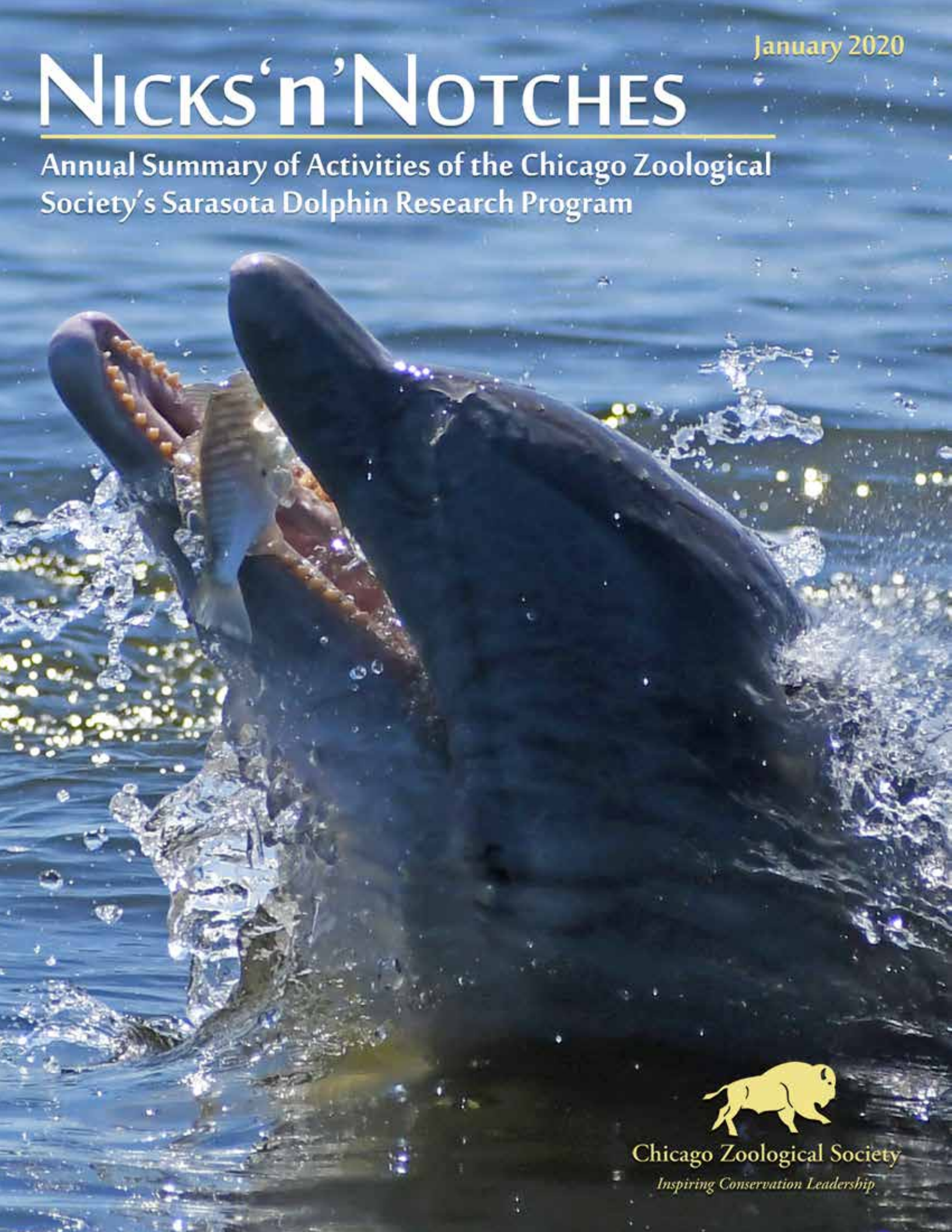
January 2020

Nicks'n'Notches

Annual Summary of Activities of 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

In This Issue

Entering our 50th year of marine mammal research, conservation, and education

As the Sarasota Dolphin Research Program (SDRP) enters its 50th year, it seems reasonable to reflect on the legacy of conducting the world's longest-running study of a wild dolphin population. What has developed over the decades is certainly beyond anything dolphin trainer Blair Irvine and his high school assistant could have imagined when we began tagging dolphins in Sarasota Bay in October 1970 to study their movements and activities. Blair and I are humbled by the fact that the program is now recognized by many around the world as a pioneering model. Because of the data rigorously collected over the decades, the resident Sarasota Bay dolphins are used as a reference population for comparative studies by, among others, the National Oceanic and Atmospheric Administration (NOAA), to investigate issues faced by at-risk dolphin populations. Data from the Sarasota Bay dolphins have played a crucial role in studies of the impacts of the *Deepwater Horizon* oil spill and other pollution, as well as biotoxins, on bottlenose dolphin populations around the southeastern United States. Our highly skilled and experienced staff members are asked to participate in important research projects around the world. The unparalleled access afforded by the long-term resident Sarasota Bay dolphins has facilitated the development, testing, and/or refinement of many field research approaches and tools, including telemetry, veterinary techniques, and acoustic monitoring and communication studies.

While population-level conservation research and capacity building needs guide many of our program's activities (see the following page), we have also had a leadership role in appreciating the importance of acknowledging dolphins as individuals, tracking their lives over time, and sharing their individual stories. Without any need to anthropomorphize, the dolphins' own stories can help members of the public better relate to the animals, care about them, and respond to their needs. Our discovery in the early 1970's of long-term local residency by dolphins set the stage for being able to monitor individuals throughout their lives, to develop an understanding of their social structure, and to better understand the challenges they face day-to-day. We learned that dolphins in small, resident inshore communities are exposed every day to multiple, concurrent threats from both natural and man-made sources, and that cumulatively these can have great impact on the future of these individual communities. We continue to focus much attention on characterizing and attempting to mitigate these local threats, through research, outreach, education, and direct intervention.

Direct intervention, through rescues, is not as desirable as prevention, but it can be necessary for entangled, injured, or out-of-habitat dolphins, and it can help to prevent population decline. Over the years we have engaged in 23 rescues of bottlenose dolphins along Florida's west coast. Saving these individuals leverages their future generations. Three of the four mothers in the photo above likely would not have been alive to produce these calves without our intervention. Our research over the past 49 years, tracking identifiable individuals and their reproductive success through their lives, has shown that a single female can produce 11 calves or more during an up to 48-year-long reproductive lifespan. Helping dolphins to survive to produce these calves is crucial for these long-term dolphin communities to continue and to maintain their long-established, complex social structures. Each individual makes a difference for the community.

Recently, dolphin communities along the west coast of Florida faced uncertain futures as a severe red tide harmful algal bloom raged from summer 2018 into winter 2019, depleting dolphin prey fish and killing dolphins with its toxins. So far, it appears that the prey fish are recovering more quickly than after some other severe red tides. On another positive note, the Sarasota Bay dolphins have produced 18 calves in 2019, including the first representative of a sixth generation in our study. Our team is looking forward to following their lives over the next half century, and using this knowledge to build the case for creating a better environment for the dolphins and their human neighbors. Along with the continuing gratification of helping these animals and their ecosystem, comes the pleasure of working with the ever-growing "Sarasota family" of staff, students, volunteers, alumni and collaborators who have made all of this possible.

Thank you for caring about the
dolphins of Sarasota Bay!

Director, Sarasota Dolphin Research Program

Some of our accomplishments, by the numbers

The "natural laboratory" situation of Sarasota Bay facilitates cutting-edge work done by a diverse group of specialists who complement the expertise and interests of the SDRP. Over the years, staff, students, and collaborators have produced more than 265 peer-reviewed publications, 4 books, more than 100 technical reports, and have made more than 660 presentations to scientific audiences, students, stakeholder groups, and the general public. Perhaps the most meaningful component of our legacy, though, involves training the next generation of conservation leaders. To date, 41 master's and 43 doctoral students have benefited from SDRP data collection opportunities, data, samples, or guidance. In addition, more than 425 undergraduate interns have received multi-month training by the SDRP. Foreign participants in our training programs include 66 of the interns, along with 40 post-graduate scientists and 108 health assessment project participants, from 45 countries. A number of the alumni from our training programs have moved into key positions in wildlife management at NOAA and the Marine Mammal Commission, and elsewhere around the world. The accomplishments of the program over the decades reflect the efforts of many: staff, students, volunteers, collaborators, and the long-term support of several key individuals and organizations.

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 providing 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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Conservation Research and Action

SDRP Red tide update

Randall Wells and Elizabeth Berens McCabe, Chicago Zoological Society

In the January 2019 issue of *Nicks'n'Notches* we reported on a severe *Karenia brevis* red tide harmful algal bloom in Sarasota Bay and along the west coast of Florida. After months of wreaking havoc to our south, this red tide flowed into Sarasota Bay at the beginning of August 2018 and remained until mid-January 2019. As red tide cell counts reached as many as 90,000,000 cells per liter of seawater, 900 times the concentration where fish begin to die, devastation ensued, with huge rafts of dead fish floating in and out on the tide. The levels of underwater biological sounds heard through our acoustic monitoring stations declined dramatically. Catches of primary dolphin prey fish during our seasonal fish surveys declined 88% from Aug/Sep 2017 to Aug/Sep 2018.

The red tide and its aftermath appear to have taken a toll on the local dolphins as well. Although we documented 11 dolphin births in 2018 and 18 so far in 2019, five resident dolphins are known to have died from the red tide's toxins, and three of the 2018 calves disappeared during the red tide. Five of the 2019 calves have disappeared, well after the red tide but while food resources for their moms were reduced. All of the 2-4-yr-old dolphins examined in our June 2019 health assessment were underweight or at the low end of normal ranges, as seen in 2006 following another severe red tide.

On the positive side, preliminary data suggest that the ecological impacts of the 2018-19 red tide, while acutely intense, may not have been as severe as for the prolonged 2005-06 blooms. Dolphin prey fish appear to be rebounding more quickly. By mid-summer 2019, catches during our seasonal fish surveys were only 35% below 2017 levels. The 2005-06 red tide was associated with increased adverse human interactions, including deaths of 2% of resident Sarasota Bay dolphins from recreational fishing gear ingestion. To try to preclude a recurrence of adverse dolphin interactions with anglers due to lack of fish, we preemptively increased community outreach efforts, with dozens of presentations over the past year. Fortunately, we have not yet seen the same level of increase in human interactions with the recent red tide. Continuing research is focused on determining whether we can predict circumstances under which increased adverse human interactions might be expected to occur, allowing us to proactively target outreach efforts to try to reduce anthropogenic impacts.

A raft of dead fish in Sarasota Bay during August 2018.

Turning the tide: Addressing adverse human-dolphin interactions

Katie McHugh, Chicago Zoological Society

With support from the Disney Conservation Fund, the SDRP maintains a commitment to better understand and mitigate adverse human-dolphin interactions (HI) in Sarasota Bay and engage community members in conservation. As part of this effort, we continue expanding our outreach activities to better engage key stakeholders in dolphin conservation to reduce HI, focusing on local user groups who interact with dolphins in different ways (*e.g.*, anglers, recreational boaters, boat rental companies, ecotour operators) but whose activities can put dolphins at risk. This includes informal town-hall style presentations or events, centered on sharing best practices for boating and fishing near wildlife, reducing marine debris to prevent entanglement, and reporting injured animals to facilitate effective intervention.

This year, we completed a project focused on updating data on boat based disturbance and evaluating responsible dolphin viewing practices using both traditional methods and new technology. As part of this effort, we conducted 122 focal follows (systematic behavioral observation sessions) during 2018-2019 on dolphins of different ages and sexes found within a hotspot of dolphin and human activity, to assess how frequently they encountered boats, how well boaters complied with viewing guidelines, and whether dolphin behavior was impacted by these interactions. Preliminary data indicate that dolphins within the hotspot area must navigate intense boat activity, with boats passing within 100 meters every 2 minutes and stopping to view them every 14 minutes on average throughout the day! Because of this, we provided targeted outreach to boaters, including a workshop for ecotour operators and new signage focused on proper viewing behavior to minimize disturbance. Because dolphins and boats are frequently observed in this area, we also deployed one of our new passive acoustic listening stations (PALS) at the site to provide a continuous acoustic record of dolphin and boat sounds, enabling us to assess patterns of human and dolphin activity remotely. We also partnered with FlyWire cameras to conduct a short trial of video monitoring technology alongside the listening station in 2018. Our 2019 NSF Research Experiences for Undergraduates student, Gabriela Hernández-Ramírez, reviewed combined acoustic and video data to assess the effects of boat noise and boat-based viewing on vocal behavior of dolphins, and these datasets are supporting additional student research this fall aimed at assessing boater compliance with viewing guidelines and whether installation of an outreach sign at the site resulted in improvements in boater behavior. We are still verifying and analyzing data from this project, and plan to use what we learn to improve future outreach efforts with boaters in our study area.

We also continue to monitor and respond to interactions between dolphins and anglers, including injuries from entanglement in recreational fishing gear. During 2019, we have been watching for signs of heightened HI in the wake of an intense red tide event that seriously impacted our coast. A sudden spike in both dolphin interactions with fishermen and injuries from fishing gear was observed after a similar event in 2005-2006 within our study area, with dolphins increasingly seeking human sources of food and suffering consequences of those interactions. Early this year, the SDRP rescued two calves of mothers with previous HI histories who had become entangled in fishing gear, sounding the alarm that HI may again be on the rise, now impacting a new generation of resident dolphins. As of August 2019, we have observed elevated rates of interaction during population monitoring surveys, but so far they have not reached the high levels we saw in the mid-2000s. We are cautiously optimistic that fish communities may rebound quickly enough to avoid our worst fears, but will continue working to improve HI monitoring strategies to highlight emerging areas of concern – including seeking direct input from affected anglers through a web app developed to facilitate citizen science reports of dolphin interactions with fishing gear (https://dolphin.report).

New outreach sign posted at a dolphin viewing hotspot to educate boaters about federal Marine Mammal Protection Act guidelines.

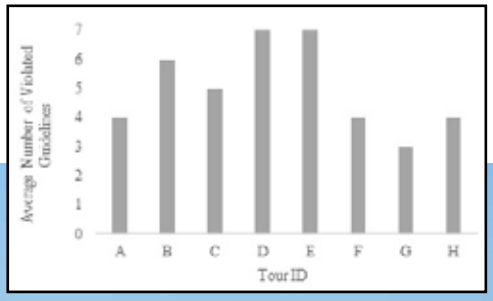
Assessing human-dolphin interactions in Southwest Florida: Insights through injuries, strandings, and tour operator compliance

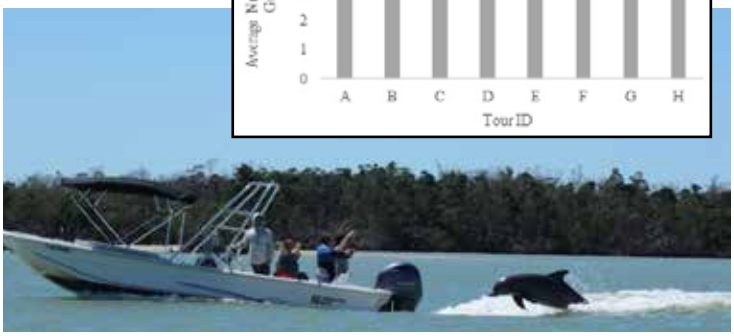
Lindsay Hooper, Florida State University

Ecotourism, including dolphin and whale watching, is one of the fastest-growing subsectors of the tourism industry, but in some cases ecotourism activities can negatively impact the species they view. These impacts can have both short and long-term effects, including those resulting from behavioral changes, such as increased whistle production, shifts in individual home ranges or, in some cases, decreases in population abundance or reproductive success.

Various actions have been taken in an attempt to mitigate human impacts on marine mammals, including the creation of the Marine Mammal Protection Act (MMPA) and the National Oceanic and Atmospheric Administration (NOAA) Marine Mammal Viewing Guidelines. Despite the existence of these measures, negative interactions with marine mammals still occur, often due to a lack of compliance. In order for conservation measures to be effective, these negative interactions need to be minimized. Therefore, it is important to assess compliance and the motivation behind it.

Tourism plays a large role in the economy of southwest Florida. This, combined with the fact that the dolphin population in the Naples region is understudied, is why I am conducting my Master's research in this area. To better understand the interactions between ecotours and dolphins in this region, I joined eight public ecotours that advertised dolphin watching, and observed their compliance to the MMPA and NOAA viewing guidelines. During the tours, I also noted any educational outreach they provided to their guests. Public ecotours were chosen for observation due to their ability to be observed while on board, as well as the potential influence they can have on both passengers and fellow boaters. To complement these observations, I surveyed captains to examine their opinions of the guidelines and to determine factors that may influence their compliance. Questionnaires were also distributed to ecotour passengers to assess how ecotour compliance affected their tour experience. My observations revealed that compliance to the guidelines in this region is low, and that a few specific guidelines, including not approaching dolphins closer than 50 yards and not pursuing dolphins, were violated more often than others. In addition, captain knowledge and support for the guidelines did not affect their compliance. While passengers value compliance, they often weren't aware of the existence of the guidelines, so didn't recognize noncompliance as an issue.





Bottlenose dolphin interacting with a boat, and preliminary findings with regards to ecotour violations of dolphin viewing guidelines.

As part of this research, I will also assess the level of injuries resulting from human interactions (HI) in Naples and compare that to what is known about the Sarasota dolphin community. I will examine photos taken during boat-based photo-ID surveys in both regions for evidence of injuries likely caused from HI (*e.g.*, boat strike scars, entanglement scars). I will also analyze the stranding records of dolphins in Sarasota, Manatee, and Collier counties to examine any spatial and / or temporal trends in strandings over the past twenty years, specifically identifying those thought to be caused or influenced by HI. The research will help us better understand and assess the influence of harmful HI on the health of the dolphins in these two regions.

This research is part of my Master's research at Florida State University and was funded by the Florida State University Department of Earth, Ocean, and Atmospheric Science's Winchester Fund, with guidance from Dr. Reny Tyson Moore of the Sarasota Dolphin Research Program.

Using digital acoustic tags and focal follows to understand the energetic costs of boat disturbance of dolphins

Austin Allen, Andrew Read, Doug Nowacek, Jeanne Shearer, Duke University; Katie McHugh, Randall Wells, Chicago Zoological Society; Peter Tyack, University of Saint Andrews; Frants Jensen, Woods Hole Oceanographic Institution; Andreas Fahlman, Oceanogràfic Valencia

Boat approaches elicit a range of behavioral responses in cetaceans; previous studies in Sarasota Bay have enhanced our understanding of the impacts of these approaches. Increasing attention is being placed on quantifying sub-lethal impacts on cetacean populations, including increased energy expenditure from swimming faster and maneuvering to avoid boats. Our main goal is to better understand the specific context of approaches (*e.g.*, boat type, speed, water depth, approach angle, etc.) which cause increased movement and associated energy expenditure, and ultimately determine if the energetic costs of repeated avoidance is likely to impact dolphins' daily energetic needs.

To understand dolphin movements during boat approaches, we rely on digital archival DTAGs, which record the dolphin's acoustic environment and movements and are attached to the dolphin's back by suction cups for up to 24 hours. In 2019 we deployed 8 DTAGs and followed the dolphins for several hours after release. During follows we recorded behavioral data, water depth, distance and bearing to the dolphin and any boats within 400 meters, as well as boat type and speed. Using our boat's GPS, we can then recreate the dolphin and approaching boats' position over time to determine how the dolphins' response (measured via DTAGs) changes with the type of approach. We are also analyzing DTAG deployments from the previous 9 years to determine the degree and frequency of change in animal movement when boats are detected acoustically on the tags. To get from activity to energy expenditure, we are using calibration experiments with trained dolphins at Dolphin Quest to establish a link between tag-based measures of activity and metabolic energy. Together, these studies will help us estimate how much of their daily energy budget is used to avoid boats, and ultimately, whether boat approaches interfere with dolphins meeting their daily energetic needs.

Above: DTAG is attached to record the dolphin's activity, behavior, and acoustic environment for up to 24 hours after release.
Left: F238 wears DTAG in June 2019. This year's project focused on determining how dolphins respond to approaching boats.

Phthalate exposure in Sarasota Bay bottlenose dolphins Part 2: Examining demographic, spatiotemporal, and hormonal correlates of exposure

Miranda Dziobak and Leslie Hart, College of Charleston

Phthalates are a group of man-made chemicals commonly used to extend the durability and flexibility of plastics. They are also used in consumer goods, such as cosmetics, personal care products (*e.g.*, shampoo), and cleaning solutions. Phthalates are not chemically bound to the materials they modify, and can therefore leach into the environment, posing a contamination risk to humans and other wildlife. Phthalates enter marine ecosystems through industrial, commercial, and municipal wastewater, surface runoff, landfill leakage into groundwater, and via deposition from rainfall. Once in the environment, phthalates can be absorbed through the skin, ingested, or inhaled, providing several routes of exposure for dolphins. Laboratory and epidemiological studies have linked phthalate exposure with endocrine disruption in humans and other mammals, thereby raising concerns regarding the health of exposed bottlenose dolphins. Because they are long-lived and apex predators, bottlenose dolphins may be vulnerable to chronic exposure and associated health effects.

Our recent pilot study (2016-2017) revealed detectable concentrations of phthalate metabolites in over 70% of dolphins sampled in Sarasota Bay, indicating some level of environmental contamination. In fact, levels of some metabolites were comparable or higher than concentrations reported in human reference populations. Human epidemiological studies have demonstrated differences in exposure related to demography (sex and age), geography (urban vs. rural), and time (year), as well as correlations with hormones related to growth and reproduction. Currently, influences on exposure and phthalate-associated health effects are unknown for Sarasota Bay dolphins.

This study will fill an important knowledge gap by characterizing the extent and variability in phthalate exposure faced by dolphins inhabiting Sarasota Bay. In humans, urine is the most reliable kind of sample used to measure exposure; mammals rapidly metabolize phthalates and excrete metabolites via feces and urine – they do not

bioaccumulate like PCBs or DDT. Following methods from the pilot study, archived (2010-2015) and prospective urine samples (2018-2019) will be screened for metabolites of the most commonly used phthalate parent compounds. These data will help to identify demographic, temporal, and geographic differences in exposure. Additionally, we will examine correlations between phthalate metabolite concentrations and hormones associated with phthalate exposure in humans. These analyses will allow us to explore the potential for phthalate-related endocrine disruption in bottlenose dolphins.

This work is being done as part of Miranda Dziobak's Master's thesis. Funding for this study was provided by an anonymous donor and the School of Education, Health, and Human Performance Dean's Fund at the College of Charleston.

Leslie (L) and Miranda (R) process samples during 2019 Sarasota Bay health assessments.

Vaquita conservation effort update

Randall Wells, Chicago Zoological Society

The future of the vaquita, a tiny porpoise found only in the Upper Gulf of California and only known to scientists since 1958, appears bleak as illegal fishing nets continue to kill them. In a July 2019 article published in the journal *Royal Society Open Science*, Dr. Armando Jaramillo-Legorreta and co-authors estimated that fewer than 19 vaquitas remained as of summer 2018, based on acoustic monitoring. They also stated that "from March 2016 to March 2019, 10 dead vaquitas killed in gillnets were found. The ongoing presence of illegal gillnets despite the emergency ban continues to drive the vaquita towards extinction. Immediate management action is required if the species is to be saved." Little of substance has occurred subsequently to reduce the threats to vaquitas. A 2019 survey team observed six vaquitas, including one first identified in 2018.

In 2017 we participated as part of an international team working at the request of the Mexican government on an *ex situ* conservation effort - to try to capture and hold vaquitas where they would not be exposed to threats from illegal fishing nets. The effort, known as VaquitaCPR, described previously in *Nicks'n'Notches*, was ultimately unsuccessful. Aspects of this project were documented in the Terra Mater film "*Sea of Shadows*" purchased by National Geographic at the Sundance Film Festival and released in 2019. The film describes the black market Chinese trade in swim bladders from the endangered totoaba fish and the role of this fishery in the likely imminent extinction of the vaquita.

Among the lessons learned from experiences with the vaquitas was that it is important to know well in advance what conservation tools are available and viable for a given species. By the time *ex situ* conservation actions were attempted with vaquitas, it was too late. To increase the probability of success for *ex situ* conservation, efforts should have been attempted, tested, and refined when many more vaquitas remained, recognizing that there could be a learning curve that might involve animals being lost. In the interest of making sure this lesson was put to good use, the "*Ex Situ* Options for Cetacean Conservation Workshop" was convened at the Cistercian Monastery in Heilsbronn, Nuremberg, Germany, in December 2018. The workshop was hosted by Zoo Nuremberg, the National Marine Mammal Foundation and YAQU PACHA (Organization for the Conservation of South American Aquatic Mammals), with support from Ocean Park Corporation, YAQU PACHA, and Zoo Nuremberg. A diverse group of biologists, veterinarians and population managers met to discuss if, when, and how to include *ex situ* options for addressing significant challenges to the conservation of dolphins and porpoises. Thirty-seven experts from 14 countries met for three days to review the situations that led to the extinction crises for the Yangtze River dolphin (baiji) in China and vaquita porpoise in Mexico, with the goal of ensuring that all potential conservation options are considered and available for other dolphins and porpoises facing the risk of extinction.

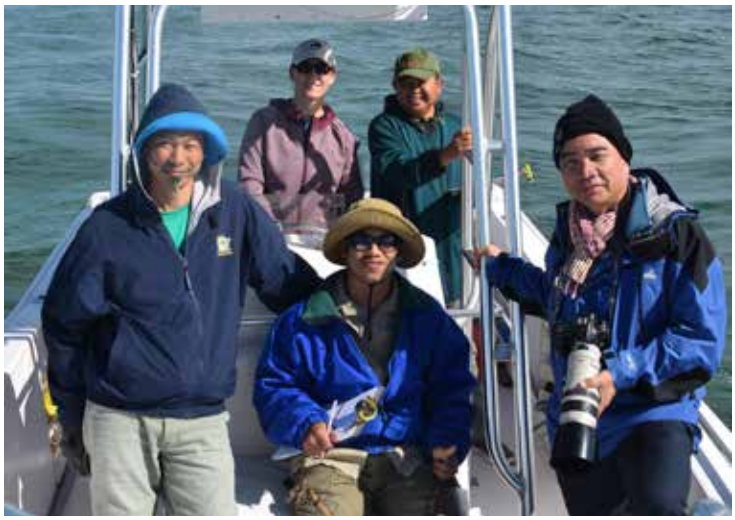
One outcome of the workshop was recognition of the need to build conservation capacity in areas where dolphin and porpoise populations are among the most threatened. In direct response to this need, the SDRP hosted researchers from Senegal (Atlantic humpback dolphin), Kenya (Indopacific humpback dolphin), and China (Yangtze finless porpoise) for training during 2019, described elsewhere in this issue of *Nicks'n'Notches*.

The film "Sea of Shadows" describes the illegal trade in totoaba swim bladders, and includes a segment on efforts in which we were involved to try to temporarily remove vaquitas from exposure to illegal fishing nets.

Building capacity of Cambodian dolphin researchers

Phay Somany, WWF-Cambodia and Lindsay Porter, University of St. Andrews

In response to the high mortality rate of Irrawaddy dolphins in the Mekong River in the past years, WWF-Cambodia and the Fisheries Administration (FiA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF), Cambodia, organized a series of International Expert Workshops, held in 2009, 2012, 2014 and 2017. These workshops included experts from the Chicago Zoological Society (CZS)'s Sarasota Dolphin Research Program (SDRP), the IUCN Cetacean Specialist Group, the Marine Mammal Commission (MMC), The Marine Mammal Center (TMMC) and the University of St. Andrews. An important output from the 2012 workshop is the Kratie Declaration on "The Conservation of the Mekong River Irrawaddy Dolphins" which consists of 25 management and research recommendations that now provide the basis for the management and conservation of Irrawaddy dolphin in the Mekong River. In 2017, progress on these recommendations was reviewed and additional recommendations put in place, to promote the continued success of the management strategy. A key recommendation was to build capacity within the Mekong River dolphin team, to enhance data management and analytical skills as well as to experience dolphin research in other parts of the world.



Above: Cambodian dolphin researchers on the SDRP observation vessel Nai'a, with Katie McHugh.
Below: The 21st Mekong River dolphin calf recorded since January 2018. Photo provided by Teak Seng, WWF-Cambodia.

In November 2018, with the support from SDRP, Disney Conservation Fund, TMMC and MMC, Mr. Phay Somany and Mr. Hang Sereyvuth from FiA, Mr. Lor Kimsan and Mr. Eam Sam Un from WWF-Cambodia and Dr. Lindsay Porter from the University of St. Andrews, traveled to Sarasota for training on photo-identification database development and to gain field-based experience in photo-identification, behavioral observations and biopsy sampling. It was an incredibly busy week, packed with new experiences and information exchange. For several of the visiting team, this was their first trip outside of Cambodia and the opportunity to experience a new culture was invaluable. Time was made in the busy schedule to visit Epcot and have a truly Florida experience! The cognitive research conducted on the facilities' dolphins was eye-opening (and the ride on Spaceship Earth was heart stopping!)

As a result, the Mekong River dolphin research team developed new skills in behavioral observation methodology, biopsy processes, necropsy procedures, and database management. An ongoing initiative from this capacity building trip is the development of the photo-identification database "FinBase" and its adaptation for use in Cambodia. The Mekong Dolphin research team benefited greatly from the exchange of experiences and ideas with the SDRP team. The knowledge gained from this capacity building trip has significantly contributed to addressing research needs in Cambodia and has helped to fill knowledge gaps in field study techniques and long-term data management. This experience has improved the practice of management and conservation of the critically endangered Mekong River dolphins, a living natural treasure of the Royal Government of Cambodia, for the next generation.

Ionian Dolphin Project and Sarasota Dolphin Research Program collaboration underway

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 founded in 1986. Between 21st March and 2nd April, I had the opportunity to visit the Sarasota Dolphin Research Program (SDRP). At the IDP we aim at ensuring the long-term viability of marine mammal species living in coastal waters of the eastern Ionian Sea. Our two study areas (*i.e.*, Inner Ionian Sea Archipelago and Gulf of Ambracia) are remarkably diverse in terms of environmental features, species present and threats caused by human activities, therefore offering opportunities to understand their links with dolphin status and conservation needs.

The Gulf of Ambracia and its high density of resident bottlenose dolphins offers an ideal "natural laboratory." The extensive research effort conducted for almost 50 years on Sarasota Bay dolphins provides a unique baseline for comparison. Both areas have exclusively bottlenose dolphins in their semi-enclosed waters and significant survey and

photo-identification effort has been done (and on-going), following similar methodologies in order to monitor their respective dolphin populations. In addition, despite having some of the highest densities reported for this dolphin species worldwide, both bottlenose dolphin communities face significant anthropogenic threats of different natures.

During 2020 we intend to adapt the IDP dataset to FinBase, an information management tool currently used by SDRP (guidance/advice by SRDP personnel will help significantly to overcome the initial technical difficulties arising during this process). This will greatly facilitate archiving, retrieval, and consistent analyses of sighting data, especially with regards to population dynamics and social structure. Through my participation in the SDRP surveys I received basic training on remote biopsy sampling techniques. For summer 2020 we aim at raising funds to have a SDRP delegation come to Greece to dedicate a couple of weeks to extensive biopsy sampling of bottlenose dolphins in the Gulf of Ambracia and possibly in the neighboring waters of the open Ionian Sea. Analysis of these samples will initially focus on persistent organic pollutant (POP) concentrations (the potential contribution of these compounds to adverse dolphin health effects must be considered). Other analyses may include cortisol; high hormone levels can impair reproduction, immune response, growth, and development, and make the animal more nutritionally vulnerable when prey is scarce. Measuring cortisol levels in wild dolphins can potentially help researchers identify populations that are dealing with challenging conditions. The levels of cortisol might be relatively high in the “Ambracian dolphins” given the increasing degradation of the Gulf. In addition, in spring 2020 one of my main collaborators at the IDP (Carmen Andrés) will be participating in an internship with the SDRP, which should help her to develop new skills and learn research methods and techniques to be implemented once back in Greece.

Last but not least, I would like to take this opportunity to thank Dr. Randall Wells and all the SDRP team for their dedication and support during my stay with them. I very much look forward to continuing a fruitful collaboration between our two projects.

Joan alongside Gretchen Lovewell, Erin Fougeres and Mike Walsh helping hold F316 during a disentanglement effort.

Conservation capacity building in Senegal

Ibrahima Ndong, African Aquatic Conservation Fund, Senegal

First, I would like to thank the Sarasota Dolphin Research Program (SDRP) staff, and my boss, Lucy Keith-Diagne, for the opportunity to participate in the program. I learned a lot from them, including how to work as a team, take samples and follow up on aquatic species, especially dolphins. And this was a great opportunity for scientists, like me, from Africa, and Senegal in particular. In the islands of Sine-Saloum in Senegal there is a protected and very endangered species, the Atlantic humpback dolphin. Their habitat is highly prized by the oil industry which put these species at greater risk.

The first thing that impressed me with the SDRP was the grouping of different experts from all over the world to exchange, share and teach. We have a population of dolphins in Senegal at risk because these protected aquatic species are not well-studied and appear to be frequently killed in fisheries. The SDRP has allowed me to better understand the behavior of dolphins, their interactions with each other, and also with humans. The program has better equipped me to participate in the conservation of these species.

During the dolphin health assessment in Sarasota I was able to participate in biopsy sampling. This was my first time seeing how to obtain genetic information about a living species. I also learned different field techniques, including taking pictures and species identification, and the way Jason explained the techniques used to identify dolphins was beautiful. With these techniques, I can develop methods to identify the species we have in Senegal. It would be nice to expand the photo-ID program for Atlantic humpback dolphins in Senegal and in its range in the surrounding countries. During my time in Sarasota, I also had the opportunity to follow and track dolphins, which allowed me to understand the behavior of the dolphins and by seeing what the animal was doing. This was the first time I used mapping software and this approach allowed me to see how the data collected with GPS and other tracking materials also give us additional information about the species.

In our organization we have a program, the Senegal Stranding Network (africanaquaticconservation.org/programs/senegal-stranding-network), which documents strandings of live and dead cetaceans and sea turtles along all of Senegal’s Atlantic coast. Every three months we do a beach survey of the North coast, which is 184 km long. Surveys take three to five days to collect data on all aquatic species stranded on the beach. We also respond to other reports of stranded cetaceans and turtles along the Central Coast year-round, and we hope to cover the southern coast of Senegal starting next year. During my stay with the SDRP, I was able to attend necropsy sessions with Mote’s Stranding Investigations Program manager, Gretchen Lovewell. She is a great person and her lovely team helped me gain experience with the anatomy of dolphins and the main signs

of different causes of mortality. This experience will help us in the program that we are conducting in Senegal.

Finally, I would like to share my experience with my colleagues in Senegal and Africa for the conservation of our aquatic species. Thank you again Randy and to everyone with the SDRP for this amazing experience!

Left to Right: Paulo Colchao, Mei Zhigang, Randall Wells, Ibrahima Ndong, and Michael Mwang'ombe.

Conservation capacity building in Kenya

Michael Mwang'ombe, Watamu Marine Association, Kenya

From 1st to 30th of June, I was invited to attend the Sarasota Dolphin Research Program (SDRP) dolphin health assessment project that took place for two weeks, and after that I spent an additional two weeks learning more about other various projects of the SDRP. The health assessment project involved bringing together dolphin experts and scientists working on different projects to better understand dolphin health and how their well-being can be assured through examining the threats to them and analyzing biological samples. One purpose was to train conservation professionals and students from around the world about techniques used by the SDRP. The beauty of this project was not only how it involved law enforcement but also the community. This particular project inspired me because it's the dream path that our Kenya Marine Mammal Network (KMMN) and Kenya Marine Mammal Research and Conservation (KMMRC) programs wish to follow and achieve some day.

There was a lot to learn, but I have identified the main study areas that can be implemented back in Kenya with collaboration and more training. One technique was dolphin capture and handling. Though it's a controversial conversation among many dolphin lovers, learning how to safely capture and handle marine mammals is an essential skill for anyone working in the field of animal welfare, because there comes a time when an animal is in need of human assistance and physical intervention. Without knowledge on proper procedures the process can be a danger to both the animal and the humans involved in the rescue. I got to spend some time observing the approaches and precautions that were taken while following the animals and how they were handled after being captured. Also, I got an opportunity to be on the "Catch boat," the boat that was used to catch the dolphins. Once the target dolphins were in the compass, we would get into shallow waters and try to make the compass much smaller so that the handlers could easily get to the dolphins. Once the dolphins were caught, there was a lot of information that was collected about them. My main interest was on freeze-branding, mapping rake marks using GIS, collecting blood samples, ultrasound, acoustics and tagging. Though maybe not all of this can be replicated with KMMN, with continued training, observation and collaborations, we can achieve our goals to learn more about resident populations in our two main sites that have been recognized through six years of photo-ID.

Michael engaged in training boat operators and Kenya wildlife service personnel on dolphin watching guidelines and importance of contributing sighting data through WhatsApp.

On the second week of my stay, I also got involved with Mote's stranding program and got a chance to help with sea turtle and dolphin necropsies. I felt this experience equipped me with skills to handle any stranding that we might encounter. Using what I learned from this program, I organized and scanned previous stranding reports and also plotted all the anecdotal reports that we had received into a map, which allowed us to view where there had been previous strandings. The knowledge gained will help us in the process of forming our stranding network in Kenya, which previously did not exist due to lack of capacity. This is in line with the recommendations from the presentation we did at the IWC Scientific Committee Meeting in Nairobi, May 2019.

This was also a great opportunity to network and also learn from other groups doing the same work as we do and see areas of improvement and after the first two weeks, there were a lot of potential improvements that were identified, along with how we could take advantage of these lessons to take our project into the next phase.

And when I arrived back in Kenya we got great news that three out of four Important Marine Mammal Areas (IMMA) submitted to the IUCN-Important Marine Mammal Task force had been accepted and will be published formally online using the IMMA e-Atlas (marinemammalhabitat.org/imma-eatlas). The fourth one will remain an Area of Interest (AOI) due to limited data, but with the experience gained with the SDRP, we are starting a new phase of our project which will help provide data to update the IMMA and also campaign for the 4th AOI to be recognized as an IMMA. We hope, with support from the Kenyan Government, that this could be a game changer in cetacean conservation in Kenya. We hope to continue training with the SDRP, especially in the areas of biopsy sampling, data analysis, photo-ID, acoustics, and stranding response and necropsy, to help us fulfill the recommendations from both the IWC Meeting and IMMA's but also to gather more knowledge to inspire the Kenyan population to appreciate the roles these magnificent animals play.

Photo-identification of Burmeister's porpoises in the Beagle Channel

Natalia Asplanato, Laboratorio de Ecología y Conservación de Vida Silvestre, Ushuaia, Tierra del Fuego, Argentina

Burmeister's porpoise, *Phocoena spinipinnis*, is a small cetacean endemic to South America. It lives mainly in coastal waters from southern Brazil around the tip of South America to northern Peru. In Tierra del Fuego, Argentina, this species is found both on the Atlantic coast and in the Beagle Channel. Even though this species is now classified as Near Threatened by the IUCN, many aspects of its ecology are still unknown and there is a lack of information about population sizes and trends. Photo-identification is a tool widely used to study marine mammals, but it has not yet been reported from any Burmeister's porpoise studies. The aim of this project was to test the feasibility of using photo-identification to study this species in the Beagle Channel. We conducted 18 boat-based surveys from Bahía Lapataia to Punta Segunda during 2018-2019. Data were collected only in Beaufort 2 sea-state or less. Photographs were taken using a Nikon 7100 with a 70-300mm lens and a Canon 7D with an 18-270mm lens. In total, 10 sightings of 15 different groups were recorded. The groups were difficult to follow as their course underwater was irregular. They swam fast and changed direction erratically. However, most of the groups approached the boat when the engine was off and remained around for at least 30 minutes. In total, 534 photographs were taken and 31 individuals with distinctive marks were recorded. Marks found on the dorsal fin and on the flank were used to identify each individual. Five individuals were seen at least twice in different surveys.

Studying Burmeister's porpoises is challenging, but not impossible. Through these preliminary results it is possible to say that, even though they have an erratic swimming behavior, photo-identification as a tool to study this species is feasible. Future studies using this methodology will allow us to deepen the knowledge about their biology and their ecology in the Beagle Channel. This research was supported by ANPCyT. As this is part of my PhD project, I would like to thank my advisors, Drs. Randall Wells, Natalia Dellabianca and Luciana Riccialdelli for guiding me in the study of this amazing species.

Above and Below: Burmeister's porpoises with distinctive markings, in the Beagle Channel, Argentina.

Behavior, Social Structure, and Communication

Dolphin communication studies

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

A major effort that we have begun in 2019 is to verify and make accessible the large database of whistles that we have recorded during health assessments over the past 35 years. We are going through the recordings systematically, and with the help of WHOI Visiting Investigator Frants Jensen, incorporating them into a standardized database format. We hope that this will make the whistles more accessible to a variety of research projects, including the Passive Acoustic Listening Station (PALS) project that is currently ongoing in Sarasota (see articles elsewhere in this issue). We are also using the catalog in our analysis of DTAG recordings, where we label whistles as signature and non-signature. This work has led to interesting findings about shared non-signature whistles that we are exploring further.

We are also using the catalog for our study of signature whistle development. With the help of University of Massachusetts Amherst undergraduate Adraiana Rozas, mother-calf whistle similarity was quantified on a scale of 1 to 5 by multiple judges for 158 mother-calf pairs (80 male and 78 female calves). Unlike our 1995 study with a smaller sample size, which found that male calves were more likely to produce whistles similar to those of their mothers than were females, we did not find a significant difference between males and females. Overall, 29 males and 26 females (35% overall) produced whistles highly similar to those of their mothers (values greater than 3.7 on a scale of 1-5). We looked more closely at patterns of similarity among mothers in our sample that had two or more calves. In several cases, we noticed striking similarities among whistles of siblings. All of the calves of six mothers (n=17 calves) produced whistles similar to their siblings. Yet in only three of these six cases did the calves also produce whistles similar to the mother. Thus, siblings appear to play a role in signature whistle development. Gaining a better understanding of the process of signature whistle development will provide insight into how signature whistles function in the natural communication system of dolphins.

We are very happy to report that Dr. Brittany Jones, who studied signature whistles with us over the last 5 years, has now passed her PhD defense. Her thesis is titled “Communication Accommodation Theory: A dolphin perspective.” Brittany found that Sarasota dolphins choose male alliance partners based on whistle similarity to their own signature whistle and that animals adjust minor whistle parameters when they are counter-calling, a phenomenon called vocal accommodation, which is likely to help in making their bond stronger (see January 2019 *Nicks’n’Notches*).

Right: Ginger and her calf during health assessments. Calves often develop signature whistles similar to their mother or siblings.

Study of vocal matching in dolphins by means of interactive playback experiments

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

Bottlenose dolphins can modify their sounds based on the experience of calls from other individuals, a skill that is named vocal production learning. They can change features of their signals to make them more similar or dissimilar to sounds that they hear. They are also capable of producing accurate copies of new calls after just one or few exposures. This ability may seem a trivial matter if we think about human language and consider the obvious importance of learning for our acquisition of vocabularies. However, vocal learning is actually a very rare skill among mammals, and aside from humans has only been documented in cetaceans, seals, bats and elephants.

Studies of vocal learning in songbirds and dolphins have shown that the rapid imitation of a call can be used to effectively address the conspecific that produced that sound. This kind of rapid vocal exchange can be referred to as “vocal matching.” While previous studies on bottlenose dolphins focussed on signature whistles, in June 2019 we conducted playback experiments during the health assessment in order to further investigate the role of vocal matching in these animals across various call types. As in previous projects in Sarasota, we played back sounds to dolphins while they were gently held in the water, and monitored their vocal and movement responses. This time, however, we used an interactive playback design in which we recorded calls from the subject of experiments and then rapidly played those same calls back as acoustic stimuli, thereby generating a

vocal match. Based on the identity information encoded in signature whistles, we hypothesized that vocal matching of signature whistles, rather than vocal matching of other call types, is used by dolphins in order to label other individuals. We predicted that subjects would respond to vocal matching of their signature whistle by reciprocating the match (*i.e.*, producing the same call again), while we predicted that they would not reciprocate the match in response to other call types. We also predicted that subjects would respond with more signature whistles and more head turns towards the speaker after vocal matching of their own signature whistle.

We were able to carry out 21 complete playback trials on a total of 8 dolphins, including 6 playbacks of the positive stimulus (signature whistle) and 15 playbacks of control stimuli (calls other than signature whistles). In agreement with our predictions, dolphins always responded to the positive stimulus by producing their signature whistle. Also, they responded with a higher average number of signature whistles and head turns towards the speaker when exposed to signature whistles compared to other calls. Interestingly, however, in 3 out of 15 trials the subject responded to the control stimulus by producing again the same call that was matched, 2 times for a non-signature whistle and 1 time for a click series. Dedicated analyses of call similarity will enable us to quantify how similar these vocal responses were to the call that was matched, compared to other calls produced by experimental subjects during health assessments. Our current sample size is too low for conclusive results, and we aim to continue this study in the future and to carry out more playbacks. While our preliminary results mostly confirmed our predictions, the evidence that dolphins sometimes reciprocated the vocal match after interactive playbacks of non-signature whistles and click series may indicate that vocal matching does not occur exclusively for signature whistles in these animals. This may open new exciting questions on how bottlenose dolphins address their conspecifics with acoustic signals.

Male alliance, Pi and Noah, being recorded during health assessments. Animals sometimes match each other's whistles, and this year's playbacks tested how the animals responded to hearing immediate matches of their vocalizations.

Quantifying responses to whistle playbacks using acoustic and movement-recording DTAGs

Laela Sayigh, Walter Zimmer, Frants Jensen, Woods Hole Oceanographic Institution; Marco Casoli, Vincent Janik, Peter Tyack, University of St. Andrews; Katie McHugh, Randall Wells, Chicago Zoological Society

Bottlenose dolphins communicate using individually specific signature whistles that help individuals identify and maintain contact with conspecifics. We have carried out a variety of playback experiments during health assessments that have answered questions about the function and perception of signature whistles (see past issues of *Nicks'n'Notches*, and the article by Casoli *et al.* in this issue). Now, with the help of new tag technology, we are starting to carry out these experiments with free-swimming animals.

In 2019, we continued to deploy sound and movement recording DTAGs on Sarasota dolphins as part of the health assessments, with nine tags deployed and 47 hours of data collected. These deployments had a dual purpose, to study energetic costs of boat disturbance (see article above by Austin Allen, *et al.*) and to investigate how animals respond to playbacks of familiar and unfamiliar whistle stimuli. During these experiments, we performed two playbacks to each dolphin, with each consisting of two whistles separated by 3 seconds of silence. One stimulus was from a dolphin from a geographically separated population (unfamiliar signature) and the other was from a highly associated dolphin (familiar signature). The impetus for carrying out these experiments was to establish robust responses to whistle playbacks, in order to eventually study how noise impacts these responses. Our initial predictions were that dolphins would approach familiar whistles and avoid unfamiliar whistles.

We conducted similar experiments during the 2017-2018 field seasons and analyzed these data to quantify movement responses directly from tag accelerometers. This dataset consists of 17 whistle playbacks to 13 individual dolphins. Clear motion responses were evident in every case, with varying degrees of intensity and duration. Two young males showed short-lived responses (less than 10 seconds), whereas three mothers with dependent

DTAG suction cupped to a Sarasota dolphin to study energetic costs of boat disturbance and to investigate how animals respond to familiar and unfamiliar whistle stimuli.

calves showed stronger and more prolonged responses (exceeding 1 minute). Two adult males traveling together also showed strong and prolonged (about 1 minute) reactions. Surprisingly, whether the stimulus was a signature whistle of a familiar or unfamiliar dolphin did not appear to affect the magnitude or duration of the response. Although more data are needed, especially from young animals, our preliminary results indicate that older (greater than 4 years) dolphins show stronger responses to whistle playbacks than younger (independent) animals. Further research is needed to determine whether and to what degree social context, behavioral state and playback design (*e.g.*, stimuli features, post-tagging effects) may have influenced these responses. In the coming year, we plan to analyze the 2019 data sets as well as to increase our sample size with additional playback trials.

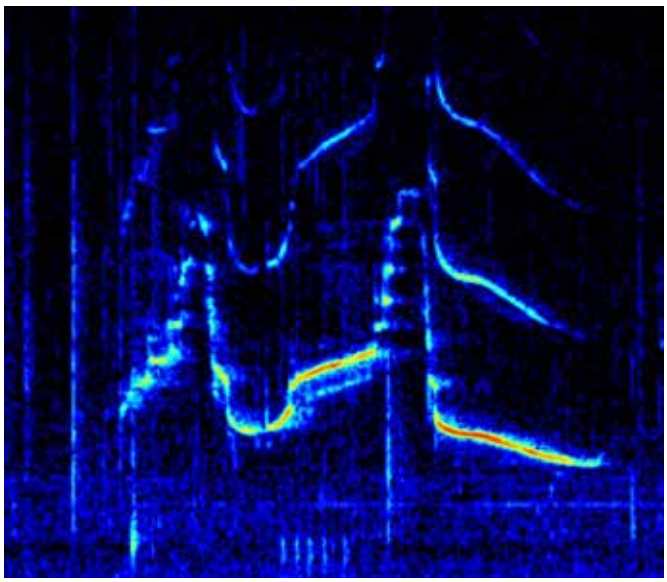
Dolphin wearing a DTAG turning in response to a playback. Movement responses can be measured directly from accelerometers in the tag.

Who said that?

Austin Anderson and Athena Rycyk, New College of Florida; David Mann, Loggerhead Instruments

The Passive Acoustic Listening Station (PALS) network has nine acoustic monitoring stations around Sarasota Bay, recording audio around the clock. This means up to 27 TB of acoustic data are being recorded per year. A human can't possibly listen to all those recordings to identify dolphin whistles. Recognizing this challenge, an automated system of identifying dolphin whistles has been developed. Through collaboration with New College of Florida (NCF), a library of bottlenose dolphin whistles was created by undergraduate students using the network's recordings. A data science graduate student from NCF, Austin Anderson, used the sound library to build a highly accurate dolphin whistle detector using machine learning algorithms. These algorithms can process one hour of audio recordings in two minutes and close to a **quarter million** whistles have already been identified.

Dolphin whistles can not only tell us that there is a dolphin present, but can tell us who. Bottlenose dolphins produce individually-distinctive signature whistles. We took the next step and developed a tool that clusters whistles based on their contour (shape). At the Sarasota Dolphin Research Program's (SDRP) Cortez station, three whistle contours in particular were heard very often. This spurred a collaborative effort to identify the dolphins producing those whistles. SDRP sighting data in the area narrowed down the list of potential dolphins, and the specific signature whistles of the short-listed dolphins were provided by Laela Sayigh, Vincent Janik, and Peter Tyack from the Sarasota Dolphin Whistle Database. Combining this information led to the identification of the specific dolphins producing those three abundant whistles. Even more exciting, we discovered those three signature whistles are from related dolphins. A mother and two of her calves (born in different years) have all been frequenting the same station! The signature whistle of the mother is shown below. We can now track when those specific dolphins visit the station, or any other station, without human observers on-site and regardless of time of day. The next step is to expand the clustering tool to include more signature whistles.



A visual representation of a signature whistle produced by dolphin F197, with time shown along the x axis, and frequency on the y axis. The shape of the whistle is specific to this individual dolphin.

F197 and her 2019 calf 1974. Her whole family still likes to hang out by the listening station.

Health and Physiology

Health assessment project summary: June 2019

Randall Wells, Chicago Zoological Society

With primary support from Dolphin Quest, the Sarasota Dolphin Research Program (SDRP) conducted a capture-release dolphin health assessment in Sarasota Bay during June 3-14, 2019. Of particular importance this year was measuring dolphin body condition following the loss of at least 88% of their primary prey fish in summer 2018 during the severe red tide, as documented by the SDRP's ongoing, long-term Sarasota Bay fish surveys. A team of 190 biologists, veterinarians, trained dolphin handlers, and trainees participated over the two weeks, with about 100 people on the water each day, in a dozen boats. Many of the participants were involved because of a NOAA Prescott-funded training component to the project, providing training and dolphin handling opportunities and experience to state and local law enforcement officers, veterinarians, vet residents, vet interns, vet technicians, NOAA personnel, Marine Mammal Commission personnel, stranding response personnel from other organizations, our local volunteer rescue team members, international trainees (from Senegal, Kenya, China, Peru, and Spain), and alternative dolphin catchers. Each dolphin sampled contributed to 46 research and monitoring projects. In total, we sampled 16 dolphins, or about 10% of the local resident dolphin community (7m:9f), ranging in age from 2 to 44 years. Eight of these were caught for the first time, including six 2- to 4-yr-olds. All of these young animals were either significantly underweight relative to reference ranges, or at the low end of normal ranges, similar to what we observed in 2006 following a previous severe red tide. One older animal was also in the lower end of normal weight. One of the dolphins examined during the project was a young male that had been rescued and disentangled by Mote's Stranding Investigations Program and the SDRP on April 1st (F316). His previous severe entanglement wound was found to be healing well. He is still well below expected body condition, but improving. Many of the samples and data from the health assessment project are currently being analyzed and will be published in peer-reviewed journals and presented at scientific conferences.

Using ultrasound to assess dolphin health

Jenny Meegan and Carolina Le-Bert, National Marine Mammal Foundation

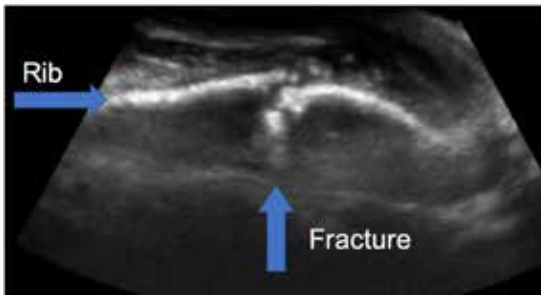
In the aftermath of the *Deepwater Horizon* (DWH) oil spill, impacts to common bottlenose dolphins in heavily oiled coastal areas of the northern Gulf of Mexico were well documented by the Natural Resource Damage Assessment (NRDA). Some of these health issues included pneumonia and reproductive failure, which were detected using ultrasound during health assessments of dolphins in the heavily oiled regions.

In an effort to better understand the long-term effects of oil exposure on bottlenose dolphins, a multi-year investigation, funded by the Gulf of Mexico Research Initiative (GoMRI), was launched to expand on the previous NRDA studies of heavily oiled areas of the Gulf. Part of this investigation has included regular health assessments of dolphins performed both in the oil spill footprint, as well as in Sarasota Bay, Florida. Since Sarasota Bay dolphins were not exposed to oil, they continue to serve as a healthy, wild dolphin reference population, for comparison to dolphins in the heavily oiled regions.

As part of the SDRP health assessments, each dolphin receives a complete ultrasound evaluation. The use of this non-invasive diagnostic tool allows the team to assess pregnancy status, evaluate lung health, and identify other potential underlying injuries or illnesses. This information provides veterinarians and scientists with real-time health data. This year's ultrasound examinations were performed by Drs. Jenny Meegan and Carolina Le-Bert, veterinarians specializing in dolphin medicine. Some unique findings this year included a male dolphin (F264) identified to have a healing rib fracture (see image on next page), as well as a young female dolphin (F287) with several bright, circular foreign objects attached to the pyloric stomach wall (see image on next page). These objects were likely to be the parasitic trematode *Braunina cordiformis*, also known as the dolphin stomach worm.

Right: Dr. Carolina Le-Bert of the National Marine Mammal Foundation, performing an out-of-water ultrasound exam on a Sarasota Bay dolphin. Left: Team members prepare to secure a third dolphin in the net corral and begin veterinary examinations of all three in the group. Photo by Global Support and Development.

While these findings were considered incidental, they do illustrate the value of a thorough ultrasound examination in providing veterinarians and scientists with a complete health profile for each individual dolphin assessed. Scientists can then use this information to compare health profiles collected from dolphins in the heavily oiled region, providing further insight into the potential impacts of the DWH oil spill on overall health for dolphins in this part of the Gulf of Mexico.



Left: Ultrasonographic image of a rib (horizontal arrow) highlighting a rib fracture (vertical arrow).

Right: Ultrasound image of several round hyperechoic (bright white) foreign objects which appeared attached to the pyloric stomach wall in a young female dolphin (see arrows).

Measuring coupling of heart and lung function in bottlenose dolphins

Ashley Blawas and Doug Nowacek, Duke University; Andreas Fahlman and Alicia Borque-Espinosa, Fundación Oceanogràfic; Randall Wells, Chicago Zoological Society

The lungs and the heart work together to accomplish the important physiological process of bringing oxygen from the air to the cells and removing carbon dioxide from the cells to the air. For marine mammals that are required to hold their breath while they move underwater, it is beneficial to complete this task quickly and efficiently so that the animal can maximize time spent underwater and have sufficient oxygen stores to supply to its cells during the dive. Our research investigates the relationship between the lungs and the heart to understand how these systems work together when a dolphin is resting in water under normal conditions and when the animal is out of water, as it would be under stranding conditions, when it is feeling the full effects of gravity on its body.

In order to quantify the relationship between the function of the lungs and the heart, we collected simultaneous measurements of the breathing rate and the heart rate by using a low-resistance flow meter that could be placed over the blowhole of a dolphin to record breaths while three suction cup electrodes measured the heart's electrical activity. Our results show that there are predictable changes in the heart rate following a breath, a phenomenon called respiratory sinus arrhythmia (RSA), in the dolphins both when they are submerged in water and out of water. RSA in dolphins is expressed as an increase in heart rate after a breath is taken, followed by a gradual decrease in heart rate until the next breath is taken. This relationship between the rates of pumping by the lungs and the heart is thought to improve the efficiency of oxygen delivery to the blood and save energy and therefore may be important for the way dolphins manage their oxygen stores.

There are several important implications of this work, both in understanding the basic physiology of marine mammals and in its conservation impacts. RSA may be an important mechanism for dolphins and other marine mammals to manage their oxygen stores. By establishing a quantitative baseline for RSA in a well-known population of bottlenose dolphins we will have a "yardstick" for comparison to understand how different populations and different species may be managing their oxygen stores more or less efficiently. Likewise, establishing this baseline will also allow us to understand how changes in breathing rate or heart rate due to anthropogenic stressors like noise, changes in prey distribution, or boat presence may affect oxygen management. Finally, we have collected data both when the dolphins are submerged in water and when they are out of water to understand how the relationship between the lungs and heart may change when a dolphin is in a stranding situation. If the relationship between the lungs and the heart is compromised when the animal is out of water, it may not be able to gain as much oxygen in a single breath and may have difficulty returning immediately to normal physiological function when returned to the water. By quantifying these physiological changes we can better manage stranded animals in order to produce successful outcomes.

Developing a non-invasive diagnostic tool for assessing lung health in dolphins

Alicia Borque-Espinosa, Andreas Fahlman, Felip Burgos, Fundación Oceanogràfic; Randall Wells, Chicago Zoological Society; Ashley Blawas, Duke University

For marine mammals, life is a complex balance between breathing at the surface and oxygen use while foraging or traveling underwater. Oxygen consumption depends on the underwater activity, but also on the unique physiological traits of these animals. Thus, the respiratory and circulatory systems are coordinated to maximize time underwater, obtain enough food for survival, and minimize time at the surface where marine mammals are exposed to a number of threats such as predators or boat strikes. Therefore, any physiological or functional change that affects this balance will have a direct impact on the animal's fitness. Consequently, for marine mammals like dolphins, improper

function of gas exchange may have a significant effect on their survival.

Respiratory disease is one of the most common causes of mortality among marine mammals. While lung disease can have different origins (*e.g.*, bacterial, fungal, etc.), reduced lung capacity may decrease the volume of air with each breath, increasing the respiratory effort and reducing gas exchange efficiency in the lungs. Thus, inappropriate lung function could decrease the available oxygen during diving, limiting diving capacity, time underwater, and thereby their chances to obtain enough food or engage in other important behaviors.

Marine mammals often mask respiratory issues until they are severely affected. Common methods to assess lung health in these animals include radiography, computed tomography, ultrasound, bronchoscopy, bronchoalveolar lavage, blow and blood samples, and cytology. However, some of these are logistically challenging in large marine species, others have low sensitivity to detect certain types of diseases, and none provide information about the functional changes in lung function or gas exchange associated with the disease. Thus, dolphin spirometry, a supplementary diagnostic technique, is being developed by researchers at the Fundación Oceanogràfic in Valencia (Spain), in collaboration with the Chicago Zoological Society. This method will help to assess lung health, and for sick animals help to specify the type of disease.

In human medicine, spirometry (or pulmonary function testing) is the most common diagnostic tool for detecting respiratory disease. For spirometry testing in humans, the doctor asks the patient to make a maximal respiratory effort while blowing into a spirometer, and the resulting relationship between the flow-volume is used to assess changes in function. Currently, the researchers from Spain have adapted the methodology used in human medicine to assess lung health for the bottlenose dolphin. The dolphin spirometer has a soft interface that allows the flow meter to be placed over the blowhole. This allows the dolphin to breathe normally while measurements of respiratory flow and breath duration are made. The results in dolphins managed under human care showed that pulmonary disease could be detected using spirometry in stranded wild animals while spontaneously breathing.

Spirometry being performed during the 2019 Sarasota dolphin health assessment.

The Sarasota dolphin health assessment provides an opportunity to collect lung function data from a dolphin population that has been extensively evaluated. Thus, the results provide important information about the health status of this population and about the functional changes related to lung disease. In addition, these data increase our baseline to continue working on the development of this non-invasive and easy tool, to help improve our understanding and conservation efforts.

Flow cytometry functional immune assays

Consuelo Rubio-Guerri, Mar Felipo Benavent, Fundación Oceanogràfic; Randall Wells, Chicago Zoological Society; Alicia Martínez, Enrique O`Connor, Principe Felipe Research Center, Valencia University

Since 2016, Fundación Oceanogràfic in collaboration with Principe Felipe Research Center and University of Valencia started to measure the functionality of immune cells in the marine mammals living at the Oceanogràfic of Valencia, Spain. Human protocols were adapted to use in these species (bottlenose dolphins, beluga whales and walruses) to obtain the baseline for these functional studies. With these studies we can know if an animal is immunocompromised. This is super important because we are obtaining additional information about the health status of the animal and we can treat the animal better when we have more complete information about its status. An immunosuppressed animal can obtain infectious diseases and die or can be in this state as a secondary effect of an infectious disease.

Our objective is to help stranded animals on our Spanish coasts by assessing their immune system functionality. However, when we started to assess the wild dolphins that stranded alive, we saw many differences from the bottlenose dolphins that live at the Oceanogràfic, and we could not conclusively assess the immunological capacity of the animal. We didn't know if these differences were because of existing sickness of the wild dolphins that arrived at our coast or because wild dolphins live in a different environment.

We have had the opportunity to be part of the team of the Sarasota health assessment project this year and compare the results that we have obtained from dolphins under human care with data from healthy wild bottlenose dolphins. We have performed the protocols in Sarasota that we carried out with the dolphins at the Oceanogràfic, thanks to University of South Florida Sarasota-Manatee and Beckman Coulter. Each day after the blood samples arrived at the dock, we conducted experiments until really late at night. We have observed some differences in the preliminary results with dolphins under human care. This is really interesting because our hypothesis that the functionality of the immune

system is different if these animals live in a controlled environment or in the open sea is fulfilled. These samples will give us the baseline data to assess wild dolphins that strand on our coasts and see if they are immunosuppressed, and determine why. Now, we have to see what these results imply and how they will affect the interpretation of the data obtained in wild animals.

Veterinarians collect blood from a dolphin's fluke for immunoassays.

D-dimers as potential indicators of health status

Ashley Barratclough, National Marine Mammal Foundation; Nicole Stacy, University of Florida

During each dolphin health assessment, blood samples are collected. In order to maximize the amount of information from each sample, a wide array of blood tests is performed. A novel test in both veterinary medicine in general as well as marine mammal medicine is the measurement of D-dimers. These are products of blood clot break-down and therefore give an indication of the health status of the animal and whether any previous bleeding or blood clots have occurred. High levels of D-dimers can inform the veterinarians about whether previous trauma has occurred, or if there is an underlying disease occurring. The Sarasota Dolphin Research Program (SDRP) is the first organization to attempt to measure D-dimer levels in wild dolphins. Previous work by the U.S. Navy Marine Mammal Program first investigated blood coagulation in dolphins in 2005. We hope to be able to use this diagnostic test to improve our understanding of wild dolphin health and subclinical disease.

Assessing social activity through tooth "rake marks"

Wendi Fellner, Disney's Epcot's The Seas

Imagine if, instead of greeting an acquaintance with a handshake or a hug, it was customary to use your teeth! This is exactly what dolphins do in some friendly and not-so-friendly encounters, and we can see the evidence long after these social interactions in the form of "rake marks" that are left on the skin by the grasping dolphin's teeth. Although it has long been known that receiving some number of rakes is a normal part of social activity for a dolphin, we are now working to better understand how many is normal, how often dolphins receive deep rakes that penetrate beyond the surface layer of skin, and whether there are differences among dolphins of different ages or sexes. The long-running work of the Sarasota Dolphin Research Program (SDRP) with the dolphins that reside in Sarasota Bay gives us a special opportunity to study rake activity because so much is already known about the dolphins' social lives and personal histories. For example, because of regular surveys of the dolphins and their close associates, it is often possible to know when a calf has achieved independence from its mother. Observing the number of rakes worn by dependent calves and newly independent subadults yields precise information about social activity before and after this important milestone. Having an accurate understanding of what's normal is important for understanding the welfare of dolphins everywhere, both in the ocean and for dolphins under human care.

During the health assessment of the Sarasota dolphins, each dolphin 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 the dolphins carried an average of 18 rakes overall with males averaging more than three times as many as females (male = 28, female = 9) and adults averaging five times more than calves (adult = 25, subadult = 12, calf = 5). Superficial rakes that only broke the epidermis were much more common than deeper rakes that went into the hypodermis/blubber for both males and females. Having a better understanding of the pattern of rakes worn by healthy individuals at different stages of life helps inform health and welfare decisions for both ocean- and aquarium-living dolphins.

Seventeen-year-old male dolphin Thrasher with several superficial rakes on his peduncle (tail stock) and deeper rakes on his dorsal fin (see picture above).

Vertebral bone density assessment in free-ranging bottlenose dolphins

James Powell, Portland State University

Ultrasonic bone density assessments have been conducted during capture-release health assessments in Sarasota since 2014, using a custom bone sonometer. Initial assessments for this study were conducted on the radius in the pectoral flipper, a skeletal site homologous with the region measured in the human forearm. Ultrasonic bone density assessment is a through-transmission technology requiring access to both sides of a bone, thus adequate skeletal sites in the bottlenose dolphin are limited. Accurate and reliable placement of the bone sonometer on the flipper required a dolphin to be out of water on-board a research examination vessel. In some health assessment projects, dolphins may be processed entirely in-water, thus excluding pectoral flipper bone assessment. Dolphins in poor health, mid- to late-term pregnancy, or who respond adversely to handling on-deck are typically not out of the water long enough to facilitate bone density measurements.

Alternatively, vertebral scans performed on the caudal peduncle (tailstock) can be conducted on dolphins held in-water or on-board a research vessel with the flukes voluntarily presented while the dolphin remains upright rather than rotated. Additionally, the bone sonometer can be placed more rapidly for a vertebral scan by simply palpating the transverse processes of the vertebrae and immediately placing the transducers in position. This advancement would not only expedite the clinical assessment but could also allow researchers to explore new questions based on this new skeletal examination site. From a biological perspective, whereas the dolphin radius lacks any muscular attachments and skeletal loading on that bone is limited to overcoming the resistance of water during locomotion and maneuvering, the caudal vertebrae are acted upon by regular, strong muscle actions and represent a more active musculoskeletal target site. Knowledge of vertebral bone density could open different areas of scientific inquiry that may not be directly possible to address with radial density values.

Proof-of-concept efforts for this advancement have been initiated. Ultrasonic assessment of tailstocks archived from dead-stranded dolphins by Mote Marine Laboratory's Stranding Investigations Program and the National Ocean Service were performed. Standard radiographs confirmed placement of transducers properly aligned with the target vertebrae. Vertebral scans on live dolphins were performed during the 2019 bottlenose dolphin health assessments both on-board a research vessel and in-water. In-water assessments were slightly more challenging than on-board assessments and were complicated by water depth, wave action, and the dolphin's general reaction to handling, but were still successfully conducted. The newly configured bone sonometer and techniques established in Sarasota will facilitate the use of this technology to assess dolphins in other areas and situations where in-water examination is necessary.

James Powell tests his bone sonometer on a dolphin's peduncle while colleague Spencer Fire collects the data on his computer.

Hearing measurements of bottlenose dolphins in Sarasota Bay

Mandy Cook, Portland State University

Dolphin, F318, during AEP testing, showing placement of the jawphone on the lower left jaw of the animal and AEP sensors on the animal's dorsal surface. A recording hydrophone is located on the melon (between the beak and the blowhole) of the animal.

Bottlenose dolphins can hear sounds from about 75 Hertz (Hz) to more than 160,000 Hz, well beyond the range of human hearing (20-20,000 Hz). These animals rely heavily on their hearing to successfully navigate through their environment, find food, and communicate with each other. Noise in the marine environment—both naturally-occurring and man-made—can negatively affect a dolphin's ability to hear, and can potentially cause temporary or permanent hearing loss. Since 2003, we have been measuring the hearing abilities of bottlenose dolphins in Sarasota Bay using auditory evoked potential (AEP) techniques similar to the ones used to test the hearing of newborn human infants. A jawphone (an underwater speaker embedded in a suction cup) is attached to the lower jaw of the dolphin, and short tones are played that vary in frequency and loudness. Sensors (also embedded in suction cups) attached to the head of the dolphin detect the brain waves produced in response to the tones. These responses are then analyzed to determine each dolphin's hearing abilities.

Nine dolphins (four males and five females, between two and twenty-seven years old) had their hearing tested during the June 2019 health assessments. To date, our findings show that bottlenose dolphins in Sarasota Bay do not exhibit significant hearing losses with increasing age, nor are male dolphins more likely than female dolphins to experience hearing problems. In addition, these animals are not exhibiting hearing losses due to chronic environmental noise exposure, including man-made noise. Continued testing during future health assessments will allow us to determine if the hearing abilities of individual animals change over time.

This work was partially supported by a grant from the Portland State University Faculty Association Professional Development Fund.

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 standardized 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 have been eighteen births in 2019, 13 of which have survived. For the second season in a row, a well-known resident, FB25, was documented with her eleventh calf. She has been sighted more than 900 times since 1984. Bobbitt and 1494 both had 2018 calves that did not survive long, but were each able to have another calf this season. Tramp was sighted later in the calving season with a newborn, her seventh calf (see photo).

While most members of the Sarasota Bay dolphin community are observed throughout the year, some dolphins, especially adult males, will range farther from time to time. Lemuel and F234 returned after absences of one and three years, respectively. We do not know where Lemuel was over the past year, but F234 was sighted 27 miles north of Sarasota Bay by two research groups who contribute to the Gulf of Mexico Dolphin Identification System (GoMDIS).

Unfortunately, we have lost several other community members over the past year, and only six of the eleven calves born in 2018 have survived. Two of our 2017 calves and one of their older siblings died during the severe red tide algal bloom last fall. Thankfully, the waters seem to be returning to normal including the return of fish to the bay discussed in the prey monitoring update article. Interestingly, a record number of our community members have been observed with fresh shark bites (see photo), narrowly missing becoming prey themselves!

Our long-term, monthly photo-ID surveys are the core effort of our program, supporting all other projects. More than 52,400 dolphin group sightings since 1970 have yielded more than 158,000 identifications of more than 5,600 individually distinctive dolphins. In support of these identifications, more than 830,000 dolphin photographs and videos are currently archived by the Sarasota Dolphin Research Program. Data from monthly monitoring surveys and all of our photo-ID efforts are archived in a relational Access database (FinBase) designed specifically for bottlenose dolphin photo-ID data and images. Work has begun to integrate this database with our focal animal behavioral follow database, which contains 2,689 follows of 220 individual dolphins from 25 projects dating back to 1989. This database 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!

A dolphin manipulates a large mullet before swallowing it whole.

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, 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.

Tricia's two-year-old calf surfaces next to our research vessel with a superficial bite from a large shark.

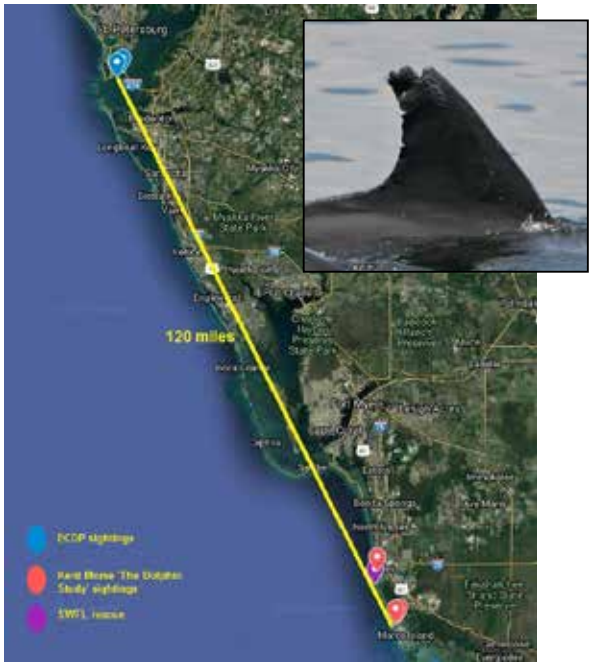
Tramp's less than two-day-old calf surfaces next to her in Palma Sola Bay.

Using GoMDIS (Gulf of Mexico Dolphin Identification System) to piece together the life histories of individual animals

Carolyn Cush and Randall Wells, Chicago Zoological Society

With support from the National Fish and Wildlife Foundation (NFWF) and the FAU/Harbor Branch Oceanographic Institute (HBOI), the Gulf of Mexico Dolphin Identification System (GoMDIS) enters its seventh year as the standardized and centralized repository for bottlenose dolphin catalogs from collaborators around the Gulf. As we add catalogs and discover matches, we continue to see one of the main benefits of this collaborative effort: piecing together sighting histories of the same animal from multiple groups to get a better picture of a particular animal's story and range. A recently found and interesting example is an animal that was known to the Eckerd College Dolphin Project (ECDP) in Tampa Bay that made a fairly sudden shift to the south, all the way down to Marco Island, FL. The straight line distance between the furthest two sightings is more than 120 miles!

For GoMDIS, we collect the best left and right fin images of every animal from each of our collaborators. Each image set therefore contains one or two images of each unique



Dorsal fin photo of STKR in 2005, Tampa Bay, FL (photo by Eckerd College Dolphin Project, collected under NMFS Scientific Research Permit Nos. 1077-1794, 15512 and 19540). Sighting history of STKR/Cockatoo/ FMMSN1006 now spans more than 120 miles and 13 years.

Disentanglement of FMMSN1006 (aka STKR and Cockatoo) in 2010 from a crab trap line off the coast of Naples, FL (photo by Florida Fish and Wildlife Conservation Commission Field Laboratory under MMPA sec109h).

animal they have seen, which serves as their catalog. After we have processed the images and associated data into the system, we can then begin the search for animal matches between these catalogs. Typically, we don't know if any of these animals are shared (seen in more than one researcher's catalog) until we conduct a search for that individual.

In the summer of 2005, an animal known as STKR was seen twice in Tampa Bay, FL by the ECDP. Roughly five months later, in January 2006, it was seen by an eco-tour off Marco Island, FL (The Dolphin Study, run by Kent Morse) and had been cataloged as 'Cockatoo.' This was the furthest documented extent of this animal's movements, more than 120 miles to the south. While this catalog is not officially part of the GoMDIS collaborative effort because GoMDIS can only include data collected under federal research permits, it still provides valuable insight for animals in southwest Florida. In 2010, this animal was rescued by the Florida Fish and Wildlife Conservation Commission's Southwest Florida Field Lab as it had become entangled in a crab trap line off Naples, FL. It was then observed again by The Dolphin Study in Naples in 2018.

Without this collaborative effort, this animal would not have much of a story. It would have existed as three different animals in glimpses of time in separate study areas without any connections among the sightings. In addition to expanding the sighting history to 13 years, we have confirmation that the animal survived after the disentanglement. We are hopeful to continue this animal's story, as SDRP has expanded survey efforts in the Naples area. At this time, we could not even begin to speculate the reasoning behind the original long distance shift, but cases like this certainly add to the intrigue and appeal of the GoMDIS project. We will continue to search for this animal in the years prior to 2005, as it appears to be a large animal and may exist under a different identification - part of the detective work involved is examination of photographs of the dorsal fins. Because dorsal fins change over time, it is possible this animal has been documented in earlier years but the fin may look somewhat different. We will closely examine all the nicks and notches like clues to assist with this puzzle.

Bottlenose dolphins in southwest Florida: Abundance and distribution

Reny Tyson Moore, Christina Toms, Jason Allen, Chicago Zoological Society

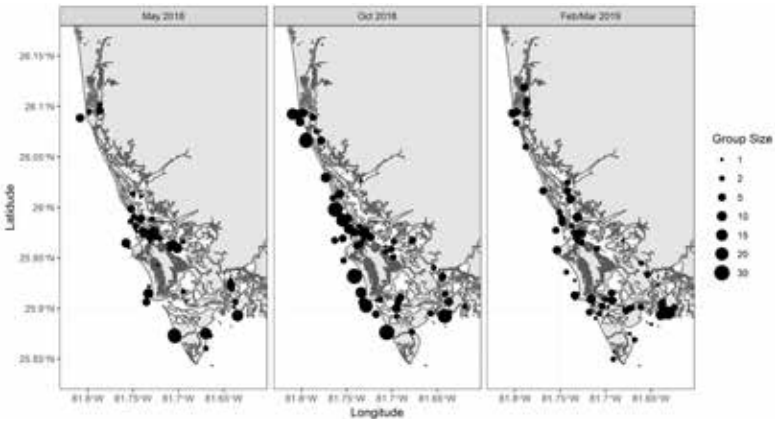
The coastal and inshore waters near Naples and Marco Island, Florida, are home to a stock of bottlenose dolphins for which very little is known, but which appear to be facing increasing anthropogenic (man-made) threats as evidenced by multiple entangled and/or rescued individuals in recent years. In 2017, the Sarasota Dolphin Research Program (SDRP), in partnership with the Rookery Bay National Estuarine Research Reserve (RBNERR), started a photo-identification (photo-ID) program in this region to gain a better understanding of the animals that live there and the threats they face. In 2018 we began the first phase of this program, which involved carrying out photo-ID capture-mark-recapture (CMR) surveys to estimate the population size of bottlenose dolphins in the region and to build a photo-ID catalog of distinctive individuals inhabiting these waters. CMR surveys lead to abundance estimates through consideration of the numbers of resightings of distinctive individuals.

From May 2018 through March 2019, we conducted nine photo-ID CMR surveys. We observed 216 unique groups of dolphins, with group sizes ranging from 1 to 30 individuals. The largest groups were observed along the coast, in Gullivan Bay, and near passes to the Gulf of Mexico. CMR models indicated that 116 - 260 (mean = 171) dolphins inhabit the inshore waters from Naples to the northern Ten Thousand Islands National Wildlife Refuge, and that at least 330 individuals use the coastal and inshore waters in this region. These surveys also provided new information

regarding the health and behavior of dolphins in this region. For example, we observed several dolphins each sampling period with unusual skin conditions or markings that may be related to a disease and/or prolonged exposure to freshwater. We also observed a high proportion of individuals with physical evidence of adverse human interactions or concerning behavior (damaged fins, entanglement scars, patrolling behavior around boats), in addition to three individuals entangled in fishing gear. The prevalence and drivers of these human interactions are currently being examined by Lindsay Hooper, a Master's student from Florida State University (and previous SDRP intern), to provide insights into the extent of these threats (see article above).

As this phase of the project comes to a close, we must thank the staff of RBNERR as well all the CZS and SDRP staff, interns, and students who helped bring it to fruition and see it through to completion. We are also very grateful to the Batchelor Foundation and to the Wauterleks for the financial support they provided for this research. Stay tuned for future results from other ongoing studies in the region!

Skipper (left), a female dolphin that the SDRP team disentangled in September 2014, observed with another dolphin who was entangled in 2018 (right).



Above: Distribution of dolphin sightings near Naples/Marco Island during the photo-ID CMR study, with reference to field estimates of group size.

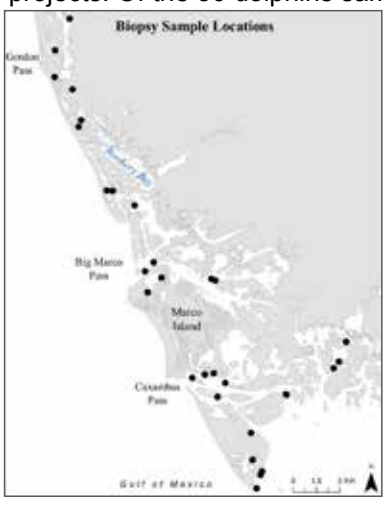
Right: Biopsy sampling locations in the Naples/Marco Island study area.

Applying the BEAT! Expansion of a newly developed tool to the Naples area to assess unknown bottlenose dolphin ages

Christina Toms, Chicago Zoological Society; Andria Beal, Jose Eirin-Lopez, Florida International University

The Sarasota Dolphin Research Program (SDRP) teamed up with colleagues from Florida International University (FIU) to expand on an exciting new bottlenose dolphin epigenetic age-determination tool (BEAT). Age is a critical piece of information for the ecological study of animal populations. The BEAT was developed as an epigenetic-based approach to determine the age of individuals without having to track them since birth or examine a tooth and count growth layers (see Beal article below). The BEAT was ground-truthed with dolphins of known ages from the Sarasota community. The next step was to implement it in a new population with dolphins of unknown ages. The dolphins of the new SDRP study site in Naples/Marco Island were excellent candidates. The SDRP initiated a population abundance study in this area in 2017, in partnership with Rookery Bay National Estuarine Research Reserve (RBNERR, see Tyson Moore article above). Results highlighted some additional concerns in this region, including multiple cases of skin lesions, similar to that described in other populations in association with viral and fungal-related diseases. Very little is understood about the causes of dolphin skin lesions and their prevalence raises questions about population health and potential stressors in the environment. A remote biopsy dart sampling project was developed to apply the BEAT tool and further investigate some of these concerns through a suite of analyses possible from small skin and blubber samples.

The biopsy project was conducted during August 19-23, 2019 out of RBNERR. Four field days of effort resulted in 30 sampled dolphins from throughout the study area. Each biopsy sample was subsampled for 7 projects, with a total of 206 separate samples obtained. Projects included age analysis with BEAT, stable isotope analysis for foraging ecology, population genetics, contaminant research, hormone analysis, fatty acid analysis, and a sample archived for future projects. Of the 30 dolphins sampled, only two had not been seen in previous photo ID efforts, and four dolphins had been seen 8-11 times in the past four field seasons.



A huge thank you to the staff of RBNERR as well as the SDRP staff and our intern, Kylee, who were all fundamental to the execution of this project. We are very grateful to The Animals, Research, and Conservation Committee of the CZS Women's Board for financial support for this research.

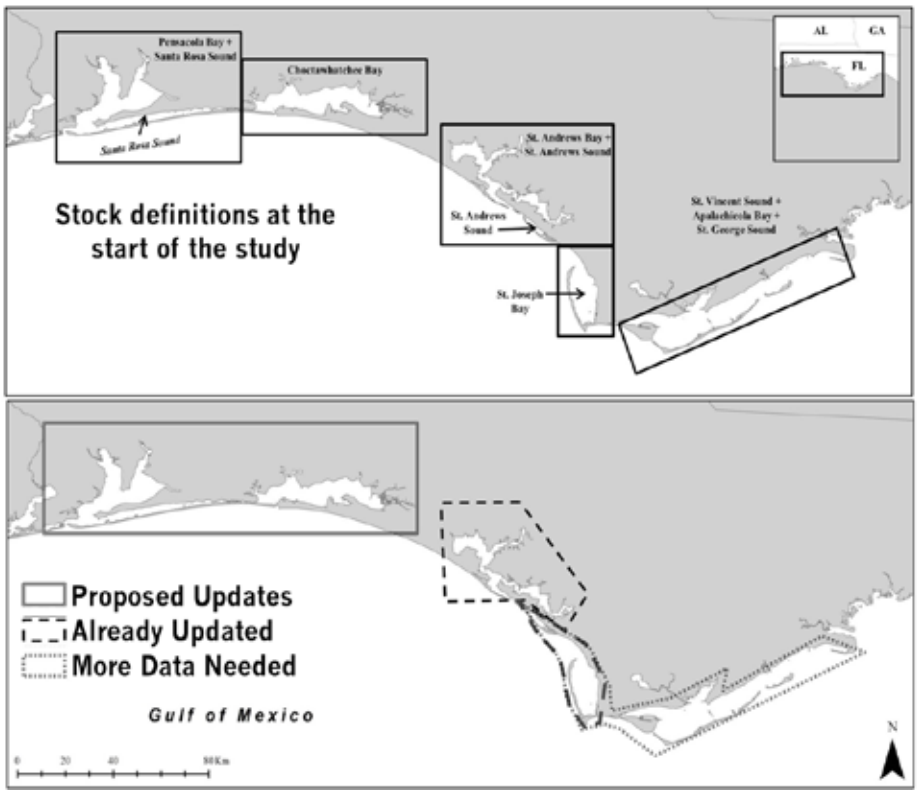
Last push to PhD! From zebrafish to dolphins… final notes on bottlenose dolphin populations in the Western Florida Panhandle

Christina Toms, Chicago Zoological Society

The ecological devastation that came with the *Deepwater Horizon* oil spill of 2010 inspired a masters student working in the field of behavioral neuroscience to press pause for the last time on videos of zebrafish responding to behavior experiments and jump ship back to the world of marine mammal conservation. At the time, very little was known about the inshore bay, sound and estuary (BSE) bottlenose dolphin populations hit hardest by the spill, and without previous data, oil spill impacts were challenging to assess. I traded my neuroscience lab coat for a 300 mm zoom lens and got to work on what was to become quite the adventure to learn about dolphins living in one of these areas - the Pensacola Bay system of Florida.

My dissertation was designed to (1) provide the first comprehensive assessment of population dynamics for bottlenose dolphins in the Pensacola Bay system and (2) determine the degree of connectivity between populations in the Western Florida Panhandle. When I started, population sizes of dolphin BSE populations in the Northern Gulf of Mexico were unknown except for four of the 32 managed areas (called "stocks") defined at the time, and the boundaries between stocks were ill-informed. It was expected that in the Western Florida Panhandle, Pensacola, Choctawhatchee, St. Andrews Bay, St. Joseph Bay, and St. George Sound/Apalachicola Bay/St. Vincent Sound areas, were all distinct populations but data were lacking across several of these systems to know if this was really true. We now have evidence that the structure and connectivity of these systems differs from what we originally expected.

The genetic portion of my work showed Choctawhatchee and Pensacola Bays are not genetically distinct populations and should likely be combined into a single management unit. This supports past work by colleague Dr. Steve Shippee, who demonstrated substantial movement of individuals between Choctawhatchee Bay and the lower portion of the Pensacola Bay system. There's some evidence that the St. Joseph Bay and St. George Sound/Apalachicola Bay/St. Vincent Sound areas are not as distinct as expected either. Genetic data available so far groups animals found in the inshore systems throughout this entire area into a single genetic population unit. Furthermore, estimates of contemporary migration suggest an emigration rate as high as 15% per generation from the combined St. Joseph /St. Vincent Sound/ Apalachicola Bay/St. George Sound area to St. Andrews Bay, compared to only 7% from the other direction (from Pensacola and Choctawhatchee Bays) into St. Andrews Bay. These results are preliminary, and conclusions may change with more sampling from these areas (sample sizes were low from areas east of St. Joseph Bay) but highlight the fact that there's much to learn about dolphins that live in these systems.



Proposed updates to stock boundaries based on data from this study. Note that the boundary between St. Joseph Bay and St. Andrews Sound was already updated based on photo-ID and tagging studies conducted in that area by other colleagues. The genetic data analyzed here support the update. More samples are needed in the Apalachicola Bay region to determine whether this should also be combined with St. Joseph Bay.

Presumed resident dolphin photographed while feeding and socializing in mid-Pensacola Bay.

A study published in 1993 only found 33 dolphins in Pensacola Bay, based on surveys conducted from a plane. In my research, we conducted a full boat-based assessment of this system and found seasonal abundance to vary from ~220 dolphins to ~310 over a 2.5 year period. That's quite a difference!! Furthermore, many dolphins in this system were seen repeatedly over time, suggesting this area may be their full time home. We also know that the Pensacola Bay system has many environmental contamination issues that could have contributed to skin lesions documented in response to a historic flood that occurred in the middle of my study. While I only scratched the surface at offering a better understanding of dolphin populations in these systems, we now have the capacity to better monitor and manage these populations moving forward.

My work would not have been possible without help from a host of dedicated interns, volunteers, and colleagues from multiple institutions, to whom I am eternally grateful. My work was supported by NOAA Fisheries SEFSC, the UCF Physiological Ecology and Bioenergetics Lab, the University of West Florida (UWF) Center for Environmental Diagnostics and Bioremediation, the UWF Office for Undergraduate Research Scholarships, and the Chicago Zoological Society.

Recovery from Red Tide in Sarasota Bay: Prey monitoring update

Elizabeth Berens McCabe,
Chicago Zoological Society

The Sarasota Dolphin Research Program (SDRP) explores the relationship between wild dolphins and their prey by conducting seasonal multispecies fish 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 in wild dolphins, and to explore the effects of *Karenia brevis* red tides on different fish species and community structure across the bay. Since 2004, this project has also facilitated a variety of novel research and new collaborations, most recently, quantifying baseline levels of plastics in Sarasota Bay fish. Based on our 2019 fish survey data and *K. brevis* cell concentrations, last year's red tide in Sarasota Bay appears to have been an intermediate ecological disturbance, followed by a large spike in fish abundance post-bloom!

Red tides can affect and even kill fish through (1) exposure to brevetoxin (the neurotoxin produced by the red tide organism, *K. brevis*) in the water, (2) consuming food that is tainted by brevetoxins, or (3) exposure to hypoxic

The compass set off Flip in Sarasota Bay while monitoring fish population recovery from red tide.

Interns Shannon O'Neill and Ella Howell release net as part of seasonal multi-species fish surveys.

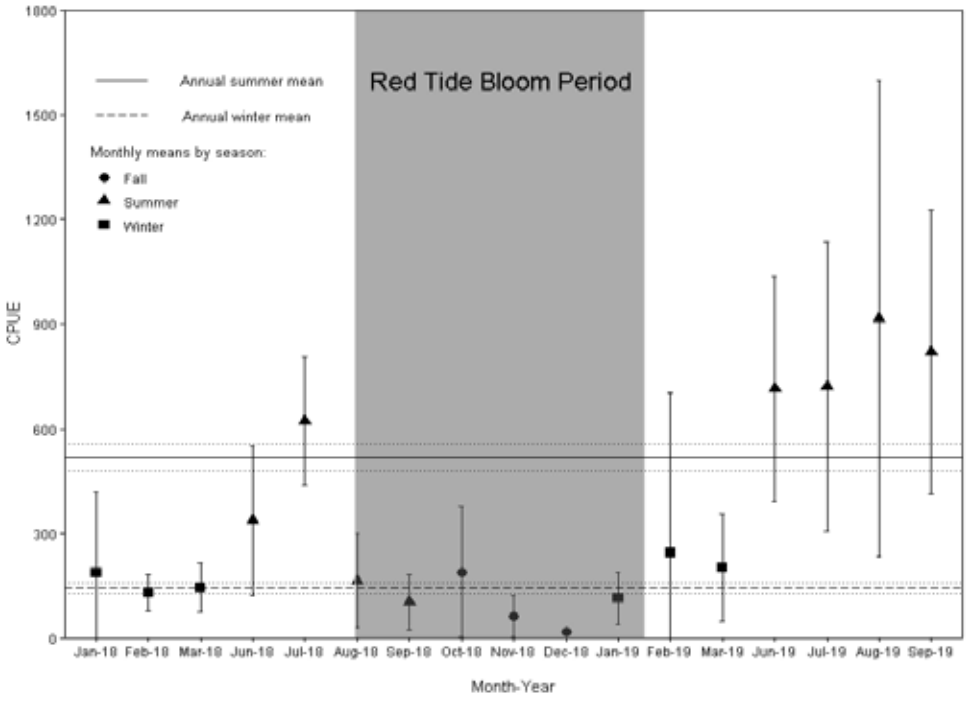
Crew measures a bonnethead shark that was caught during a fish survey before releasing it alive.

water (water with low or depleted oxygen), which often accompanies severe red tides. Our previous research has shown that red tides correspond to significant decreases in fish abundance and diversity and changes in community structure.

From August 2018 to January 2019, a persistent but patchy bloom of red-tide was present in Sarasota Bay. Sudden and dramatic declines in fish abundance (see graph) and changes in community structure occurred immediately and were similar to those seen during Sarasota Bay's last severe red tide in 2005/2006. Unlike 2005/2006, species diversity increased during bloom conditions this past summer. Fish abundance (excluding small schooling fish species) increased 549% from December to January. After red tide cell concentrations dropped down to background levels by January 9, fish abundance increased another 96% from January to February/March. Population recovery is defined as the number of months between the bloom event and the month in which monthly and annual 95% confidence intervals overlap; therefore, these jumps in fish abundance indicate population recovery while red tide cell concentrations in the study area still occurred above fish kill levels (100,000 cells/L)(see graph). The abundance of fish species typically eaten by dolphins (ladyfish, pinfish, pigfish, sheepshead, mullet, spotted seatrout, spot, and Gulf toadfish) increased 1150% from December to January, and another 793% from January to February/March 2019.

Overall catch rates of fish this summer (June-September 2019) followed a similar trend. Excluding small schooling fish, we averaged 793 fish caught per seine set, our 3rd highest summer catch rate since this survey began. Increases in the abundance of dolphin prey species were even more dramatic. We averaged 677 fish of dolphin prey species per set, our highest abundance of dolphin prey ever recorded. While abundance is important, dolphins can only consume prey within a certain size range. Preliminary analysis shows that in 2019 the proportion of pinfish, pigfish, and spot within the size range that dolphins typically consume (≥96.3, 73.8, 119 mm, respectively) remained consistent with past years. Differences in bloom intensity and severity likely played a role in the quick recovery of fish populations in Sarasota Bay. Timing was also important, as the bloom was dissipating at the same time seasonal larval movement into Sarasota Bay was occurring. Ongoing analysis of fish collected during this survey will quantify levels of brevetoxins in various tissues of individual prey species post-bloom and to establish a baseline of dietary values (stable isotopes and fatty acids) after red tide events. Based on the frequency and severity of red tides in Florida, bloom events likely play an important role in regulating fish communities in estuarine and near-shore waters.

We thank the many interns and dedicated volunteers who have worked on this project - the work would not be possible without you! Funding for the regular seasonal surveys was provided by the Charles and Margery Barancik Foundation, and support for supplemental fish surveys during the red tide event was provided by Mote Scientific Foundation. This research was authorized by the Florida Fish and Wildlife Conservation Commission (16-0809-SR, current Special Activity License) and by Mote Marine Laboratory's Institutional Animal Care and Use Committee (18-10-RW2, current permit).



Monthly catch per unit effort (CPUE, mean ± 95% confidence intervals) of fish (excluding Clupeidae sp.) caught during 2018-2019 purse-seine surveys in Sarasota Bay, FL during each season. Mean summer (June-Sept) and winter (Jan-Mar) CPUEs (± 95% confidence intervals) from 2004-2018. Grey shading indicates the extent of the 2018 red tide bloom period.

Intern Jessica Ozog measuring the fish length during a fish survey.

Shark research in Sarasota Bay – update and future plans

Krystan Wilkinson, Chicago Zoological Society

In 2015, the Sarasota Dolphin Research Program (SDRP) initiated a collaborative study using active and passive underwater acoustic recording systems in Sarasota Bay and nearby areas to monitor the movements of multiple marine species, including dolphins and their predators, large bull sharks. In April 2017, five bull sharks – four females and one male (172-200 cm long) – were fitted with passive acoustic tags along Florida's Gulf coast. Since then, the tagged bull sharks have been detected on the Sarasota Coast Acoustic Network (SCAN) as well as multiple collaborators' acoustic networks. Passive acoustic receiver stations are strategically placed in select locations and if/when a bull shark with a uniquely coded tag swims by one of these receivers, the tag sends a signal to the receiver, and the receiver notes the tag ID as well as the date and time. Researchers must periodically recover and download the data on each receiver to retrieve the animal detection history. In Sarasota, we have acoustic receiver stations placed at offshore sites, along shore, at a few locations within the bay, as well as in each of the passes that connect Sarasota Bay to the Gulf of Mexico. Regional collaborative networks, such as iTAG in the Gulf of Mexico and FACT along Florida's Atlantic coast, allow researchers to share detection data of tagged animals in neighboring acoustic receiver arrays.

Since 2017, we have gathered detection information from four of the five tagged sharks. Because the receivers must be physically downloaded – and some arrays are only downloaded once per year – there is a delay in collecting the detection information, thus we are still receiving these data. Three of the five sharks were detected in the SCAN array and/or collaborator's arrays in Tampa Bay (north of Sarasota) and Charlotte Harbor (south of Sarasota). One female was not detected in these areas; rather, she was detected off of Alabama's coastline! Excitingly, one of the sharks, female 50600, has been detected in the neighboring Tampa Bay area in 2017, 2018 and recently in 2019. The number of days detected varied among individuals, ranging between 1 and 111 days. It is important to note that animals are only detected where receivers are deployed; therefore, a lack of detection information may indicate that the animal is using waters where receivers are not located or could be due to other factors, such as damage to the tag. Additional bull shark tagging is continuing using a method that will increase tag retention.

Juvenile dolphin 1652, also known as "The YOY who lived" because it was first observed with fresh shark bites as a YOY in 2016, was observed with new but healing shark bite wounds in July 2019.

In addition to our shark tagging efforts, we have begun to collect baseline data, in collaboration with researchers at the Georgia Aquarium and long-time SDRP colleague Sam Rossman, to understand the dietary overlap between large and small shark species and the Sarasota Bay bottlenose dolphin community. Results from shark dietary and movement analyses will be integrated with information on dolphin diet and movement from the SDRP to provide a better understanding of the role of top predators in the environment. This research is funded by the Mote Scientific Foundation.

Of note, as of 30 September, at least ten of our Sarasota resident dolphins or their calves have received shark bites in 2019. While it is not unusual to observe fresh shark bites on the dolphin residents during the warm months, this is higher than normal (range prior to 2019 was 0-6 bites per year). The reasons for this increase are unknown; however, the 2018 harmful algal bloom (red tide) event killed a large number of fish, including sharks and rays. This may have changed the availability of prey for both the sharks and the dolphins which could alter the interaction events between these top-level predators. Further research is needed to better understand red tide impacts to local marine communities and how these disturbance events may change the predator-prey dynamics between sharks and dolphins.

F199 surfacing with a bite on her peduncle from a large shark.

Marine rays in Sarasota Bay and coastal waters

Kim Bassos-Hull, Mote Marine Laboratory;
Krystan Wilkinson, Chicago Zoological Society

We are currently entering our 11th year of study on one of the other large marine animals that inhabits Sarasota Bay and coastal waters, the spotted eagle ray. The Sarasota Dolphin Research Program (SDRP) has been supportive of this collaborative research as we aim to collect and provide important life history, ecology, and conservation information on this near-threatened ray to Florida fisheries management agencies and the IUCN (International Union for Conservation of Nature). Last year in *Nicks'n'Notches* we provided a background on the initiation of this study and how the SDRP was credited with Kim's training for being able to effectively start a long-term study on this species. While we have learned and published quite a bit about life history and seasonal presence, we are currently investigating movement patterns, predation impacts, fisheries impacts and diet of this ray with other collaborators.

To better understand movement patterns of rays (that do not surface to breathe like dolphins), researchers have a variety of tagging tools available to them, and we have been able to incorporate all of them at some point in our project. By using a PIT tag (the same type of small chip tag that is put in dogs and cats to be able to ID when scanned with a special reader), we have been able to document recaptures (and growth patterns) of some of our rays over periods from weeks to more than 4 years! We can also confirm this with photo-ID as spotted eagle rays have unique spot patterns with each individual. During 2013 we were able to apply a satellite-linked tag to a large female ray and learn about her diving behavior (she dove during the day to feed on bottom and stayed close to surface at night), and she moved all the way up to the northeastern part of the Gulf of Mexico then down close to Cuba before the tag released.

Above: Mote researchers attach a satellite-linked tag to a small manta ray near Longboat Key, Florida in September 2013.

Right: Preparing to release two devil rays with acoustic tags off Longboat Key in September 2019.

Mote researchers (along with high school interns) release an acoustically tagged ray in Sarasota Bay in April 2017.

Since satellite-linked tags are very expensive, and with the expansion of the iTAG network of underwater acoustic receivers around the Gulf of Mexico and FACT network on Florida's east coast in recent years, we have moved to using acoustic tags with our spotted eagle ray research. Since 2016 we have tagged 42 eagle rays and learned (thanks to data shared by iTAG and FACT) that rays tagged in or near Sarasota Bay will often head south during winter and use Charlotte Harbor or even as far as the Florida Keys as winter use areas. Some of our rays go north to the Gulf of Mexico waters off the Florida Panhandle in summer, and Sarasota is but a quick stopover. The majority of rays we acoustic tagged, however, spend weeks to months and return each year to the Sarasota area indicating this is likely an important feeding and pupping area.

Complementing this research on movement patterns is our study of eagle ray diet. Using a non-lethal gastric lavage technique we have gathered gut contents from some of these eagle rays and used DNA barcoding (genetics) to determine they eat a variety of molluscs (gastropods and bivalves). Interestingly, during the past three years (2016-2018) with significant red tide events, our acoustically tagged eagle rays left as soon as red tide was present. Through some preliminary benthic surveys we have determined that there was a lot of mortality to some of the mollusc prey of these rays. It will be interesting to see if this impacts the rays' ability to find adequate food in Sarasota Bay or if they move to other areas to feed.

Our program has also been opportunistically documenting Mobulid rays (manta and devil rays) when they are present in Sarasota coastal waters (which is rare). These filter-feeding rays have recently become CITES listed worldwide due to concerns about fisheries to obtain their gill rakers, and little is known about their biology and movements in the Gulf of Mexico. To date we have been able to attach a satellite-linked tag to one manta ray in 2013 and catch, sample, tag and release more than 100 devil rays since 2013. Most recently (September 2019) we were able to acoustically tag two devil rays (a first for this species), and data from these tagged rays will provide important information about their movements in the Gulf of Mexico and beyond.

Dolphin Rescues, Releases, and Follow-up Monitoring

As requested by NOAA's National Marine Fisheries Service, we lead or participate in dolphin rescues and/or conduct follow-up monitoring for dolphins that have stranded, are entangled, have been rehabilitated and released, or rescued from out-of-habitat situations. The following articles summarize efforts during the past year, including follow-up of previous interventions or post-release monitoring cases.

F314 Rescue and follow-up

Aaron Barleycorn, Chicago Zoological Society

On February 17th, Florida Fish and Wildlife Conservation Commission (FWC) biologists received reports of a dolphin calf with fishing line entangled around its flukes and its mouth in Stump Pass, near Englewood, FL. Several reports came in over the next few weeks giving a clearer view of the entanglements. Both lines were cutting deeply into the dolphin, and were deemed life threatening.

On March 11th, Sarasota Dolphin Research Program (SDRP) biologists led a team from several different organizations to rescue the calf. After a few hours of searching we located the calf with his mom near the site of their initial report. We were able to temporarily catch them both and assess the calf. The lines were able to be completely removed, and none too soon - the line in the mouth was embedded in the roof of the mouth and was cutting dangerously close to his eye. The mom was given a satellite-linked tag in order to keep track of the pair. Several surveys were conducted in the area in the following months to keep track of them. They were last seen on July 30th swimming along the coast of Don Pedro Island. The mom had shed her tag and both looked healthy and free of any new entanglements.

Fishing line through the mouth and flukes of male calf, F314.

The rescue was conducted under a NOAA permit and included participation from SDRP, Mote Marine Laboratory, FWC, Clearwater Marine Aquarium, the University of Florida's College of Veterinary Medicine, and Charlotte County Sheriff's office.

F316 Rescue and follow-up

Aaron Barleycorn, Chicago Zoological Society

On March 21st, a Sarasota Dolphin Research Program (SDRP) survey team noticed one of our 2-year-old resident calves was extremely skinny and had fishing line entangled around its fluke. During subsequent sightings it became clear the line was interfering with his ability to swim and he was struggling to keep up with his mom (F199). Subsequent sightings indicated that he was deteriorating quickly. He was no longer with his mom, he was swimming slowly, and was still very emaciated. A rescue was authorized by NOAA's National Marine Fisheries Service to try to intervene. He appeared so weak that we were concerned he might not survive the stress of a rescue, but we knew if we did nothing, he was certainly going to die.

On April 1st, the SDRP led a rescue with the usual myriad organizations participating. We had sent a boat out early to locate the calf, and they quickly found him in a shallow area of Roberts Bay. The rescue team was able to get him in hand within an hour of leaving the dock. The dolphin remained amazingly calm during the rescue. We were able to disentangle him, give him antibiotics and quickly release him with guarded optimism. The line we removed was braided polyfilament, a particularly damaging type of fishing line because it has a smaller diameter and rougher surface than monofilament, meaning that it cuts through dolphin tissues more easily and faster. The line had cut most of the way through F316's fluke, but tissue was beginning to heal along the leading edge.

During a routine survey on April 23rd, we saw F316 for the first time since the rescue! He was still alone and skinny, but appeared to have gained some weight, and he seemed to be able to move without complication. During our June health assessment, we recaught F316 for a checkup. Although still underweight, he was in much better shape than the day of the rescue, and his fluke was healing well. We will continue to monitor his progress during our monthly photo-ID surveys.

The rescue was conducted under a NOAA permit and included participation from the SDRP, Mote Marine Laboratory, Florida Fish and Wildlife Conservation Commission, Clearwater Marine Aquarium, the University of Florida's College of Veterinary Medicine, and several local volunteers.

F316 before (above) and after removal of the braided polyfilament line cutting through his fluke (left).

Updates on previously rescued dolphins

Aaron Barleycorn, Chicago Zoological Society

Scrappy: In July 2006, Scrappy, a juvenile male, was observed entangled in a men's Speedo bathing suit. He had managed to put his head through the waist and one of the leg holes, and the suit had worked its way back to the point where it was cutting into the insertions of his pectoral fins. On August 3rd 2006, Scrappy was temporarily captured, and the suit was removed. Now 21 years old, he is doing fine and has formed a male alliance with C835.

Ginger: In December 2008, Ginger, a recently independent juvenile female dolphin, stranded on Siesta Beach. She was taken to Mote, treated for complications from the stranding, and released two months later. The SDRP radio-tagged her and closely monitored her for two months post-release, until the tag transmissions ceased. She has since been regularly seen during our monthly population monitoring surveys. Ginger's story inspired an SDRP volunteer to write a children's book about her time at Mote called "*No Dead Fish for Ginger*." She and her 2-year-old calf (a girl!) got a check-up during our 2019 health assessment and are in good health.

Nellie: In February 2010, the calf of resident dolphin FB25 was seen with plastic twine and a metal hook tightly wrapped around her head, with the line embedding in her head. She was temporarily captured, disentangled and released on March 1st 2010. She was named "Nellie" in honor of Dr. Nelio Barros, a great friend and colleague, who had recently passed away. She and her 2-year-old calf (another girl!) got a check-up during our 2019 health assessment and are in good health.

Lizzie: One of our Sarasota residents, Lizzie, had an eventful 2012. She was given a temporary satellite-linked tag during our annual health assessments in May, and she and her 3-year-old calf were regularly followed to compare their behavior with and without the tag. During one of these follows SDRP staff noticed that Lizzie had become entangled with monofilament line around one of her flukes. Shortly after, her calf was struck by a boat propeller that left a large gash on his dorsal fin. Lizzie and her calf were temporarily captured on July 20th to remove the fishing line and the tag. Lizzie has been observed during 2019 with her 1-year-old calf.

Skipper: In August 2014, a dolphin calf was reported near Marco Island, Florida with fishing line entangled tightly around its tail. The SDRP was asked by NOAA to organize a rescue, and on September 4th the rescue team was able to temporarily catch and disentangle the calf. She was named Skipper (her brother, Seymour, was rescued in the same area previously). SDRP staff have been conducting population surveys in the area near her rescue (see articles above), and often see Skipper (now a juvenile dolphin) during our effort.

Bill: On March 1st, 2016 we received a report of a dolphin that was entangled in a crab trap line off Nokomis Beach. We went to the dolphin's last reported location from the night before, and found 10-year-old resident dolphin "Bill" with just his blowhole above the water. He had managed to get his tail wrapped in the float line of a crab trap, and was weighed down by the trap to the point where he was unable to move and barely able to keep his head above water. We used a boat hook to grab a bit of line floating next to Bill and pulled up line until we got to the entanglement. We were able to remove the line without cutting it. Bill was tail kicking during this time and appeared to have full motion of his fluke. There were some lacerations where the line had wrapped, but they did not go very deep. Now fully disentangled, we released the dolphin and watched him swim away. He is often seen during our monthly photo-ID surveys.

Follow-up monitoring of intervention cases through satellite-linked tracking

Randall Wells, Chicago Zoological Society

Interventions for dolphins in life-threatening situations are increasing in frequency in the southeastern U.S., involving rescues for on-site disentanglements and releases, translocations and releases, or rescues or strandings followed by rehabilitation and release. Follow-up monitoring remains a crucial component of interventions. Information on the success of the intervention, as judged by the survival and behavior of the animals post-release, can guide decisions about further intervention if the animal fails to thrive in the wild, and can inform future efforts with other animals under similar circumstances. Such information is increasingly important as interventions are being considered among the possible restoration options in response to the *Deepwater Horizon* oil spill and other environmental contaminant situations.

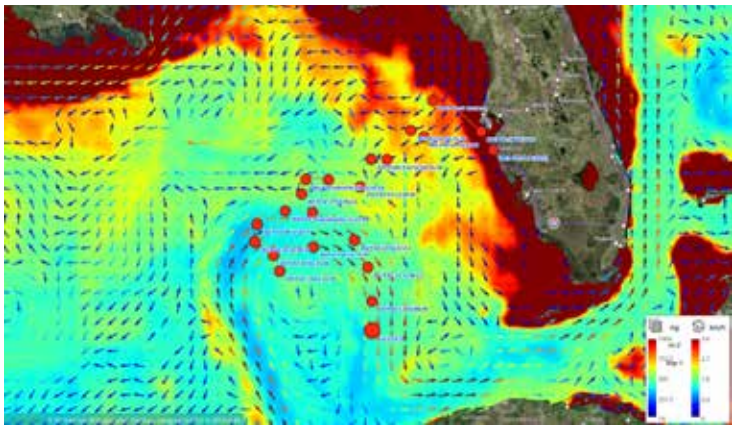
The Sarasota Dolphin Research Program (SDRP) provides follow-up monitoring services to the members of the national marine mammal stranding network through a grant from NOAA's John H. Prescott Marine Mammal Rescue Assistance Grant Program. We maintain a supply of satellite-linked tags and tagging and tracking supplies, and provide tracking services to organizations who request them. Over the past year, we provided tags to a number of organizations for possible deployment, and these were ultimately deployed in five cases, involving bottlenose dolphins (2), short-finned pilot whales (5), and an Atlantic spotted dolphin.

Salem bottlenose dolphin

On Halloween 2018, Mote Marine Lab's dolphin hospital admitted an older, stranded female bottlenose dolphin, "Salem," that was brought from Tampa for treatment of infections and a shark bite. By 28 January 2019, Salem was determined by veterinarians and NOAA to be ready for release. As part of our NOAA Prescott grant, we attached a satellite-linked time-depth-recording tag to monitor her behavior remotely, because we

Salem, immediately following release, with satellite-linked tag and freezebrand R11.

had no prior information on where she originated, and thus no prior knowledge of where she might go upon release. She was released offshore of Tampa Bay. From the start, the dolphin engaged in behaviors that were unusual for a bottlenose dolphin, including moving to the middle of the Gulf of Mexico in waters thousands of meters deep, while not making any deep dives. She stopped transmitting after 16 days, when she was entering the Gulf Stream south of the Florida Keys. There were no indications of problems with the tag, suggesting the dolphin may not have survived.



Salem's track after release, relative to surface currents (shaded arrows indicating distance and speed) and primary productivity (shaded water). The largest, southernmost red dot with the tag ID 177523 next to it was the last location transmitted by Salem.

Lamda Atlantic spotted dolphin

On 29 October 2018, ~10-yr-old male Atlantic spotted dolphin was released off Bimini, in the Bahamas. The dolphin, observed off Bimini since 2013, is known by the Wild Dolphin Project as "Lamda." He was reported to the Bahamas Marine Mammal Stranding Network/ Bahamas Marine Mammal Research Organisation as being in distress near Great Stirrup Cay on 24 August 2018, and after he was stabilized by Atlantis Animal Rescue Team, he left the bay on 25 August 2018. He stranded on Great Stirrup Cay on 26 August 2018 and was transported to Atlantis for rehabilitation. The dolphin was tagged with a satellite-linked location-only tag (provided by a donation to DBRI, not Prescott) as it was transported by seaplane to Bimini. Over the first three months of tracking, the dolphin moved back and forth along the SW edge of the Great Bahama Bank, ending up in the waters near his release site, in his previous range. Tracking continued through the cessation of tag transmissions (probably due to battery exhaustion) on 14 February 2019. He was observed by researchers during January through August, with other spotted dolphins including previous common associates, and appeared to be in good condition. Hurricane Dorian impacts have interfered with subsequent observations.

Tracking map showing all good-quality locations for Lamda; the largest symbol near the top indicates the last received location.

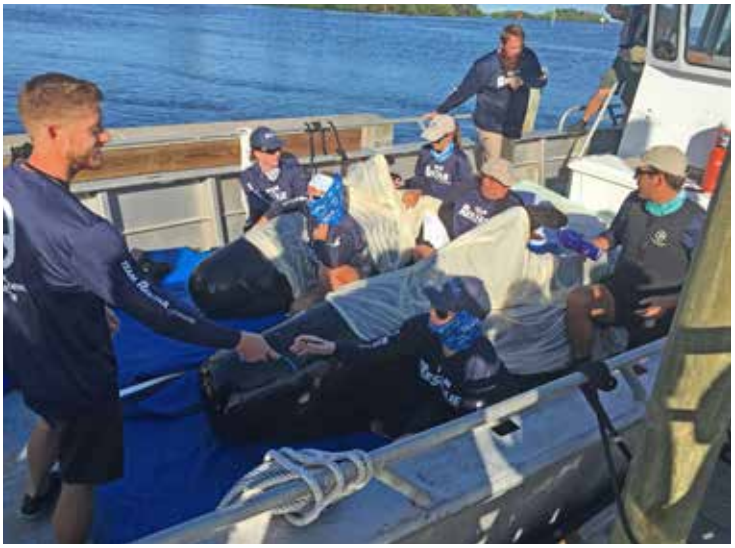
Lamda, observed on 28 August 2019.

Short-finned pilot whales

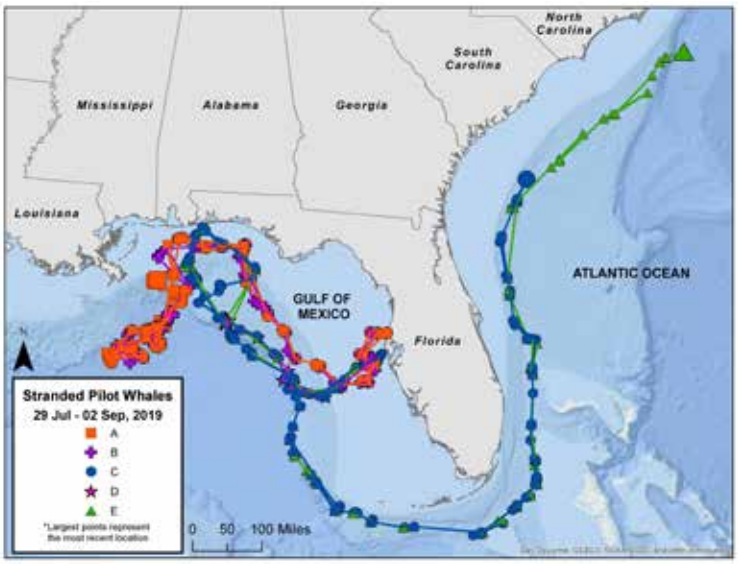
On 29 July 2019, five short-finned pilot whales stranded on Redington Beach, FL. Clearwater Marine Aquarium (CMA) led the response to the mass stranding. They were maintained in shade under tents in shallow water while preliminary assessments were made. The three largest whales (C, D, E) were determined to be suitable for immediate release, while the other two (A, B) were taken to CMA rehabilitation facilities for further testing. The members of the trio were tagged with time-depth-recording tags, and released about 4 miles offshore of Redington Beach. On 1 August 2019, we tagged the remaining pair of whales, and they were released ~20 miles offshore of the Anclote River. Tracking was conducted for 9 to 36 days post-release, through the transmission lives of the tags, as part of our NOAA Prescott grant. The whales remained together in their two release groups for the duration of tracking. Dives of more than 1,200 m depth, lasting more than 22 minutes, were recorded on occasion. Of particular note, several of the whales demonstrated amazing synchrony, diving to the same depths at the same time. All of the whales moved northwest

Preparing to release three pilot whales from offshore of Redington Beach, FL on 29 July 2019. As one whale is loaded onto a transport vessel, the others remain within the shade provided by the tents.

to the DeSoto Canyon. Whales A and B remained in the DeSoto Canyon area, while the remaining whales moved along the shelf edge, southward and around the Florida Keys, and then northward in the Atlantic. The last whale, E, was tracked to a point offshore of Cape Hatteras, North Carolina, to an area known through Duke University research to be habitat frequented by pilot whales. Two of the whales ceased transmitting following declines in dive behavior, suggesting the possibility that they may not have survived. Signals ceased abruptly for the other three following periods of reasonable movements and dives, with no indications of tag problems, so the reasons for signal loss remain unknown. Unfortunately, none of the whales reached the 42-day threshold considered to define a successful intervention. However, subsequent resightings of the very distinctive fins of these whales could change this decision.



The last two whales have been tagged and are preparing for transport to the release site ~20 miles offshore of the Anclote River on 1 August 2019.



Tracks of all five whales over the entire tracking period, showing only the best quality locations. The largest symbols are at the last known locations for each whale.

Stranding response training during health assessments

Randall Wells, Chicago Zoological Society

It often takes a village to effectively accomplish responses to live dolphins in trouble. In the southeast U.S., interventions are required all too often for dolphins that are entangled, out-of-habitat, or injured. Responses requested by NOAA often involve capture, with veterinary examinations determining if the animals can be released immediately with minimal treatment, or if they must be taken to facilities for further treatment, hopefully followed by release, with follow-up monitoring. The rescue teams typically include veterinary personnel, stranding response team members, biologists, trained handlers, law enforcement officers, NOAA staff, and a dolphin catcher. There is a strong need to increase capacity for interventions, and we made this a priority for our health assessment project in June 2019. Under our current NOAA Prescott grant, we provided training/experience opportunities to:

1. four potential dolphin catchers,
2. more than a dozen law enforcement personnel from the Florida Fish and Wildlife Conservation Commission (FWC) and Sarasota Police Department,
3. 37 veterinarians, vet residents, vet interns, and vet technicians from Mote Marine Laboratory (MML), Dolphin Quest, Bayside Hospital for Animals, University of Florida (UF), National Marine Mammal Foundation (NMMF), FWC, Disney, Georgia Aquarium (GA), North Carolina State University (NCSU), Chicago Zoological Society (CZS), and Clearwater Marine Aquarium (CMA),
4. NOAA personnel (SERO, Headquarters, Marine Mammal Health and Stranding Response Program, Permits, NRDA) and Marine Mammal Commission staff,
5. 45 stranding network personnel from MML, FWC, UF, CMA, CZS, NCSU, Harbor Branch Oceanographic Institute, GA Conservation Field Station, and Portland State University,
6. 17 of our local Sarasota Dolphin Research Program volunteer rescue team members, and
7. researchers and/or stranding responders from Senegal, Kenya, China, Spain and Peru.

Personnel changes at institutions create an ongoing need for continuing training opportunities, and responses benefit from personnel with additional experience.

Law enforcement personnel get experience with handling live dolphins, working side-by-side with experienced handlers, in preparation for responding to stranding situations.

Sarasota Bay's passive acoustic listening station (PALS) network

David Mann, Loggerhead Instruments; Katie McHugh, Reny Tyson Moore, and Randall Wells, Chicago Zoological Society; Austin Anderson and Athena Rycyk, New College of Florida; Kim Bassos-Hull, Mote Marine Laboratory

Our mission to monitor dolphin vocalizations, sounds their prey make, and boat noise across the bay has made great strides this year! In addition to expanding our listening network to ten solar-powered, land-based passive acoustic monitoring stations (see map), David Mann (Loggerhead Instruments, Inc.) made several technological and data processing improvements. These include piloting new acoustic monitoring station software and hardware to allow for more remote-control over the stations and expanding upon on-board data processing capabilities.

The data collected by the listening network supported undergraduate research this past summer at Mote Marine Laboratory and master's research at New College of Florida. Gabriela Hernández Ramírez, an NSF Research Experiences for Undergraduates (REU) student, advised by Drs. Katie McHugh and Athena Rycyk, listened to data from the Cortez station and compared dolphin vocal behavior to the presence of boat noise. She found less dolphin vocal activity when boats were very close to the station. Austin Anderson, a graduate student in New College of Florida's data science program, has used the recordings to develop whistle extraction and matching algorithms using machine learning.

Each yellow marker represents the location of an acoustic monitoring station. In the bottom left corner is a picture of one of the newest stations. The solar panel powers the station, the grey box houses the battery, memory cards, cell modem, and processor, and the manatee sign shows this resident's commitment to manatee conservation.

The network's data are also the focus of a scientific manuscript describing the use of passive acoustic monitoring stations, such as those in our listening network, to detect and monitor ecological responses to environmental perturbations, such as those resulting from harmful algal blooms. This research demonstrates this utility through a case study whereby two of the first stations deployed within our network recorded significant differences in biological and anthropogenic sound before and during the severe red tide that affected Sarasota Bay in 2018.

And the BEAT goes on, an epigenetic aging tool for small cetaceans

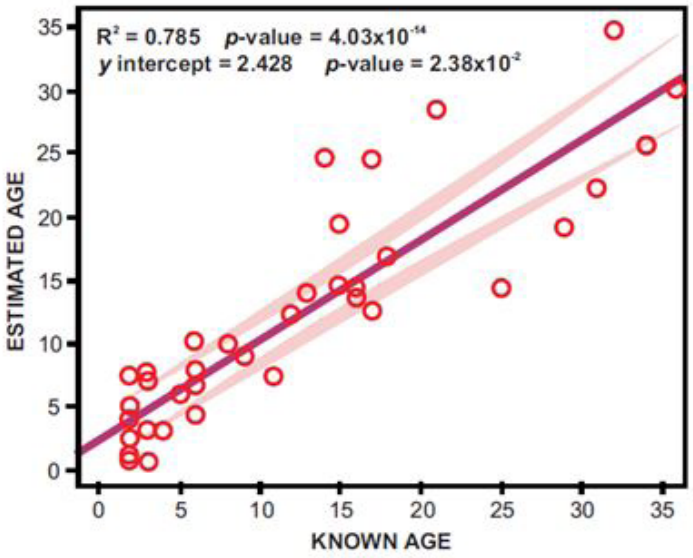
Andria Beal, Jeremy Kiszka, and Jose Eirin-Lopez, Florida International University

Last year we had only just begun our path towards creating an epigenetic age determination tool for small cetaceans, with the idea to use skin samples to determine the age of dolphins! This year we are happy to report that our work has been published in *Frontiers in Marine Science*. But first, what do we mean by epigenetics? This is various modifications and molecules that occur on or interact with DNA to influence gene activity and phenotype without changing the DNA sequence. Epigenetic changes can influence when genes are turned on or off. One of the most studied epigenetic modifications is DNA methylation. This is when a small molecule (a methyl group) attaches to a cytosine (one of the four nitrogenous bases) in the DNA sequence. The addition of these methyl groups in certain areas of the genome can turn off or silence some genes so that the protein the gene codes for does not get produced. As individuals age, they need less or more activity of certain genes, and this correlates to changes in the amount of DNA methylation found at different genes in the genome.

For this project, we were given 39 known-age skin samples from the Sarasota resident dolphin community. We had a spread of ages from 2 to 36 years with a fairly even divide of males and females across ages. The tool uses skin samples to acquire the %DNA methylation at genes whose %DNA methylation changes with age. In the graph, the known age of each sample is plotted against the estimated age using the model equation generated from multiple regression: this is what we named the BEAT model. This graph shows the accuracy of the BEAT model, with the residual error for estimating age at less than 5 years. In this graph you can also see that there is less error in estimating the age of younger individuals, less than 15 years old. It is possible that this is because we had many more samples in this age range, or it could be that after dolphins become sexually mature (occurs around 10 years of age), males and females differ in their change in DNA methylation with age

from this point. This model will be further adjusted as more samples of older age dolphins become available. For more information and specifics on this tool please look up our manuscript!

Now that this model has been created, it is time to put it to work! The BEAT is being used on unknown-age samples from the Sarasota community and individuals from the Naples/ Rookery Bay area. This tool allows us to by-pass 50 years of studying a population closely, in order to know the age of most of the animals in the population, to having a highly accurate estimate within as little as a month and costing only a couple thousand dollars for about 92 samples. Additionally, by providing the key population parameter of age, we can better evaluate age-specific threats to populations such as pollutant and toxin accumulation. Moving forward, we hope to study age-specific impacts of environmental stressors, such as red tide, upon these populations using epigenetics and furthering the connection between epigenetics and conservation studies.



The accuracy of the BEAT model is indicated by plotting known age of samples used to create the BEAT against the estimated ages of the same samples using the BEAT equation. The residual error was 4.83 meaning that we can accurately estimate age in individuals within 5 years of their actual age.

Dolphin showing off his flipper while socializing.

Pectoral flipper radiography to facilitate age estimation

Ashley Barratclough, National Marine Mammal Foundation; Daniel García-Párraga, Oceanogràfic Valencia

X-ray images (radiographs) of human hands have been used for decades as a method of confirming age by examining the predictable chronological changes occurring to the growth plates of each bone. We utilized a bank of radiographs from managed care dolphins of known age at multiple facilities across the world to establish a similar technique enabling us to radiograph the flipper of dolphins and use it to predict their age. In the 2019 health assessments we applied this new technology to free-ranging dolphins for the first time. We aim to establish a new non-invasive method of determining the ages of dolphins via a single radiograph. This will provide an alternative method to accurately obtain ages across all age ranges as dolphin flipper bones continue to develop throughout their entire lifespan. Accurately estimating the ages of animals during health assessments will improve understanding of population demographics, reproductive status, and interpretation of biological data. The manuscript establishing the technique in managed bottlenose dolphins was recently published in *PLoS One*. Funding to establish this technique was provided in part by a grant from the Gulf of Mexico Research Initiative, Oceanogràfic Valencia and by the National Marine Mammal Foundation.

Radiographs of bones in flippers can provide ages of dolphins.

Evaluating common bottlenose dolphin diet and vulnerability to disturbance using quantitative fatty acid analysis

Theresa-Anne Tatom-Naecker, University of California, Santa Cruz

A nuanced understanding of common bottlenose dolphin diet is key for assessing dolphin and ecosystem health and the potential impacts of disturbances like harmful algal blooms ("red tides") and recreational and commercial fishing. Like many marine mammals, bottlenose dolphins are underwater predators, making it difficult to directly observe feeding, especially in their typical murky estuarine habitats. Instead, diet must be estimated via indirect methods. However, many traditional indirect methods, such as studying the stomach contents of stranded animals or analyzing stable isotopes, have systemic biases and logistical constraints. These include relying on stranded animals, estimating only the most recent meal, and/or revealing the trophic level but not the actual species of the consumed prey.

More recently, quantitative fatty acid signature analysis (QFASA) is being used to evaluate diet, taking advantage of the fact that prey fatty acids are deposited in predator blubber with minimal structural change. QFASA provides a record of diet over several months, identifies prey species and their relative proportions in predator diets, and can be used with live or stranded animals. At the core of QFASA is a statistical model that compares the fatty acid signature of a predator's blubber to a "library" of potential prey species, each with a distinct fatty acid signature. However, the model requires predator species-specific calibration coefficients to account for the differential metabolism of individual fatty acids. These coefficients are estimated via controlled feeding studies lasting at least five months. Due to this constraint, correlation coefficients for cetaceans have not been calculated, and so while QFASA has been used to estimate diet in other marine mammal species, it has not yet been applied in cetaceans. For my dissertation, I am focusing on validating QFASA in cetaceans and using it to investigate how Sarasota Bay bottlenose dolphin diet varies under normal conditions and in response to disturbances like the 2018-19 severe red tide.

Fortunately, I have access to blubber and prey fish from both free-ranging dolphins and dolphins under human care through the Sarasota Dolphin Research Program (SDRP) and its longtime collaborator, the National Marine Mammal Foundation (NMMF). Blubber is routinely collected from free-ranging dolphins during the SDRP's live-capture-release health assessments, and during the June 2019 health assessment, blubber was sampled from 16 dolphins. The NMMF manages the bottlenose dolphins that are under Navy care. The quantity of different prey species consumed by the Navy dolphins is recorded every day, equivalent to a controlled feeding study. The NMMF has generously donated samples of dolphin blubber and prey fish from their archives, which I will use to calculate the first cetacean calibration coefficients.

Dolphin catching a mullet. New research is determining fatty acid signatures of Sarasota dolphin prey fish.

In summer and fall 2019, I completed the first phase of my analysis, determining the fatty acid signatures of the Sarasota dolphin blubber and the NMMF dolphin blubber and prey fish and calculating the correlation coefficients. This spring, I will determine the fatty acid signatures of potential Sarasota dolphin prey fish collected during the SDRP's seasonal multispecies fish surveys; this will create the aforementioned prey "library." Equipped with the correlation coefficients, free-ranging dolphin fatty acid signatures, and the prey "library," I will use the QFASA model to estimate dolphin diet in the months before June 2019. I will repeat this procedure over the next three years, allowing me to examine over the course of several years how dolphin diet varies under both normal and disturbed (for example, red tide) conditions. Understanding natural diet variation and how existing red tide disturbances disrupt diet is critical in order to evaluate bottlenose dolphin vulnerability to other disturbances and to better predict and mitigate the effects of all types of disturbances.

A device for attaching satellite-linked tags to bow-riding dolphins – the TADpole

Michael Moore, Woods Hole Oceanographic Institution, and Randall Wells, Chicago Zoological Society

Satellite-linked tags can provide incredible data on dolphin ranging and dive patterns, allowing researchers to learn about the behavior of animals that may live well beyond the logistical limits of researcher access. The SDRP has been involved in developing and testing small electronic tags for dolphins for decades, leading to a current small finmount tag design by Wildlife Computers that is attached by a single pin to the trailing edge of a dolphin dorsal fin. Field tests have shown this tag to be safe for the animals and to remain attached to the fin for many months, approximating the tag's battery life. Typically, we attach tags to dolphins when we are able to handle them, during capture-release operations or in association with interventions such as rescues or release

following rehabilitation. However, there is a strong need to be able to attach tags to free-swimming dolphins under circumstances where capture is not possible or logistically feasible, for example in deep water, and/or with species that do not respond well to capture and handling. Currently, the only available remote application system involves a tag that is delivered as a projectile and implants in the animal by means of two darts.

We wanted to develop a less-invasive tool that takes advantage of our tried and true tag and attachment designs. With the support of Dolphin Quest, Dolphin Biology Research Institute, Cascadia Research Collective, and Mote Scientific Foundation, we have worked with Woods Hole Oceanographic Institution (WHOI) engineers to develop and test a tag attachment device mounted on a pole for securing a standard finmount tag to the trailing edge of the dorsal fin of a bow-riding dolphin, a system known affectionately as the TADpole. The device is operated pneumatically, and it is designed such that as it cores the fin and attaches a tag, it collects the resulting dorsal fin core as a tissue sample for genetic analyses. The prototype and subsequent iterations have been tested extensively with cadavers with good success.

The development of this system is an iterative process. Field tests have yet to leave a tag on a dolphin, although each improved version of the device brings us closer to success. Working in late 2018 with Robin Baird in Hawaii, we attempted to tag bottlenose dolphins, pantropical spotted dolphins, and melon headed whales, but we found the animals were faster than we were, and they moved out of the device before the tag could be secured. Working with a modified, faster-triggering device with Atlantic spotted dolphins off Sarasota in June 2019, the device collected genetic samples as it triggered, but the dolphins were still able to maneuver out of the device before a tag could be secured. Mere milliseconds are all that are required for the dolphins to move out of appropriate position. The WHOI engineers are currently modifying the TADpole to shave additional time off the triggering timing, and we hope to conduct field tests soon.

Attempting to tag an Atlantic spotted dolphin from the TADpole off Sarasota in June 2019.

Testing a newly designed GPS tag for small cetaceans

Reny Tyson Moore, Chicago Zoological Society

One of the key things that scientists want to discover about the animals they study is “where they go.” One way to achieve this is to attach a device, such as a tag, to an animal that can record and/or transmit its location. Historically, this has been done with either satellite-linked or GPS technology (similar to location services on a smart-phone). While satellite-linked tags have been available for use with marine mammals for several decades, tags that incorporate GPS technology have been hard to develop for these animals because the GPS signal requires exposure at the surface for longer periods of time than a dolphin typically requires for a breath. Location data from GPS tags are more precise than location data from satellite-linked Argos tags, so the ability to incorporate GPS into tags would open new doors for research on small cetaceans, such as bottlenose dolphins, pilot whales, and false killer whales. Fastloc® Location Technology was recently developed to deal with this problem, and is able to obtain GPS data in fractions of a second. This technology thus represents an exciting development that may allow researchers to use the power of GPS for tracking dolphins and porpoises in a more accurate and precise way, for the very first time.

In June 2019, the Sarasota Dolphin Research Program (SDRP) collaborated with Wildlife Computers, a world leader in the development of tags and long-time program collaborator, to test a newly designed Fastloc® GPS fin-mount tag for small cetaceans during our health assessment program. During this time we deployed Fastloc® tags on three resident Sarasota Bay dolphins (a juvenile female, and two young adult males) and conducted focal animal behavioral follows on these individuals to 1) assess the health and behavior of the dolphins post-tagging and release, 2) monitor the animals and examine the potential for the tags to become entangled in gear such as fishing line or trash, and 3) assess the accuracy of the data provided by the tags. Preliminary results suggest that the tags performed well; however, biofouling (from barnacle attachment, algae growth) has been a significant issue hindering overall tag performance, prompting redesign of

F266 with a fin-mounted Fastloc® GPS tag.

the tag for future deployments. Monitoring of these animals will continue, to further assess tag performance, accuracy, and entanglement risk, until the tags fall off from attachment corrosion, as designed (expected to occur within 3-6 months post-deployment). A Fastloc® GPS tag is highly sought-after in the marine mammal community, so we are very grateful for this collaboration with Wildlife Computers and to the Chicago Zoological Society's Women's Board for funding this research.

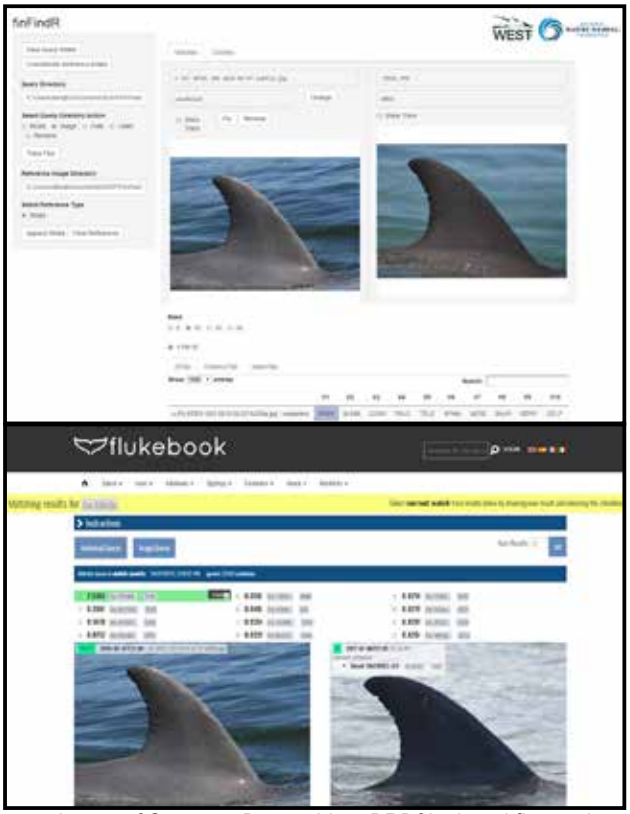
SDRP and Wildlife Computers staff with F283, the first free-ranging cetacean to receive a fin-mounted Fastloc® GPS tag.

Advances in automated dorsal fin matching

Reny Tyson Moore, Jason Allen, Chicago Zoological Society; Kim Urian, Duke University Marine Laboratory

Exciting developments have been underway during the past year in regards to automated dorsal fin matching. We have been working with engineers at WildMe, a non-profit organization specializing in open-source data management platforms for wildlife research, to integrate a fin-matching algorithm called CurvRank, recently developed through collaboration between the Sarasota Dolphin Research Program (SDRP), the Rensselaer Polytechnic Institute, Duke University, Cascadia Research Collective, and Massey University, into FlukeBook (www.FlukeBook.org), a freely available cloud-based photo-ID tool for marine animal research. As part of this build, we used our extensive database of known individuals in Sarasota Bay to test the performance of CurvRank and FlukeBook in addition to testing the performance of finFindR, a second automated fin-matching algorithm developed through collaboration between West Inc. and the National Marine Mammal Foundation, that had recently been made available. We created a test data set of 604 images of 194 unique individuals and compared these images to a catalog of 26,706 images of 888 known individuals within each platform. Images tested included all quality levels (excellent – Q1, average – Q2, and poor – Q3) of all fin distinctiveness levels (very distinct – D1, average level of distinctiveness – D2, low distinctiveness – D3, non-distinct – D4). Both algorithms performed well with 95.90% (CurvRank in FlukeBook) and 96.92% (finFindR) of Q1, Q2 and D1, D2 fins matched. Interestingly, both platforms made matches that the other platform missed. When matches between platforms were combined, 98.97% of Q1, Q2 and D1, D2 images were matched and 95.55% of all images (regardless of image quality or fin distinctiveness) were matched. Due to these findings, WildMe is working with the developers of finFindR to incorporate both the finFindR algorithms into Flukebook along with the CurvRank algorithm so that researchers from around the world will be able to maximize fin-matching performance within a single platform.

While these automatic fin-matching systems are proving to be very successful, there has been little discussion among user groups regarding the use of these systems within current photo-ID workflows. Because of this, we hosted a workshop titled "Rise of the machines - Application of automated systems for matching dolphin dorsal fins: current status and future directions" at the World Marine Mammal Conference in Barcelona in December 2019. This workshop brought together photo-ID researchers and database and algorithm developers to identify strengths and weaknesses of existing automated fin-matching systems, evaluate their success in matching dorsal fins, and assess their application in photo-ID workflows. Ultimately we hope to derive a set of best practices for using fin recognition technology and to assess whether a single 'standard' system can be developed for automated dorsal fin photo-ID. Although these efforts are still ongoing, we are very excited about the progress made thus far as these systems can save significant time for small cetacean researchers worldwide, greatly expanding the capacity and usefulness of photo-ID methods in conservation and biological efforts.



The same image of Sarasota Bay resident BRD3's dorsal fin used to test finFindR (top) and flukebook (bottom). Both systems successfully ranked BRD3 as the most likely match.

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 (SDRP) 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 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 at 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/

High school programs: High Flying Scholars 2019 trip summary

Sandra Ortiz, Jason Allen, Katie McHugh, Chicago Zoological Society

Following months of preparation, nine High Flying Scholars participated in a once-in-a-lifetime trip to Sarasota, FL. The trip took place over the second week of July and included a variety of activities aimed at exposing them to careers in field biology, as well as providing them a unique opportunity to engage with nature. Prior to the trip, the students, 5 females and 4 males, participated in a variety of workshops ranging in topics including dolphin biology, oceanography and ocean conservation. Students also had the opportunity to attend a screening and panel discussion of the documentary "*Dispatches from the Gulf 2*," and met with Randy Wells, the director of the Sarasota Dolphin Research Program (SDRP). SDRP is a program of the Chicago Zoological Society, and conducts the world's longest-running study of a wild dolphin population.

Under the instruction of SDRP marine biologists Jason Allen, Aaron Barleycorn, Kim Bassos-Hull and Katie McHugh, students spent the first four days participating in a variety

SDRP staff with High Flying Scholars and their chaperones during an initial briefing and dolphin survey training.

of exercises both out in the field and in the laboratory, shadowing and actively participating in the researcher's roles. Activities included boat safety training, behavioral and population data collection in the Gulf of Mexico and Sarasota Bay, as well as data entry and analysis, using the program's standard protocol. All data collected during the efforts will be integrated into the SDRP's database for future use in research.

Following their work with the SDRP, students spent the fifth day of the trip exploring the Mote Marine Laboratory and Aquarium, the facility that is base of operations for the SDRP. This experience included a tour of the facility's necropsy lab, osteology room (cetacean bone collection), and sea turtle hospital. Through these tours, students learned about a variety of different careers in conservation, as well as had the opportunity to connect with a variety of experts and talk about the career experiences that allowed them to work in their perspective fields. Along the way students also heard from aquarium interns, who talked to them about their college experiences and provided them advice on how to land an internship in the competitive field.

High Flying Scholars is a subset of the King Conservation Science Scholars Program. This program was offered completely free of charge to all selected, eligible applicants.

Collection of environmental data during a dolphin survey.

Jason Allen instructs the High Flying Scholars on data entry.

Sharing Scientific Findings and Participation on International and Government Panels:

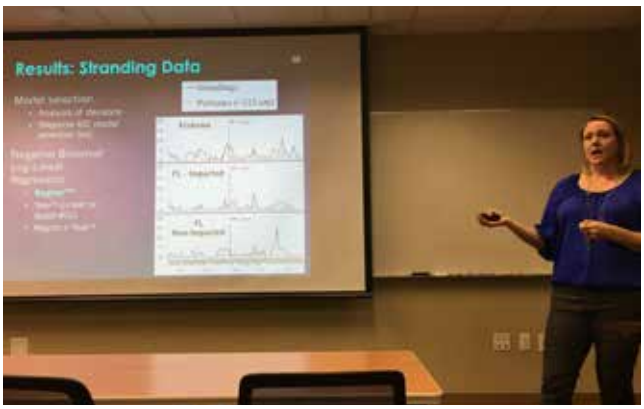
Our efforts to provide information to our colleagues and wildlife management agencies continue, through publication of numerous peer-reviewed scientific articles, through invited presentations at various scientific conferences and through participation in national/international panels such as the NOAA/USFWS 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 2019, we had trainees, including researchers, interns and graduate students, from: China, Denmark, Kenya, Senegal, Peru, Switzerland, the UK, and Spain.

Students:

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, 43 doctoral dissertation and 41 master's thesis projects have benefited from association with our program, through field research opportunities or access to data, samples, or guidance. Over the past year nine doctoral students and five Master's students have been making use of resources provided by the SDRP:



Christina Toms defending her dissertation at the University of Central Florida.

Doctoral Dissertations – Completed

Jones, Brittany. 2019. Communication accommodation theory: A dolphin perspective. University of St. Andrews, Scotland.

Powell, James. 2019. Bone mineral density of the bottlenose dolphin, *Tursiops truncatus*: a proposed model for monitoring osteological and ecosystem health. Portland State University.

Toms, Christina. 2019. Filling the gaps: Common bottlenose dolphin population dynamics, structure, and connectivity within Florida Panhandle bays, sounds, and estuaries. University of Central Florida.

Weideman, Hendrik. 2019. Contour-based instance recognition of animals. Rensselaer Polytechnic Institute.

Masters Thesis - Completed

Ronje, Errol. 2019. Abundance and distribution of a common bottlenose dolphin metapopulation in North Texas. University of Florida.

Doctoral Dissertations – Underway

Allen, Austin. In progress. Dolphin energetics and disturbance responses. Duke University.

Asplanato, Natalia. In progress. Abundance, spatial and temporal distribution and trophic ecology of Burmeister's porpoise, *Phocoena spinipinnis*, at the Beagle Channel, Argentina. Universidad de Buenos Aires.

Beal, Andria. In progress. Epigenetic estimation of age in bottlenose dolphins (*Tursiops truncatus*) using DNA methylation. Florida International University.

Casoli, Marco. In progress. Mating strategies in bottlenose dolphins: fine-scale behaviour and acoustic during male-male and male-female interactions. University of St. Andrews, Scotland.

Tatom-Naecker, Theresa. In progress. Quantitative fatty acid analysis in bottlenose dolphins: Technique validation and application. University of California, Santa Cruz.

Masters Research Projects - Underway

Anderson, Austin. In progress. Live classification of signature whistles using convolutional neural networks. New College of Florida.

Brown, Shelby. In progress. Evaluating the use of remote monitoring to establish boater compliance with marine mammal viewing guidelines in Sarasota Bay, Florida. Master of Professional Science, University of Miami, FL.

Dziobak, Miranda. In progress. Characterization of phthalate contamination in common bottlenose dolphins (*Tursiops truncatus*) from Sarasota Bay, Florida, and policy steps to mitigate exposure. College of Charleston.

Hooper, Lindsay. In progress. Assessing human-dolphin interaction in Southwest Florida: insights through injuries, strandings, and tour operator compliance. Florida State University.

Grad Student Update – Where are they now?

Kristi Fazioli, Environmental Institute of Houston

Twenty years ago, I stood defending my Master's degree at U.C. Santa Cruz, having worked my way up from an SDRP intern to a graduate student studying the coastal dolphin population just off Sarasota. I now find myself across the Gulf, in slightly murkier waters, working to better understand the dolphins of Galveston Bay, Texas as a research associate with the Environmental Institute of Houston and principal investigator for the Galveston Bay Dolphin Research and Conservation Program (GDRCP). While some challenges here differ from Sarasota, the invaluable skills I learned at SDRP are applicable everywhere I go. Nothing hones your boat handling, situational awareness, decision making, people management, and on-the-spot weather forecasting skills like being set 'free' in the Gulf of Mexico with a boat full of fresh interns!

More importantly, I continue to rely on the support system that SDRP provides and that remains strong even all these years later. When establishing the GDRCP in 2015 with another SDRP alum, Vanessa Mintzer (Galveston Bay Foundation), we gratefully looked to Randy Wells and SDRP as our "reference program." They have provided guidance and support on everything from formulating program goals and protocol standards to procuring supplies and advanced skill training, and are a reliable source of promising students and interns. Today, the GDRCP conducts long-term photo-identification monitoring and remote biopsy darting of dolphins in the highly industrialized environment of Galveston Bay. Through this program, we provide baseline data and structure for graduate students at the University of Houston-Clear Lake to build their Master's projects, as well as educate the public through outreach events, volunteer workshops and school programs. We work in coordination with NOAA to respond to environmental disasters and to contribute to research and knowledge of freshwater skin lesions, population genetics and levels of persistent pollutants in estuarine dolphin populations.

Kristi during a dolphin survey in Galveston Bay.

Whenever it occurs, I take a break from Texas and make my way to clear blue waters to visit friends and help with the Sarasota health assessment project. Continued participation in this project has provided an opportunity, unmatched by any other experience, for professional development as I learn from, and interact with, researchers and animal health professionals from around the globe. For me, this experience always reinforces the most important lesson I learned at SDRP: that working together with colleagues near and far, across disciplines and among organizations, academia and agencies always makes science stronger and the outcome better for the wildlife and environments we work to conserve.

The Galveston Bay Dolphin Research and Conservation Program (GDRCP) is a partnership between the Environmental Institute of Houston at the University of Houston – Clear Lake (EIH-UHCL) and the Galveston Bay Foundation (GBF). More information on the program can be found at: https://galvbay.org/dolphin/; and https://www.uhcl.edu/environmental-institute/research/current-projects/bottlenose-dolphin

SDRP reunion Texas style. Left to Right: Kristi Fazioli, Sherah Loe (Winter 2013), Ashley Burke-Muraida (Winter 2018), Vanessa Mintzer (Summer 2005).

Undergraduate college internships and post-graduate trainees:

At the college level and beyond, we are fortunate to have access through Mote Marine Laboratory to high quality, dedicated undergraduate student interns who volunteer with our program for at least 2-3 months at a time (for more information on internships, please contact Katie McHugh, SDRP Intern Coordinator, at kmchugh@mote.org). Over the past year, 16 interns (including interns from the UK and Switzerland) and two post-graduate international trainees (from Senegal and Kenya) provided approximately 9,460 hours of assistance to the program.

2019 Intern Perspective

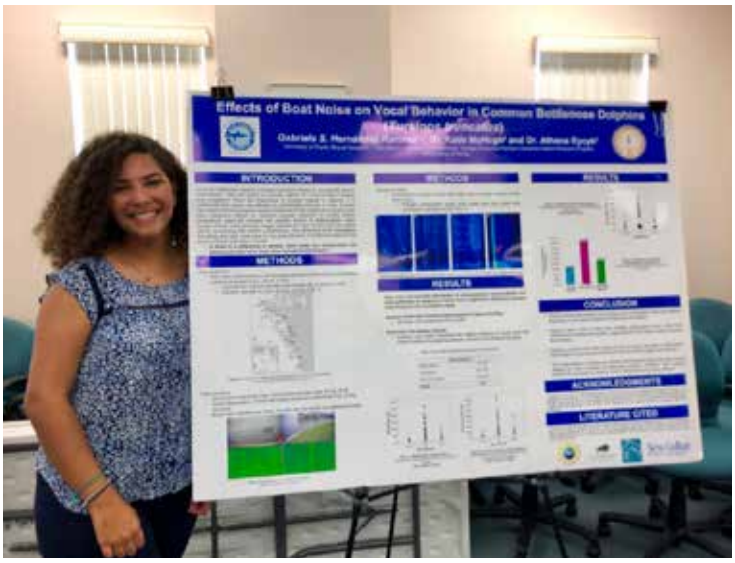
Experiences of a future marine mammal scientist

Gabriela Hernández Ramírez, University of Puerto Rico at Humacao

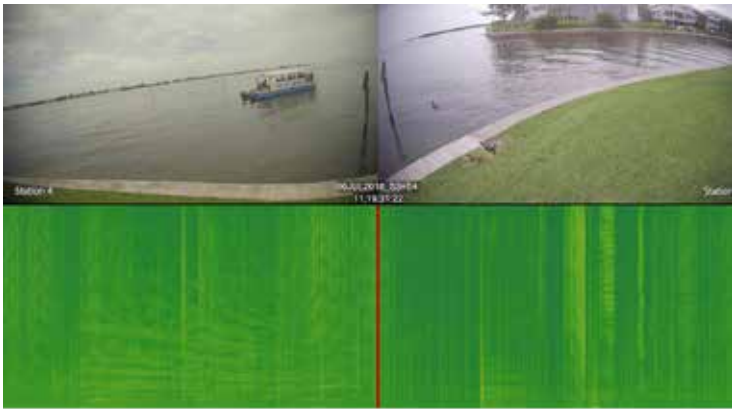
The biology and ecology of the ocean truly fascinates me. Nowadays, climate change, marine debris, noise pollution, and other anthropogenic factors are slowly damaging our blue planet and, therefore, getting humans a little closer to extinction. Without the ocean, life as we know it will no longer exist. However, if we take responsibility and make the best effort that we can, the marine environment and all its aquatic life will survive. These and many other reasons are why one of my main goals is being able to explore the ocean, what lives within and the effects that all of these factors have on it. The fact that only 5% of the ocean has been explored gives me more motivation to become a professional in the Marine Biology field and educate our society. Being born and raised in Puerto Rico, a little island in the Caribbean, and being able to study abroad for a year in Alaska, on the other side of the continent, gave me a broader look on what type of Marine Scientist I would like to become. However, I felt like I needed something else.

I was fortunate enough to participate in the National Science Foundation's Research Experience for Undergraduates Program with the mentorship of Dr. Katie McHugh, Dr. Athena Rycyk and the Sarasota Dolphin Research Program (SDRP) for the summer of 2019. For 10 weeks I designed and conducted my own research, which was focused on the effects that boat noise has on the vocal behavior of bottlenose dolphins. I wanted to test if there was a difference in whistle, echolocation, and burst pulse rate when boat noise was absent and present. Data were collected from a shore-based passive underwater acoustic station at the mouth of Palma Sola Bay, in Cortez, Florida. This station also had a camera that recorded 12 hours of video per day. I audited video clips from three days of summer 2018 to classify dolphin and boat behavior and audited acoustic files to quantify whistles, echolocation bouts, burst pulses and boat noises. The first analysis showed that boat noise was nearly always present, so instead of comparing between absence and presence, we compared the relative distance of boats to the station. Results showed that dolphins spent most of their time emitting echolocation bouts, rather than whistling and emitting burst pulses, suggesting that they spent a great amount of time foraging. They also vocalized more when boats were far from them, possibly because it could require less energy to communicate. We concluded that the vocal behavior of bottlenose dolphins that frequent Palma Sola Bay is being affected by noise produced by watercraft. However, more research needs to be conducted in order to know to what extent it is being affected.

Being an SDRP intern was one of the best experiences I've ever had. I had the opportunity to work closely with amazing marine mammal scientists during the Sarasota Bay dolphin health assessments. Here I learned how to catch, examine, release, and track a dolphin. I learned how to collect data in the field and how to analyze it in the lab. I learned how to take photographs of dorsal fins in order to identify individuals. I assisted with dolphin-prey abundance surveys by identifying, counting and measuring various species of fish. I also helped population-monitoring and dolphin-human interaction surveys and learned what to do in case of an emergency. I even had the opportunity to drive an SDRP vessel in one of the surveys (with appropriate guidance)! With Dr. McHugh I prepared a proposal, manuscript and poster presentation of my research, all for the first time! At the end of the 10 weeks I felt like a whole new person. Mote Marine Lab and the SDRP taught me lifelong skills that will help me continue a career in marine mammal science, but most importantly, they helped me become a better version of myself. I will always be grateful for this experience and hope to work with the SDRP in the future.



Gabriela presenting her research at the Mote NSF-REU Poster Session in August 2019.



Recorded video and sound from the listening station near Cortez, FL. This was used to measure the amount of vocal behavior at the site relative to the presence of boats.

Where are they now?
Former Intern Perspective - 2005

Neil Niru Dorrian, Whalefish

Wow, has it really been 14 years since my summer at Mote Marine Laboratory and SDRP? I often recall fondly the great memories and experiences I made there and how it really helped establish my career. I joined SDRP in the summer of 2005 when I was just about to enter my 4th year of my undergraduate degree in Marine Biology at the University of Stirling in Scotland. I had already spent my previous summer working in California at the Aquarium of the Bay and at the Marine Mammal Center where I was encouraged to apply for various internship programs, and one of those was at Mote. Since a young age I had always wanted to pursue a career in marine mammalogy, so this just felt like a natural path to follow. So far I have no regrets!

I am so grateful to Drs. Christine Shepard and Randy Wells for accepting my application to the SDRP intern program. As an intern, I was part of a field team conducting line-transect surveys to document both boat and dolphin sighting location and attribute information. The data collected for this project were then compiled using ArcView software to allow for spatial analysis of the dolphin sighting distributions. This experience was my first introduction to marine mammal academic field research and survey techniques, which I have since applied throughout my career. Also, during my time at Mote I was fortunate to get the opportunity to volunteer early each morning and also on evening shifts at the Mote Whale and Dolphin Hospital. I assisted in several duties in the care of two rescued Risso's dolphins, working directly within the tanks assisting in medical and physical checks, administering medications and tube feeding and also with turtle releases of Kemp's ridley, green, and loggerheads.

I can confidently say that my time at SDRP really helped reinforce and secure my path in working with marine mammals. I am so grateful for my professional career and where it has led me. Over the past 14 years I have travelled the world building a vast professional network and have worked exclusively on marine mammal-related projects, from dolphin photo-ID and southern right whale research in Argentina, to marine mammal rescue projects in Holland, UK, USA and more. I am one of three Co-founding directors of www.Whalefish.org (a not for profit marine conservation and outreach organization). I am also a Chartered Marine Scientist and Fellow of the IMarEST, an Advanced Marine Mammal Medic for the British Marine Life Rescue and I now work as an Environmental Project Manager for large scale industry-related projects all over the world. Last year I was the Central Commander of the SEIC/IUCN Western Gray Whale Monitoring Programme, and I am now currently based in the UAE managing projects within MPAs and UNESCO Biosphere reserves for other industry clients.

I am eternally grateful for the awesome friendships I made at Mote, and I am really so proud of all of their incredible professional achievements! A special shout out to Dr. Chris Shepard for taking a chance on me, I cannot be more grateful.

Niru's work as a marine mammal biologist and environmental project manager has included experience on varied projects around the world. He is seen here participating in harbor porpoise rehabilitation at SOS Dolfijn in Holland (left) and dugong disentanglement efforts in Abu Dhabi (right).

Where are they now?
Former Intern Perspective - 2005

Olivia Lee, International Arctic Research Center, University of Alaska Fairbanks

Olivia Lee conducting research on coastal sea ice change in Utqiagvik, Alaska with her son.

I started my internship with the SDRP in 2005 after just completing my BA in Marine Sciences at the University of Hawaii at Hilo. I had just returned from a 2-month volunteer position for the US Fish and Wildlife Service at Midway Atoll, and I was keen to get even more field research experience. I had very little small-boat experience and no marine mammal research experience until being one of the interns with Katie McHugh - which showed both the glamorous and less-glamorous sides of field research. Long days on the boat doing behavioral focal follows of bottlenose dolphins, followed by lab days with data entry and QA/QC were immensely helpful in understanding how marine mammal research was conducted. However my internship at SDRP was also a huge influence on me in understanding how a respectful, inclusive environment is absolutely necessary to maintain a long-term research program. I am grateful to Dr. McHugh, Jason Allen, Aaron Barleycorn, Dr. Wells, and other mentors at the SDRP for their leadership in fostering that culture in science. My internship prepared me to spend long hours in a small boat in Prince William Sound, Alaska studying the foraging tactics of sea otters, and helped me gain confidence in fieldwork to be part of a small team at a remote location on Bering Island, Russia where we tagged northern fur seal pups to study their migratory behavior. After obtaining my PhD in Wildlife and Fisheries Sciences from Texas A&M University I spent a year as a Knauss Sea Grant Fellow at the National Science Foundation (NSF), and then moved to Fairbanks, Alaska to complete a post-doc. I am currently an Assistant Professor at the University of Alaska Fairbanks, where I have been the Principal Investigator in projects funded by NASA, NSF and other state and federal agencies leading research on Arctic marine ecosystem change in Alaska. A lot of my research on changing sea ice habitat for Pacific walruses is conducted in collaboration with indigenous Alaska coastal communities. I am also a co-lead for Sea Ice Collaboration Team for the Interagency Arctic Research Policy Committee (IARPC), where I am involved in building collaborations among researchers studying Arctic sea ice change and what it means to stakeholders and decision-makers. Yet, rapid Arctic change continues to need broader representation of perspectives in order to find solutions to adapt to rapid environmental change. This prompted me to help establish the IARPC Diversity and Inclusion working group, where we aim to provide more inclusive spaces for Arctic research and collaboration. While my professional journey has not been exclusively in the realm of marine mammal research, I think the SDRP internship provides invaluable experience with relevance that cuts across scientific disciplines - that of experience in a healthy research culture, which is essential for a sustainable long-term research program. These successes, while much more difficult to measure in terms of positive productive output of a research program, are no less essential for building capacity in future scientists.

Citizen science and Sarasota Bay dolphins

Randall Wells, Chicago Zoological Society

The concept of “citizen science” is nothing new for the SDRP. Back in the 1970’s, our tagging and tracking teams were filled out largely with local volunteers. Beginning in 1982 and continuing for the next 25 years, we worked with Earthwatch, an organization that matches interested members of the public with research projects requiring assistance. Some of our more than 1,000 Earthwatch volunteers continue working with us today, providing valuable services and expertise. We regularly involve members of a team of trained local volunteers in our photo-ID surveys, our health assessments, our seasonal fish surveys, and in dolphin rescues. Since 2017, local coastal residents have become involved in our passive acoustic listening station network (PALS, see page 33), by providing locations for deployment of listening systems, and in some cases support for the systems and operations. While contributing to the development of a novel environmental and dolphin behavior monitoring system, they can tune in to the system to hear what is happening below the water’s surface in their own backyard.

Male alliance F142 and F276 surfacing together.

Volunteer perspective

René Byrskov, Denmark

Growing up on Greenland is different. You got a country that's three times larger than Texas, but with a population the size of Sarasota city. The extreme contrasts continue, despite the way our climate changes, with winters that are as arctic as it gets and scorching sunny summer days with temperatures in the high sixties or low seventies. During those days you would see minke whales, fin whales, belugas and narwhals coming into the deep fjords to eat and relax - which is about as awe inspiring sight for a kid as you could imagine. The local myths and legends are also based on the surrounding world and wildlife, so my childhood stories were more about talking whales than a talking mouse. A small distinction perhaps, but it makes a world of difference.

As I was starting school we moved back to Denmark, where I eventually, in the 90s, began a career in educational software. First support and testing, later on development and design. All very exciting if you're into that sort of thing, but when it comes to making the world a better place, it's a pretty hands off approach, with a hope that better educated people in general improves the world. It's good, but what if you could do more?

As luck would have it, on a vacation in Scotland I met a former SDRP intern, who talked about this place in Florida, with spectacular animals and amazing people, and that through a program at the time you could just sign up and go there yourself. Intriguing. It's hard to tell when you're living on the inside, but from the outside world, the US can be as mythological as Middle Earth or the Enterprise - you only see it in the movies after all. Combined with a chance to work with bleeding edge science (slightly ahead of cutting edge), it was an irresistible offer.

I was easy enough to spot at the airport (the staff was looking for the tall pale guy) and less than a day later you're already on a boat. As it turns out, the animals were as amazing as I was led to believe, and as for the people, it's not only easy to recognize when you're working with professionals, but also actual experts and pioneers in their field - and the more you dig into the history and work of the lab, the more you realize how instrumental it is to its entire field. I was impressed.

My luck continued, even though the economy was hitting a rough spot, and the old volunteer program was coming to an end. I had mastered key skills, like not falling asleep on the boat, well enough that I was allowed to come back as a regular volunteer for about fourteen years and counting. Later on, my own professional skills have also been able to be incorporated in the work I do for the lab, allowing us to do more work with videos or apps.

There is a rare satisfaction in applying your skills in one field to another field, but something I hadn't expected was how much experience I could bring home with me and apply to the rest of my life. And you would think that after doing the same thing year after year it would become routine, but whenever that transatlantic flight from Denmark to Sarasota takes me back above Greenland, there's still a pit of excitement in my stomach for what I'm about to work on.

René Byrskov out on monthly dolphin survey in Sarasota Bay in October 2019.

SDRP staff Kim Bassos-Hull, René Byrskov, local volunteer Mark Fishman, and intern Marissa Trevino on Fregata during a dolphin survey.

Communicating our Conservation Research

Martha Wells, Conservation Communications, Inc.

Communicating science and communicating about research are integral parts of marine mammal conservation, and the SDRP includes regular training in the course of our operations. Public opinion and understanding are crucial to addressing conservation issues as well as being able to work in a community to do the actual research in many cases. By definition, a conservation problem includes a human behavior component. Conservation issues frequently involve the intersection of science-based problem solving with people's opinions and emotions. As a conservation science organization, the SDRP emphasizes communication, education and outreach with multiple audiences: the people involved with the issue being explored, reporters, scientific colleagues, management authorities, financial supporters, public officials and the general public.

Most of the researchers with whom we work are passionate about marine mammals, the environment and their work, but their education has encouraged them to take a "just the facts" approach to communication. The SDRP provides training to help colleagues develop a strategic approach to communication and hone skills that help them effectively represent their work enthusiastically and accurately to relevant audiences. We must be able to share *why* our work is important and relevant, and "to what end" we pursue it in addition to *how* we do it.

A prominent recent example is the plight of the vaquita and film documentary "*Sea of Shadows*," described above. We hosted Dr. Lorenzo Rojas-Bracho, the head of Mexico's vaquita conservation program in Sarasota for media training prior to him going to the Sundance Film Festival for release of the Terra Mater film "*Sea of Shadows*." The film describes the black market Chinese trade in swim bladders from the endangered totoaba fish and the role of this fishery in the likely imminent extinction of the vaquita porpoise. The film includes a few cameo appearances and radio chatter by SDRP participants in the unsuccessful 2017 VaquitaCPR attempt to capture and hold vaquitas where they would not be exposed to threats from illegal fishing nets. To help prepare for talking with reporters, the training included

- Mastering how to "say what you mean and mean what you say"
- How to listen for what people mean beyond the words they use
- How traditional media and social media work to better manage the interview
- Visual communication – effective use of photos and infographics

Lorenzo expressed his appreciation for the training and that he wished he'd had something similar earlier in his career. We will continue to offer and provide these kinds of trainings as needed.

Lorenzo Rojas-Bracho (center) with Cynthia Smith (R), Executive Director of the National Marine Mammal Foundation, and Andrea Crosta (L), Director of the Elephant Action League, at the Sundance Film Festival, for the screening of "Sea of Shadows."

SDRP director, Randall Wells, demonstrating the importance of communicating science to the public.

Lorenzo Rojas Bracho, with VaquitaCPR Program Manager Cynthia Smith, responding to audience questions at the San Diego premiere of "Sea of Shadows."

Products

Professional Activities Summary: November 2018 through October 2019

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

Published Peer-Reviewed Journal Articles and Book Chapters

Baker, I., J. O'Brien, K. McHugh and S. Berrow. 2019. Fine-scale sociality reveals female-male affiliations and absence of male alliances in bottlenose dolphins (*Tursiops truncatus*) in the Shannon Estuary, Ireland. Marine Mammal Science 2019:1-23. https://doi.org/10.1111/mms.12631

Beal, A., J. J. Kiszka, R. S. Wells and J. M. Eirin-Lopez. 2019. The Bottlenose dolphin Epigenetic Aging Tool (BEAT): A molecular age estimation tool for small cetaceans. Frontiers in Marine Science 6: 561. https://doi.org/10.3389/fmars.2019.00561

Boggs, A. S. P., J. M. Ragland, E. S. Zolman, T. B. Schock, J. S. Morey, T. M. Galigan, G. Dalle Luche, B. C. Balmer, R. S. Wells, J. R. Kucklick and L. H. Schwacke. 2019. Remote blubber sampling paired with liquid chromatography tandem mass spectrometry for steroidal endocrinology in free-ranging bottlenose dolphins (*Tursiops truncatus*). General and Comparative Endocrinology 281:164-172. https://doi.org/10.1016/j.ygcen.2019.06.006

Cerutti-Pereyra, F., K. Bassos-Hull, X. Arvizu and I. García-Carrillo. 2019. Ciencia ciudadana apoyando la investigación y conservación de rayas águila en el Caribe Mexicano. Ecofronteras 23:22-25.

DeGuise, S., M. Levin, L. Jasperse, G. R. Risatti and R. S. Wells. 2019. T helper cell subsets and their functions in common bottlenose dolphins (*Tursiops truncatus*). Frontiers in Immunology 10:1578. https://doi.org/10.3389/fimmu.2019.01578

Desoubeaux, G., R. Peschke, C. LeBert, V. Fravel, J. Soto, E. Jensen, J. Flower, R. Wells, A. Joachim and C. Cray. 2018. Seroprevalence survey for microsporidia in common bottlenose dolphins (*Tursiops truncatus*): Example of a quantitative approach based on immunoblotting Journal of Wildlife Diseases 54:870-873. https://doi.org/10.7589/2017-11-287

Hays, G. C., H. Bailey, S. J. Bograd, W. D. Bowen, C. Campagna, R. H. Carmichael, P. Casale, A. Chiaradia, D. P. Costa, E. Cuevas, P. J. Nico de Bruyn, M. P. Dias, C. M. Duarte, D. C. Dunn, P. H. Dutton, N. Esteban, A. Friedlaender, K. T. Goetz, B. J. Godley, P. N. Halpin, M. Hamann, N. Hammerschlag, R. Harcourt, A-L. Harrison, E. L. Hazen, M. R. Heupel, E. Hoyt, N. E. Humphries, C. Y. Kot, J. S. E. Lea, H. Marsh, S. M. Maxwell, C. R. McMahon, G. Notarbartolo di Sciara, D. M. Palacios, R. A. Phillips, D. Righton, G. Schofield, J. A. Seminoff, C. A. Simpfendorfer, D. W. Sims, A. Takahashi, M. J. Tetley, M. Thums, P. N. Trathan, S. Villegas-Amtmann, R. S. Wells, S. D. Whiting, N. E. Wildermann and A. M. M. Sequeira. 2019. Translating marine animal tracking data into conservation policy and management. Trends in Ecology and Evolution 34:459-473. https://doi.org/10.1016/j.tree.2019.01.009

Lauderdale, L. K., C. Messinger, R. S. Wells, K. A. Mitchell, D. Messinger, R. Stacey and L. J. Miller. 2018. Advancing the use of morphometric data for estimating and managing common bottlenose dolphin (*Tursiops truncatus*) mass. Marine Mammal Science 35:875-892. https://doi.org/10.1111/mms.12568

McBride-Kebert, S., J. S. Taylor, H. Lyn, F. R. Moore, D. F. Sacco, B. Kar and S. A. Kuczaj, II. 2019. Controlling for survey effort is worth the effort: comparing bottlenose dolphin (*Tursiops truncatus*) habitat use between standardized photographic-identification surveys and opportunistic surveys. Aquatic Mammals 45:21-29. https://doi.org/10.1578/AM.45.1.2019.21

McBride-Kebert, S., J. S. Taylor, K. A. Wilkinson, H. Lyn, F. R. Moore, D. F. Sacco, B. Kar and S. A. Kuczaj, II. 2019. Common bottlenose dolphin, *Tursiops truncatus*, seasonal habitat use and associations with habitat characteristics in Roanoke Sound, North Carolina. International Journal of Comparative Psychology, 32:1-21. https://escholarship.org/uc/item/2fn0n4wf

McHugh, K. A. 2019. Odontocete social strategies and tactics along and inshore. Pages 165-182 *in* B. Würsig, ed. Ethology and Behavioral Ecology of Odontocetes. Ethology and Behavioral Ecology of Marine Mammals. Springer Nature, Switzerland. https://doi.org/10.1007/978-3-030-16663-2_8

Rojas-Bracho, L., F. M. D. Gulland, C. R. Smith, B. Taylor, R. S. Wells, P .O. Thomas, B. Bauer, M. P. Heide-Jørgensen, J. Teilmann, R. Dietz, J. D. Balle, M. V. Jensen, M. H. S. Sinding, A. Jaramillo-Legorreta, G. Abel, A. J. Read, A. J. Westgate, K. Colegrove, F. Gomez, K. Martz, R. Rebolledo, S. Ridgway, T. Rowles, C. E. van Elk, J. Boehm, G. Cardenas-Hinojosa, R. Constandse, E. Nieto-Garcia, W. Phillips, D. Sabio, R. Sanchez, J. Sweeney, F. Townsend, J. C. Vivanco and S. Walker. 2019. A field effort to capture critically endangered vaquitas (*Phocoena sinus*) for protection from entanglement in illegal gillnets. Endangered Species Research 38:11–27. https://doi.org/10.3354/esr00931

Sayigh, L. S. and V. Janik. 2019. Individual signatures in animal groups: Cetaceans. Pages 539-549 *in* J. Choe, ed. Encyclopedia of Animal Behavior, Volume 2. Elsevier, Oxford.

Serrano-Flores, F., J. Pérez-Jiménez, I. Méndez-Loeza, K. Bassos-Hull and M. Ajemian. 2018. Comparison between the feeding habits of spotted eagle ray (*Aetobatus narinari*) and their potential prey in the southern Gulf of Mexico. Journal of the Marine Biological Association of the United Kingdom 99:661-672. https://doi.org/10.1017/S0025315418000450

Taylor, B., R. S. Wells, P. Olson, R. L. Brownell, Jr., F. Gulland, A. J. Read, F. J. Valverde-Esparza, O. H. Ortiz-García, D. Ruiz-Sabio, A. M. Jaramillo-Legorreta and L. Rojas-Bracho. 2019. Likely annual calving in the vaquita, *Phocoena sinus*: A new hope? Marine Mammal Science 35:1603-1612. https://doi.org/10.1111/mms.12595

Wells, R. S. 2019. Common bottlenose dolphin foraging: Behavioral solutions that incorporate habitat features and social associates. Pages 331-344 *in* B. Würsig, ed. Ethology and Behavioral Ecology of Odontocetes. Ethology and Behavioral Ecology of Marine Mammals. Springer Nature, Switzerland. https://doi.org/10.1007/978-3-030-16663-2_15

Manuscripts In Press or Accepted for Publication

Andrews, R. D., R. W. Baird, J. Calambokidis, C. E. C. Goertz, F. M. D. Gulland, M. P. Heide-Jørgensen, S. K. Hooker, M. Johnson, B. Mate, Y. Mitani, D. P. Nowacek, K. Owen, L. T. Quakenbush, S. Raverty, J. Robbins, G. S. Schorr, O. V. Shpak, F. I. Townsend, Jr., M. Uhart, R. S. Wells and A. N. Zerbini. In press. Best practice guidelines for cetacean tagging. Journal of Cetacean Research and Management.

Presentations at Professional Meetings

Ajemian, M., C. Lamboy, A. Ibrahim, B. DeGroot, K. Bassos-Hull and L. Chérubin. 2019. Breaking ground with underwater sound: A novel approach to remotely measure hard prey consumption in durophagous elasmobranchs and other aquatic species. American Elasmobranch Society Conference, 25-28 July 2019, Snowbird, UT.

Cahill, B. V., K. A. Wilkinson, J. J. Morris, K. L. Cain, D. A. Dougherty, G. L. Byrd and R. E. Hueter. 2019. Historical changes in patterns of shark presence along Florida's central Gulf coast. American Elasmobranch Society Conference, 24-28 July 2019, Snowbird, UT.

Cush, C., S. McBride and R. S. Wells. 2019. Gulf of Mexico Dolphin Identification System (GoMDIS) – A collaborative effort to better understand bottlenose dolphin movements. Gulf of Mexico Oil Spill & Ecosystem Science Conference, 4-7 February 2019, New Orleans, LA.

DeGuise, S., M. Levin, L. Jasperse, E. Gebhard, C. Smith, F. Townsend, R. Wells, B. Balmer, E. Zolman, T. Rowles and L. Schwacke. 2019. Recurrence of bottlenose dolphin immune function change associated with the *Deepwater Horizon* oil spill in the northern Gulf of Mexico. Gulf of Mexico Oil Spill & Ecosystem Science Conference, 4-7 February 2019, New Orleans, LA.

Hernández-Ramírez, G., K. McHugh and A. Rycyk. 2019. Effects of boat noise on vocal behavior in common bottlenose dolphins (*Tursiops truncatus*). Mote Marine Laboratory NSF REU Poster Session, 01 August 2019, Sarasota, FL.

Products

Piniak, W. E. D., R. B. Tyson Moore, C. Domit, D. P. Nowacek, H. van der Meij, R. ter Hofstede and M. M. P. B. Fuentes. 2019. Behavioral responses of juvenile green sea turtles (*Chelonia mydas*) to the FaunaGuard Turtle Module. 39th Annual Symposium on Sea Turtle Biology and Conservation, February 2019, Charleston, SC.

Rojas-Bracho, L., C. Smith, B. Taylor, F. Gomez, G. Abel and R. S. Wells. 2018. Lessons learned: For vaquitas and other threatened cetaceans. *Ex Situ* Options for Cetacean Conservation Workshop, 14-18 December 2018, Cistercian Monastery, Heilsbronn, Nuremberg, Germany.

Rozas, A., V. Janik, R. Wells and L. Sayigh. 2019. Mother-offspring whistle comparisons in bottlenose dolphins. Southeast and Mid Atlantic Marine Mammal Symposium, March 2019.

Secchi, E. R., A. N. Zerbini, R. S. Wells and R. Bastida. 2018. Is the franciscana, *Pontoporia blainvillei*, a candidate for ex situ conservation? *Ex Situ* Options for Cetacean Conservation Workshop, 14-18 December 2018, Cistercian Monastery, Heilsbronn, Nuremberg, Germany.

Smith, C. R., F. Gomez, K. Colegrove, T. Rowles, B. Balmer, R. Takeshita, E. Zolman, B. Linnehan, S. Huston, A. Hsu, J. Meegan, W. Musser, M. Ivančić, S. De Guise, F. Townsend, T. Speakman, B. Quigley, V. Cendejas, R. Wells and L. Schwacke. 2019. The long-term impacts of the *Deepwater Horizon* oil spill on bottlenose dolphins and the development of advanced diagnostic tools to better characterize injury and recovery. Gulf of Mexico Oil Spill & Ecosystem Science Conference, 4-7 February 2019, New Orleans, LA.

Welch, B., K. Bassos-Hull and K. A. Wilkinson. 2019. Once a spot always a spot? Investigating natural marking stability in recaptured whitespotted eagle rays (*Aetobatus narinari*) off the west coast of Florida. American Elasmobranch Society Conference, 24-28 July 2019, Snowbird, UT.

Wells, R. S. 2019. The Chicago Zoological Society's Sarasota Dolphin Research Program. Disney's Animals, Science, and the Environment, 8 January 2019, Orlando, FL.

Wells, R. S. 2019. The dolphins of Sarasota Bay – Helping with small cetacean conservation efforts around the world. 13th Annual Whale Tales, 15-18 February 2019, Kapalua, Maui, HI.

Wells, R. S. 2019. Cetaceans as sentinels of ecosystem health in the Gulf of Mexico. Gulf of Mexico Oil Spill & Ecosystem Science Conference, 4-7 February 2019, New Orleans, LA.

Wilkinson, K. A., R. S. Wells, W .E. Pine, III, R. R. Borkhataria and R. E. Hueter. 2019. When the shark bites: Evaluating predator-prey interactions between sharks and resident bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, FL. American Elasmobranch Society Conference, 24-28 July 2019, Snowbird, UT.

Public, University, School Lectures

Bassos-Hull, K. 2018. Connecting for conservation: Research on marine rays in Gulf of Mexico, Atlantic Ocean and Caribbean Sea. Workshop presentation for Sharks and Rays Endless Oceans Adult Learners class at Mote Marine Laboratory, Sarasota, FL. 10 Oct 2018.

Bassos-Hull, K. 2018. Connecting for conservation: Research on marine rays in Gulf of Mexico, Atlantic Ocean and Caribbean Sea. Workshop presentation for Sharks and Rays Teacher workshop class at Mote Marine Laboratory, Sarasota, FL. 27 Oct 2018.

Bassos-Hull, K. 2018. Whitespotted eagle rays as predators and prey - Integrative ecology to develop conservation capacity in the western Atlantic Ocean. Bioseminar series talk at Florida International University, Miami, FL. 26 Nov 2018.

Bassos-Hull, K. 2018. Tag you're it! Using acoustic technologies to understand animal movement patterns in the marine environment. Workshop presentation at the Youth Ocean Conservation Summit at Mote Marine Laboratory, Sarasota, FL. 01 Dec 2018.

Bassos-Hull, K. 2019. Connecting for conservation: Research on dolphins and marine rays in Gulf of Mexico, Atlantic Ocean and Caribbean Sea. Invited presentation for Department of Biodiversity, Conservation, and Attractions, Perth, Western Australia. 22 Mar 2019.

Bassos-Hull, K. 2019. Marine debris research and prevention outreach. Presentation to Mote high school interns and invited guests (City Island Cleanup - 50+ students). 16 Feb 2019.

Bassos-Hull, K. 2019. Dolphin research and conservation. Invited public presentation at Oscar Scherer State Park Earth Day event, Nokomis, FL. 27 Apr 2019.

Bassos-Hull, K. 2019. Rays in Florida waters. World Ocean Day presentation at Mote Aquarium, Sarasota, FL. 08 Jun 2019.

McHugh, K. 2018. Dolphins: Our coastal neighbors. Florida Maritime Museum, Cortez, FL. 24 Oct 2018.

McHugh, K. 2018. Dolphins: Our coastal neighbors. Founders Garden Club, Sarasota, FL, 13 Nov 2018.

McHugh, K. 2018. Dolphins: Our coastal neighbors. USF-Sarasota Manatee, 14 Nov 2018.

McHugh, K. 2019. Sarasota Dolphin Research Program. Anders Frikke Class visit, Mote Marine Laboratory, Sarasota, FL. 24 Jan 2019.

McHugh, K. 2019. Drones in dolphin research. Community Day School, Sarasota, FL. 15 Jan 2019.

McHugh, K. 2019. Dolphins: Our coastal neighbors. Island Library Travel & Lecture Series, Anna Maria Island, FL. 07 Feb 2019.

McHugh, K. 2019. Ecotour outreach workshop – Fishermen's Hall, Cortez, FL. 06 Mar 2019.

McHugh, K. 2019. Sarasota Dolphin Research Program. Mette Mark Class visit, Mote Marine Laboratory, Sarasota, FL. 01 May 2019.

McHugh, K. 2019. Sarasota Dolphin Research Program. Wooster School – Lener Class visit, Mote Marine Laboratory, Sarasota, FL. 28 May 2019.

McHugh, K. 2019. Dolphins: Our coastal neighbors. Florida Master Naturalist Program – Coastal Systems Course, Mote Marine Laboratory, FL. 25 Jul 2019.

McHugh, K. 2019. Dolphins: Our coastal neighbors. Ringling College, Sarasota, FL. 25 Sep 2019.

McHugh, K. and R. Hazelkorn. 2019. Help Protect Our Wildlife. Sarasota County Sheriff's Office Marine Unit Local Marine Intel Workshop, Venice Community Center. 11 Oct 2019.

Sayigh, L. S. 2019. Dolphin communication: Fact and fiction. Presentation to the National Marine Life Center's Teacher Workshop. July 2019.

Toms, C. N. 2019. Filling the gaps: Common bottlenose dolphin (*Tursiops truncatus*) population dynamics, structure and connectivity within Florida Panhandle bays, sounds and estuaries. University of Central Florida, FL. Dissertation Defense. 22 Oct 2019.

Tyson Moore, R. B. 2019. The world's longest-running study of a wild dolphin population: Lessons from 48+ years and 5 generations. Duke University, Nicholas School of the Environment, Marine Megafauna course. 27 Mar 2019.

Wells, R. S. 2019. Lessons learned from the world's longest-running study of a wild dolphin population. Riverview High School Marine Science classes (*n*=5), Sarasota, FL. 18 Sep 2019.

Wells, R. S. 2019. Lessons learned about dolphin conservation needs from the world's longest-running study of a wild dolphin population. Creation Justice Ministries. St. Armands Lutheran Church, Sarasota, FL. 29 Aug 2019.

Wells, R.S. 2019. Factors influencing wild bottlenose dolphin health and survival. SEAVET, U. of Florida, College of Veterinary Medicine, Gainesville, FL. 26 Jun 2019.

Wells, R. S. 2019. Sarasota dolphin conservation research. King Scholars High Flyers, Brookfield, IL. 20 Jun 2019.

Wells, R. S. 2019. The dolphins of Sarasota Bay – Helping with small cetacean conservation efforts around the world. Think and Drink Program, Bishop Museum of Science and Nature, Bradenton, FL. 10 Apr 2019.

Wells, R. S. 2019. Cetacean natural history and life history: Odontocete behavioral ecology. Aquatic Wildlife Health Course. U. of Florida, College of Veterinary Medicine. 21 Mar 2019.

Wells, R. S. 2019. Dolphin field research approaches and techniques. Aquatic Wildlife Health Course. U. of Florida, College of Veterinary Medicine. 21 Mar 2019.

Wells, R. S. 2019. What dolphins can tell us about the effects of red tides. Duke Tampa Bay Alumni Association, Tierra Verde, FL. 19 Mar 2019.

Wells, R. S. 2019. The dolphins of Sarasota Bay – Lessons from 48+ years of research. Florida Southern College, Marine Science Distinguished Speaker Series, Lakeland, FL. 14 Mar 2019.

Wells, R. S. 2019. The world's longest-running study of a wild dolphin population. Ecotour Outreach Workshop – Fishermen's Hall, Cortez, FL. 06 Mar 2019.

Wells, R. S. 2019. The world's longest-running study of a wild dolphin population – Lessons from 48+ years and five generations. Mote Marine Science Course. 13 Feb 2019.

Wilkinson, K. A. 2019. Love bites: Insights into the complicated relationship between sharks and dolphins in Sarasota Bay. Riverview High School, Sarasota, FL. 14 Feb 2019.

Program Operations

As the lab turns...

Krystan Wilkinson, Chicago Zoological Society

We've had a few changes in the SDRP this past year. Shortly after the 2019 Sarasota dolphin health assessment project, Shauna McBride-Kebert and her husband, Alan, moved to Georgia. Shauna began a new position as a Protected Species Observer. We wish Shauna and Alan the best of luck with their next adventure.

Jonathan Crossman photographing dolphins in Sarasota Bay.

This summer we welcomed Jonathan Crossman to our staff. Jonathan was a 2019 SDRP intern from January to June. We are happy that Jonathan has returned to the SDRP as our newest research assistant where his role is focused on processing photo-ID data from the Sarasota and GoMDIS catalogs.

Christina Toms successfully defended her dissertation through the University of Central Florida at the end of October. Christina's dissertation focused on bottlenose dolphin population size, structure, and health in the western Florida Panhandle. Congratulations, Christina on a job well done!

Reny Tyson Moore spent time this summer at Duke University Marine Laboratory in Beaufort, North Carolina, as an instructor for their Marine Mammal course. This field and laboratory intensive class for both undergraduate and graduate students introduced students to the biology and conservation of marine mammals found around the world. Reny enjoyed having the opportunity to return to her alma mater to share with others her passion for marine mammal science and conservation. She was also honored to follow in the footsteps of Sarasota Dolphin Research Program (SDRP) director, Randy Wells, who in 1992, along with Peter Tyack, were the inaugural instructors for this course, and other SDRP alumni who have taught and/or guest lectured for this course in subsequent years.

Students gained hands-on experience with sound transmission during their summer course with Reny.

Kim Bassos-Hull and I served as science mentors in an episode of "*SciGirls*," the PBS Kids STEM television series. The episode features three Florida middle school girls and their investigation of spotted eagle ray presence during the 2018 red tide event. The episode is titled "High Tech Tide."

Krystan teaching about spotted eagle ray acoustic data during the filming of "SciGirls."

Gene (left) with his son, Jeff (right; also a long-time SDRP volunteer), enjoying a day on the water with the SDRP.

Sadly, we lost two friends of the SDRP this year. Local volunteer, Charlie Key, passed away on January 17th. Charlie often participated in photo-ID surveys with the SDRP and was an entertaining storyteller. We will miss hearing Charlie's tales of his time spent as a US Naval Officer in the Submarine Force. On July 9th we lost our dear friend and colleague, Gene Stover. Gene worked with the SDRP as a volunteer for decades and was hired as our Operations Specialist during 2005-2011. Gene participated with field work and maintained our small fleet. He was also known for enthusiastically accepting the odd request. If you needed something done, Gene was the guy to talk to. He was dedicated, resourceful, and always had a positive attitude. Gene will be missed by all who were fortunate enough to know him.

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Kristi Fazioli and her daughter Celeste during 2019 health assessment.

Elizabeth Moore and her daughter Merry during 2019 health assessment.

Interns and Post-Graduate Trainees

Charlotte Bergerat (Switzerland)
Shelby Brown
Jonathan Crossman
Kylee DiMaggio
Gabriela Hernández-Ramírez (REU, Puerto Rico)
Ella Howell (United Kingdom)
Suzanna Mickey
Courtney Miller
Michael Mwang'ombe (Kenya)
Ibrahima Ndong (Senegal)
Shannon O'Neill
Jessica Ozog
Megan Pew
Sangeetha Puthigai
Emily Sun
Arianna Torello
Marissa Trevino
Jessica Wenclawiak

SDRP staff, interns, Michael and Ibrahima.

Local and Returning Volunteers

Dee Allen
Ralph Arden
Ed Blair, Jr.
René Byrskov (Denmark)
Annabelle Cartwright
Heather Daszkiewicz
Michael Duranko
Kristi Fazioli
Mark Fishman
Sondra Fox
Ramsey Frangie
John Hamilton
Aren Hendrickson
Jeff Hollway
Fran Johnson
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Cathy Marine
Caryl Mason
Charlie Mericle
Cecilia Mould
Nigel Mould
Maria Kast-Ondraczek
Chip Phillips
Aya Robinson
Bryan Spaulding
Jeff Stover
James Thorson
Bill Tiffan
Martha Wells
Brooke Welch
Nick Williams

2019 Interns left to right: Suzanna Mickey, Jessica Ozog, Jonathan Crossman, Ella Howell, and Shannon O'Neill after a successful disentanglement in Englewood.

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Your gift to the Sarasota Dolphin Research Program will ensure the future of the important research and continued development of an unparalleled base of knowledge about wild dolphin populations. Each year, it costs approximately $1.0 million to fund our scientists and our internationally recognized research. Your donation will ensure that we can continue to learn about and help some of the world's most majestic creatures. For more information on how you can help, please contact Cindy Zeigler, Chief Advancement Officer, at (708) 688-8263.

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SDRP welcomes equipment donations in addition to funds

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). 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 2019:

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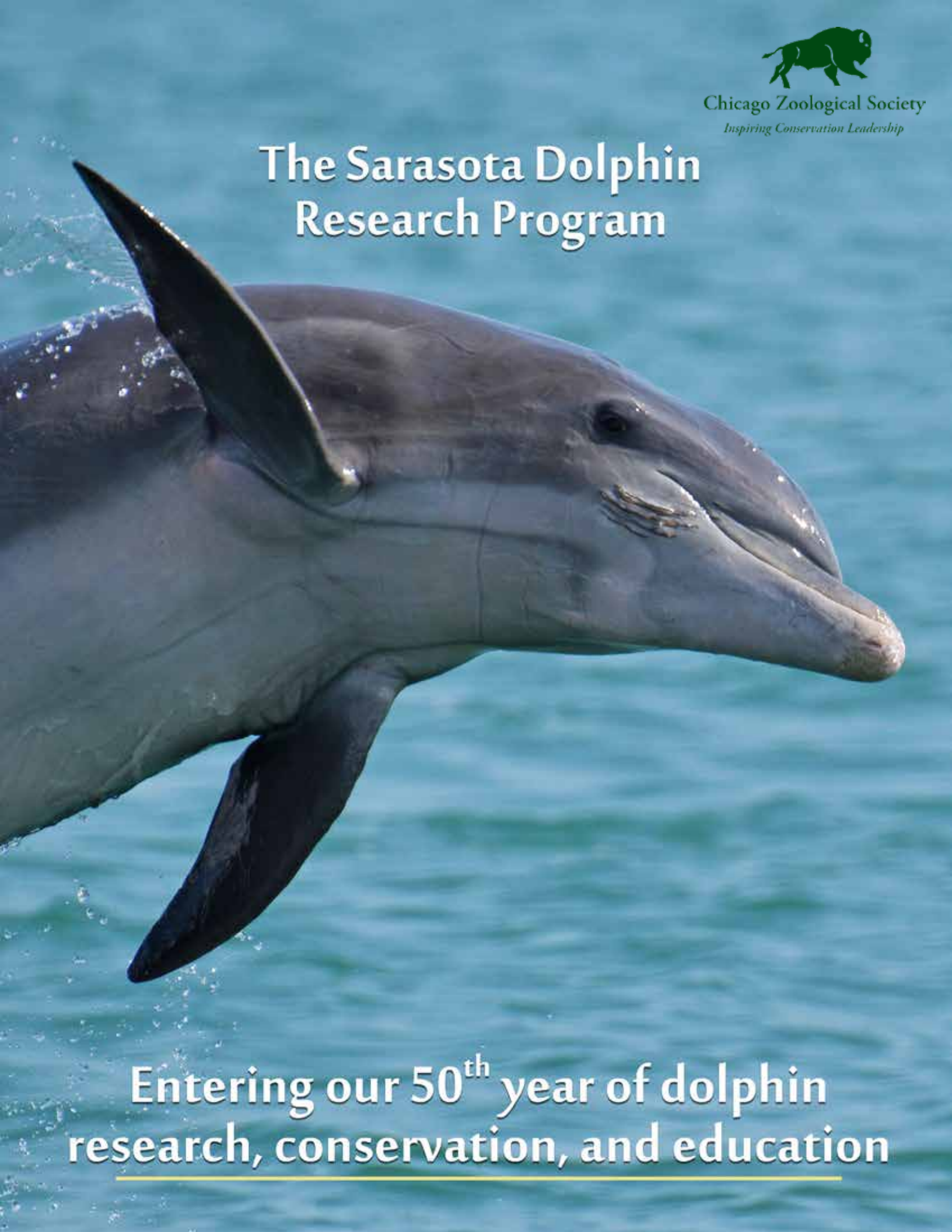
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