marine Mammal Science 33(1):389–406. DOI:10.1111/mms.12387.

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Smith, C. R., T. K. Rowles, L. B. Hart, F. I. Townsend, R. S. Wells, E. S. Zolman, B. C. Balmer, B. Quigley, M. Ivančić, W. McKercher, M. Tumlin, K. D. Mullin, J. D. Adams, Q. Wu, W. McFee, T. Collier and L. H. Schwacke. 2017. Slow recovery of Barataria Bay dolphin health following the *Deepwater Horizon* oil spill (2013-2014), with evidence of persistent lung disease and impaired stress response. Endangered Species Research 33:127–142. DOI:10.3354/esr00778.

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Wilson, R. M., R. B. Tyson, J. A. Nelson, B. C. Balmer, J. P. Chanton and D. P. Nowacek. 2017. Niche differentiation and prey selectivity among common bottlenose dolphins (*Tursiops truncatus*) sighted in St. George Sound, Gulf of Mexico. Frontiers in Marine Science 4:235. DOI:10.3389/fmars.2017.00235.

Peer-Reviewed Journal Articles and Book Chapters: Accepted or In Press

Ardente, A. J., T. J. Garrett, J. Colee, B. J. Vagt, M. T. Walsh, R. S. Wells, C. R. Smith, E. D. Jensen, T. L. Schmidtt and R. C. Hill. In press. Differences in purine metabolite concentrations in the diet may explain why ammonium urate nephrolithiasis is common in managed but rare in free-ranging common bottlenose dolphins, *Tursiops truncatus*. Aquatic Mammals.

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Products

Dolphin calf making a splash - 1095, Scooter's 2017 young-of-year.

Hart, L. B., K. Wischusen and R. S. Wells. Accepted. Rapid assessment of bottlenose dolphin (*Tursiops truncatus*) body condition: There's an app for that. Aquatic Mammals.

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van der Hoop, J. M., M. Johnson, N. Aguilar de Soto, F. Jensen, L. Rojano Doñate, D. Wisniewska and P. T. Madsen. Respiratory rates in free-swimming odontocetes as a measure of field metabolic scaling. Bio Logging Symposium, 25-29 Sept 2017, Konstanz, Germany.

C115 tosses a puffer fish.

Mote high school interns Samantha Kappaz (far left) and Brooke Welch (center) help SDRP's Dr. Katie McHugh collect data on a pair of dolphins in Longboat Pass on April 15, 2017.

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Wilkinson, K. A., R. S. Wells, R. E. Hueter and W. E. Pine, III. 2017. Acoustic and satellite-linked tracking of large bull sharks in southwestern Florida. Florida Sea Grant Coastal Science Symposium, 26 September 2017, Gainesville, FL.

Wilkinson, K. A., R. R. Borkhataria, R. Wells and W. E. Pine, III. 2017. Highway to the danger zone: The influence of seascape characteristics on predation risk for bottlenose dolphins (*Tursiops truncatus*). 22nd Biennial Conference on the Biology of Marine Mammals, 22-27 October 2017, Halifax, Nova Scotia, Canada.

Invited Public, University, School Lectures

Staff and collaborators with the Chicago Zoological Society's Sarasota Dolphin Research Program delivered 29 presentations to the public, universities, or other schools since the last issue of *Nicks 'n' Notches.*

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Donations, including boats, computers, cameras, and vehicles, greatly help with our efforts, and can be made to Dolphin Biology Research Institute (dba Sarasota Dolphin Research Program). We very much appreciate the donation this year of the 24 ft Hurricane *R/V Stern*, donated by Robert and Sarah Stern – a welcome addition to our research fleet! DBRI is a Sarasota-based 501{c}3 not-for-profit organization, incorporated in 1982, and dedicated to research and conservation of dolphins and their habitat. For more information on how you can help, please contact Randall Wells at (941) 374-0449.

Dolphin Biology Research Institute would like to thank the following contributors for their donations of $500 or more over the past year, through October 2017:

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