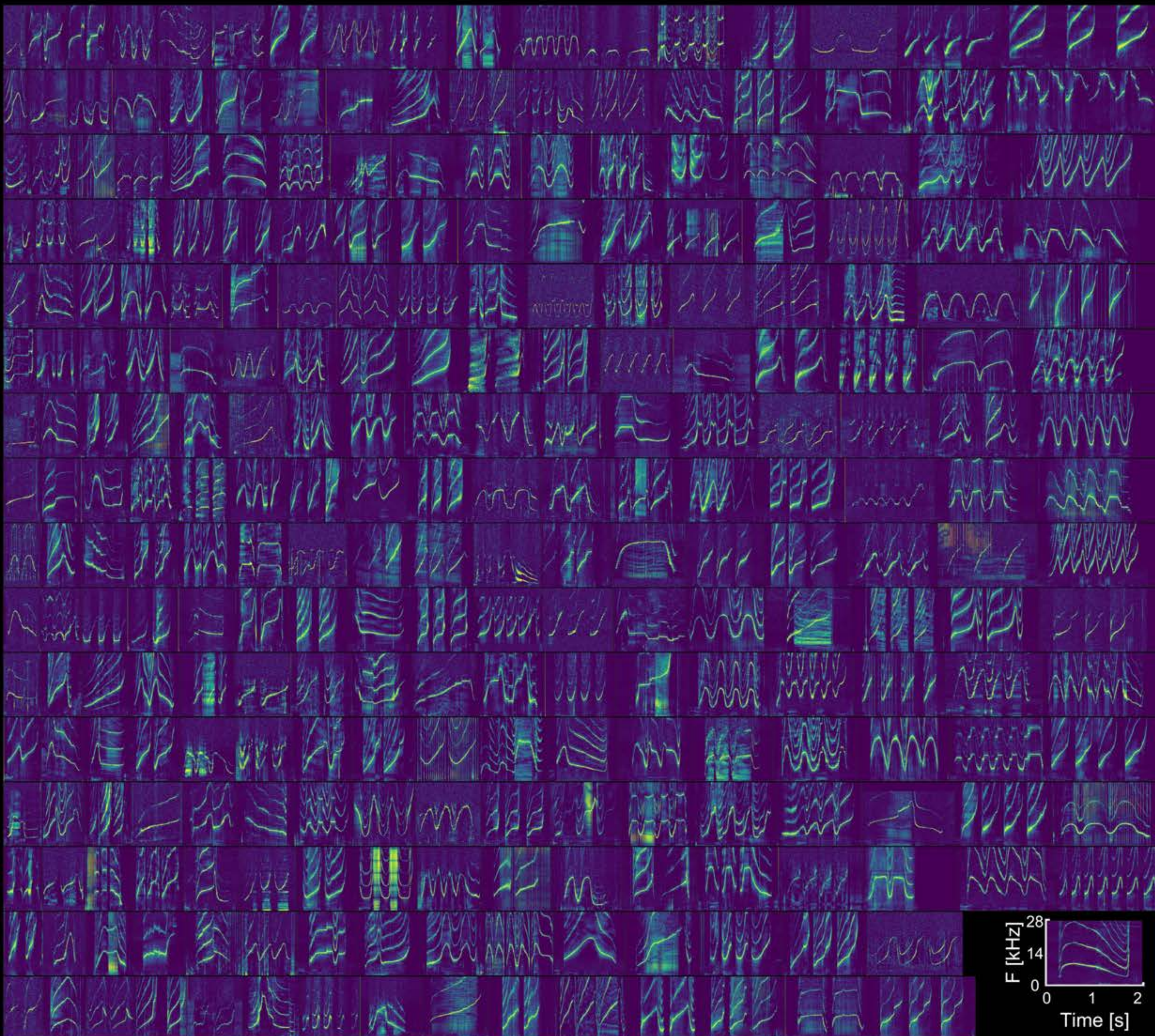
January 2022

NICKS'n'NOTCHES

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



269 dolphin 'names' - A single signature whistle from each of 269 Sarasota dolphins

Chicago Zoological Society

Inspiring Conservation Leadership

The mission of the

Chicago Zoological Society

To inspire conservation leadership by engaging people and communities with wildlife and nature

Individuals Make a Difference

The striking montage on the front cover, provided by long-time collaborator Laela Sayigh and showing signature whistle spectrograms collected over decades from 269 different Sarasota Bay dolphins, makes a compelling argument in support of appreciating these dolphins as individuals. Our Sarasota Dolphin Research Program team identifies each of the individuals visually from distinctive markings on their dorsal fins, while our acoustician colleagues can distinguish them on the basis of repeated whistles that serve as individual identifiers, similar to names. Regardless of the mode, we have come to appreciate the animals as individuals, through their long (hopefully) lifespans, family connections across generations, residency to core areas (neighborhoods) within the greater community range, individual behaviors, and social association patterns. We also have observed their individual responses to the many dramas that may occur over the course of each individual's life, such as red tides that reduce available prey, shark bites, fishing gear injuries, boat strikes, and births and losses of offspring or close associates.

Conservation is generally discussed at the population level. However, we have demonstrated the importance of individual contributions, and conversely, the value to conservation of saving individuals. We and our partners engage in rescues and follow-up monitoring of individual dolphins. Interventions can be expensive and logistically complex, and it is not unreasonable to ask if these efforts are worth it. In 2013 a group of colleagues and I published a paper that defined a threshold for determining short-term success of interventions, and suggested that the sooner the intervention is done, the greater the chance of success. Recently, a paper by Katie McHugh and colleagues built upon these findings and extended them based largely on our ongoing Sarasota dolphin monitoring program, to evaluate long-term success. The results presented in this paper were modeled by population biologist Bob Lacy, and demonstrated the increased population growth that can be expected from saving individuals.

Bottlenose dolphin populations have been adversely impacted at a number of sites around the world, including, for example, *Deepwater Horizon* oil spill effects on dolphins in Barataria Bay, Louisiana. Few tools exist for restoring these populations. Rescues and long-term population monitoring in Sarasota Bay and elsewhere provided the means to determine that saving individual dolphins, one at a time, can leverage population-level benefits, adding another tool to the dolphins' conservation toolbox. Individual dolphins make a difference, for teaching us about the lives of these amazing animals, and for sustaining and enhancing their populations.

Many thanks to all of you for caring about the dolphins of Sarasota Bay,

Director, Chicago Zoological Society's Sarasota Dolphin Research Program

In This Issue

Our SDRP Team was named as 2020 Disney Conservation Heroes by the Disney Conservation Fund. This award is made each year to individuals or teams who have devoted their lives to furthering conservation efforts in their communities.

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, and undergraduate opportunities through a number of schools, including New College of Florida.

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.

Contact us:
The Chicago Zoological Society's Sarasota Dolphin Research Program
708 Tropical Circle, Sarasota, FL 34242 USA
Tel: (941) 374-0449
rwellsdolphin@gmail.com, www.sarasotadolphin.org

Our accomplishments, by the numbers

Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

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 340 peer-reviewed publications (available at: https://sarasotadolphin.org/publications/), 4 books, and more than 100 technical reports, and we have made more than 760 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, 44 master's and 50 doctoral students have benefited from SDRP data collection opportunities, data, samples, or guidance. In addition, more than 450 undergraduate interns have received multi-month training by the SDRP. Foreign participants in our training programs include more than 90 of the interns, along with 30 post-graduate scientists and more than 100 health assessment project participants, from more than 40 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. We have participated in or led 26 bottlenose dolphin rescues, and participated in responses to 11 mass strandings of: pilot whales, false killer whales, pygmy killer whales, Fraser's dolphins, clymene dolphins, and spinner dolphins. The accomplishments of the program over the decades reflect the efforts of many: staff, students, volunteers, and collaborators, and the long-term support of several key individuals and organizations.

SDRP project summary

Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

The events of the past year have influenced the activities of our research program. While we have been awarded funding for a number of research, education, or conservation projects, the pandemic has forced us to postpone or cancel several of the larger projects, including six that involve catch-and-release efforts involving teams working in close contact. In addition, the terrible destruction in coastal Louisiana from Hurricane Ida has precluded our ability to engage in several projects based out of Grand Isle. These delays and cancellations have had adverse implications for program support, as we do not have access to the grant or contract funds until we do the proposed work. We appreciate the flexibility of funders who have allowed us to use alternative approaches to accomplish at least some of the goals of our field work in spite of COVID constraints, and to reprogram funds to address emerging issues. We are very appreciative of donor support to fill the funding gaps, allowing our team to remain intact, and to put their new-found non-field time to good use analyzing data and preparing scientific publications. As of October 2021, we have been working on more than 40 different scientific manuscripts in 2021, including 22 already published.

The list on the following pages provides information on some of the funded projects in which we have been engaged over the past year, or will begin soon. These projects are either being led by CZS researchers, or in some cases, these are subawards to the Chicago Zoological Society's Sarasota Dolphin Research Program. The CZS researchers responsible for overseeing the SDRP portions of the projects are listed as Principal Investigators. Funding for the projects is being administered primarily through the Chicago Zoological Society.

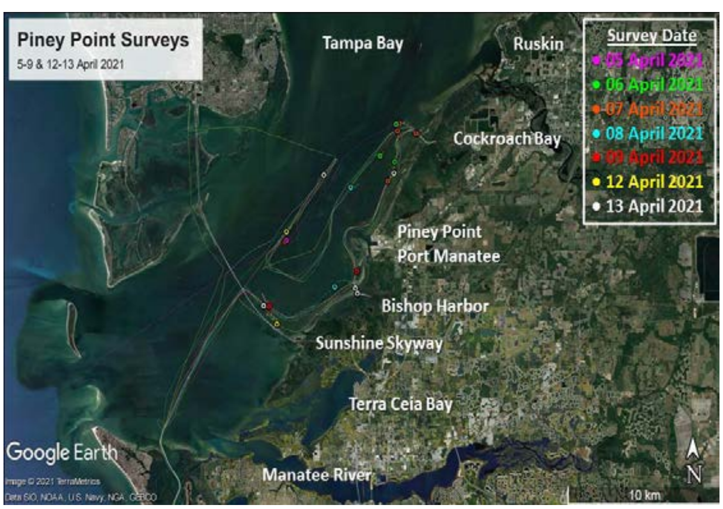
	Project Title	Funding Source	SDRP Principal Investigator	Start Yr	End Yr	Status
1	Bottlenose dolphins as sentinels of ecosystem health	Charles and Margery Barancik Foundation	Wells	2017	2022	Ongoing
2	Continuation of a National Service Center for Post-Release Monitoring of Small Cetaceans - 1	NOAA John H. Prescott Marine Mammal Rescue Assistance Grant	Wells	2018	2021	Ongoing
3	Franciscana interactions with Argentinean fisheries	Disney Conservation Fund	Wells	2018	2022	Fieldwork postponed
4	Knowledge Sharing for Dolphin Conservation	Disney Conservation Fund	McHugh	2020	2022	Ongoing
5	LCP Chemicals Georgia Natural Resource Damage Assessment: Bottlenose dolphin injury quantification and restoration planning	NOAA/Natural Resource Damage Assessment	Wells	2019	2023	Health assessments postponed
6	Sarasota Bay dolphin health assessment	Dolphin Quest, Inc.	Wells	2020	2021	Alternative fieldwork
7	Health and movements of Florida's Gulf dolphins	Florida RESTORE Act Centers of Excellence Program - FIO (through Mote Marine Lab)	Wells and Cush	2020	2023	GoMDIS ongoing; fieldwork postponed
8	Towards an understanding of the cumulative effects of multiple stressors on marine mammals – an interdisciplinary working group with case studies	DOD/Strategic Environmental Research and Development Program	Wells and McHugh	2020	2024	Partially postponed
9	William R. and Lenore Mote Early Career in Marine Sciences Fellowship: Trophic ecology of large coastal predators along the central west coast of Florida	Mote Scientific Foundation	Wilkinson	2020	2021	Partially postponed
10	Rapid detection and response to cetacean strandings and small cetacean disentanglements in central western Florida and capacity building for large whale recovery, necropsy and disposal for greater Florida	NOAA John H. Prescott Marine Mammal Rescue Assistance Grant (through Mote Marine Lab)	Wells	2020	2021	Ongoing
11	Continuation of a National Service Center for Post-Release Monitoring of Small Cetaceans - 2	NOAA John H. Prescott Marine Mammal Rescue Assistance Grant	Wells	2020	2022	Ongoing
12	Marine Megafauna Project	Mote Scientific Foundation	Bassos-Hull	2020	2021	Ongoing
13	Unmanned Aerial System capability development	Mote Scientific Foundation	Wells and Bassos-Hull	2020	2021	Ongoing
14	Sarasota Bay dolphin health assessment or biopsy dart sampling	Mote Scientific Foundation	Wells	2020	2022	Ongoing
15	Eugenie Clark Field Research Skills and Leadership Program	Mote Scientific Foundation	Wilkinson	2021	2022	Ongoing
16	Piney Point dolphin monitoring	Mote Scientific Foundation	Wells	2021	2022	Ongoing
17	Biopsy dart sampling in Alabama	National Marine Fisheries Service (via National Marine Mammal Foundation)	Wells and Allen	2021	2021	Completed

18	Coastal shark presence at offshore artificial reef locations in the Gulf of Mexico: A preliminary assessment of shark movements and the potential for human-animal conflict	Mote Scientific Foundation	Wilkinson	2021	2022	Ongoing
19	Assessment of movement patterns and critical habitat for coastal and continental shelf small cetaceans in the Gulf of Mexico using newly developed remote satellite tagging techniques	NOAA RESTORE Act (via Woods Hole Oceanographic Institution)	Wells	2021	2023	Fieldwork postponed
20	Rapid detection and response to cetacean strandings in central west Florida and enhancement of the tools for small cetacean interventions and forensics	NOAA John H. Prescott Marine Mammal Rescue Assistance Grant (through Mote Marine Lab)	Wells	2021	2022	Ongoing
21	In-natura hearing measurements from moving Odontocetes	Danish Research Council	Wells	2021	2023	To be initiated in 2022
22	Sarasota Bay dolphin health assessments	The Walt Disney Company	Wells	2021	2022	To be initiated in 2022
23	Human-animal conflict Stage 2: Shark behavior near commercial fishing activity	Mote Scientific Foundation	Wilkinson	2021	2022	Ongoing
24	Bassos-Hull research projects	Anonymous	Bassos-Hull	2020	2022	Ongoing
25	Advancing the study of diet and vulnerability to disturbance for cetaceans	National Science Foundation Graduate Research Fellowship	Tatom-Naecker	2020	2023	Ongoing
26	Advancing the study of diet and disturbance vulnerability for cetaceans worldwide	Dr. Earl H. Myers & Ethel M. Myers Oceanographic & Marine Biology Trust	Tatom-Naecker	2021	2022	Ongoing
27	Advancing the study of diet and disturbance vulnerability for cetaceans worldwide	PADI Foundation	Tatom-Naecker	2021	2022	Ongoing
28	Advancing the study of diet and disturbance vulnerability for cetaceans worldwide	Lerner-Gray Grants for Marine Research	Tatom-Naecker	2021	2021	Ongoing
29	Advancing the study of diet and disturbance vulnerability for cetaceans worldwide	American Cetacean Society - Monterey Bay Chapter	Tatom-Naecker	2021	2022	Ongoing

Massive wastewater spill off Piney Point, in Tampa Bay

Randall Wells, Aaron Barleycorn, Jason Allen, Chicago Zoological Society's Sarasota Dolphin Research Program

During the period March 30th to April 9th, 2021, 215,000,000 gallons of nutrient-laden wastewater were released from a decommissioned phosphate mine at Piney Point, through Port Manatee in southeastern Tampa Bay. Given concerns about the health of the ecosystem and its inhabitants exposed to this discharge, we initiated photographic identification surveys for dolphins in the waters including and surrounding the discharge, with the support of the Charles and Margery Barancik Foundation. This region comprises the next long-term resident dolphin community north of the Sarasota Bay community. During NMFS-sponsored surveys we conducted through all of Tampa Bay during 1988-1993, dolphins were commonly found in this region. Few dolphins were seen in the region from the Sunshine Skyway northward to Cockroach Bay during April and May 2021, with an average of only about 3 sightings and 8 dolphins per survey. No obvious health or respiratory issues were noted for these dolphins. By June, after the wastewater had largely dispersed, the monthly average increased to 10 sightings and 48 dolphins per survey. However, a severe red tide developed in the area, believed to be exacerbated by the nutrients from the discharge, and numbers of sightings and dolphins have declined. A number of well-known resident dolphins from this community have been documented, with some having been first recorded as long ago as 1984, suggesting long-term stability of the community. These data should be considered preliminary, pending more detailed analyses, and additional data from more seasons, as we continue the surveys through April 2022, thanks to the support of Mote Scientific Foundation.



Dolphin survey summary for period during and immediately following the wastewater spill. Each colored dot on the survey tracks represents a dolphin group sighting.

The survey team was able to come to the aid of an entangled dolphin during one of the surveys, and was able to use a long-handled cutting tool to remove some of the fishing line and tackle gear from its disfigured dorsal fin. This young dolphin, CMA1917, was first reported to local stranding networks as entangled in June 2019. While our team was not able to remove all of the entangling fishing gear, they were hopefully able to make life a bit easier for the animal. The dolphin was documented as making long dives after the gear was removed.

Dolphins off Port Manatee on April 9th.

2021 Red tide in Sarasota Bay

Elizabeth Berens McCabe, Katie McHugh, Chicago Zoological Society's Sarasota Dolphin Research Program

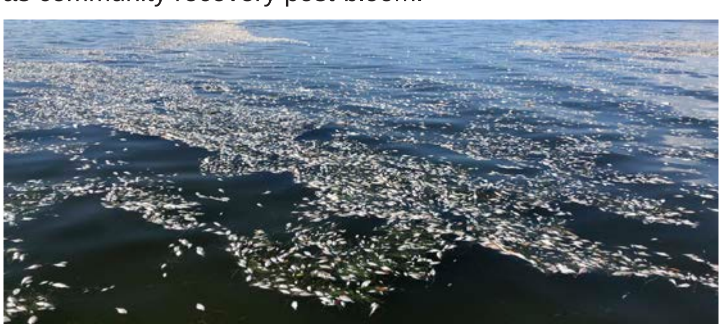
Beginning in July 2021 and continuing to the present, a patchy but persistent bloom of the toxic red tide alga, *Karenia brevis*, has been present within the Sarasota Bay estuary. While bloom concentrations occurred south of Sarasota in nearshore coastal waters since December 2020, samples taken by the Chicago Zoological Society's Sarasota Dolphin Research Program and Mote Marine Laboratory's Phytoplankton Ecology Lab did not exceed 100,000 cells per liter, the concentration level typically required for fish kills and respiratory irritation in humans, at sampling stations within the Sarasota Bay estuary until July 9th. As soon as July 12th, concentrations reached 4 million cells per liter! Between July 15th and August 12th, concentrations remained very high, fluctuating from 226,000 to more than 46 million cells per liter, with the majority of sample concentrations exceeding 1 million cells per liter. Cell concentrations dropped below the 100,000 cell per liter threshold on August 13th, with occasional pulses above fish-kill levels through the time of this writing (October).

Karenia brevis red tides are natural disturbance events that have been recorded as far back as the 1500s in Florida. *K. brevis* cells produce toxins, known as brevetoxins, which can kill fish, birds, marine mammals, and sea turtles, and cause respiratory irritation in humans. They can also expose fish to hypoxic water (water with unusually low concentrations of dissolved oxygen), a condition which often accompanies severe red tides. Both brevetoxin and hypoxia can kill fish.

For animals that survive the acute toxic effects of brevetoxin, red tides can also affect the availability of resources (food and habitat), and trigger changes in behavior, sociality, and/or predator-prey interactions. One potential lingering concern after red tide is an increased frequency of dolphin-angler interactions resulting in associated injuries and mortality from fishing gear entanglement and ingestion (see HI article, page 11).

Red tides also affect seagrass, a vital component of our coastal marine ecosystems, providing shelter for all types of fish and invertebrates, food for many animals, sediment stabilization, increased water clarity and quality, and carbon storage. Red tides make affected waters very dark and warm, blocking light from reaching the seagrass and impacting growth. Excess nutrients can exacerbate red tide blooms and support additional algal blooms, such as cyanobacteria, that can shade-out and eventually kill seagrass beds. Following long-term increases in nutrient loadings documented by the Sarasota Bay Estuary Program as far back as 2012, and a severe red tide event from August 2018 to January 2019, the Southwest Water Management District estimates an 18% loss (roughly 2,313 acres) of seagrass beds in Sarasota Bay from 2018 to 2020. This year, in addition to runoff and wastewater, the Piney Point discharge of 215,000,000 gallons of wastewater introduced over 200 tons of readily available nitrogen into Tampa Bay and parts of upper Sarasota Bay within just 10 days, further exacerbating the current red tide bloom and triggering blooms of mat-forming cyanobacteria (*Lyngbya sp.*) in upper Sarasota Bay (see Piney Point, page 8). While the full repercussions of nutrient inputs on seagrass beds, wildlife, and water quality will not be understood for some time, long-term nutrient loading from wastewater, runoff, and emergency discharges from Piney Point likely made conditions in 2021 much worse in Sarasota Bay.

For more information on the initial effects of this year's red tide on the fish community in Sarasota Bay, see Status of fish populations in Sarasota Bay, page 21. For more information on the patterns of fish community resilience following red tide bloom conditions, see Effects of multiple *Karenia brevis* red tide blooms on a common bottlenose dolphin (*Tursiops truncatus*) prey fish assemblage: patterns of resistance and resilience in Sarasota Bay, Florida, page 21. Ongoing efforts seek to examine the effects of red tide on fish, dolphins, rays, and sharks in Sarasota Bay, as well as community recovery post-bloom.



A fish kill from red tide seen on August 6, 2021, in Sarasota Bay, Florida.

Biopsy dart sampling in lieu of capture-release health assessment

Christina Toms, Aaron Barleycorn, Jason Allen, Chicago Zoological Society's Sarasota Dolphin Research Program

With COVID roaring on in Florida this past year, we've been forced to continue to rely on remote biopsy sampling in lieu of catch-and-release health assessments. This would not be possible without the continued and generous support of Dolphin Quest and Mote Scientific Foundation. While remote sampling precludes conducting veterinary exams and collecting other types of important samples and measurements, biopsy darting still affords us multiple subsamples of skin and blubber than can be used to obtain basic background information of importance. For each animal darted, we obtained 5-7 subsamples that are used for a variety of projects, including: paternity testing, population genetics, refining an epigenetic age analysis tool, measurements of environmental contaminant concentrations, lipid measure as an indication of nutritive condition, fatty acid and stable isotope diet analyses, reproductive and stress hormone analyses, as well as a skin sample to archive for future projects. Since May of 2020, we have collected samples from 67 dolphins, including 34 of the 58 highest priority individuals.

Aaron Barleycorn and Jonathan Crossman prepare to process a recently acquired sample on the bow of R/V Nai'a.

Limitations on international trainings

Katie McHugh, Chicago Zoological Society's Sarasota Dolphin Research Program

Unfortunately, the COVID-19 pandemic again hampered our ability to provide practical training opportunities onsite for foreign researchers and students during 2021. However, we still were able to provide some continued research/database support and limited new trainings to international colleagues virtually. We hope to be able to resume in-person opportunities in 2022 for those seeking training in field and lab techniques needed to support research and conservation activities with small cetaceans in other parts of the world.

F233's days-old calf surfaces next to her near Anna Maria Island. F233's mother Aya, aunt 1316, and grandmother Claire also gave birth to new calves; four of the 20 newborns in this nearly record-breaking year.

Sarasota Bay dolphin community status

Jason Allen, Chicago Zoological Society's Sarasota Dolphin Research Program

We keep track of the dolphins of Sarasota Bay through photographic identification (photo-ID) surveys conducted on 10 boat-days each month. One of the primary goals of our monitoring is to track additions, losses, and condition of the resident Sarasota Bay dolphin community members. Eight of the thirteen 2020 calves have survived and there have been 20 new births in 2021, which is only one short of 2017's record of 21! Among these is 42-year-old Vespa's 11th calf as well as four first-time moms. Well-known resident Claire, her daughter Aya, and her granddaughter F233 all have new babies; quite the summer for this lineage (involving documented generation numbers 3, 4, 5 and 6)!

Unfortunately, we have lost several community members since our last update. Bill, Pi, and C557 have all disappeared and are presumed to be dead. Scoopnick, a well-known adult male frequently seen in the Manatee River since 1981, died in February. Finally, Nellie's yearling was recovered near Siesta Key in September 2021. A necropsy, or animal autopsy, was performed by Mote Marine Laboratory's Stranding Investigations Program, and toxicological analyses found that the yearling had high tissue concentrations of brevetoxin from the red tide.

Siblings 5-year-old C250 and 2-year-old C25A socialize in Blackburn Bay. These are the 10th and 11th calves of 43-year-old FB25.

Our long-term, monthly photo-ID surveys are one of the core efforts of our program, supporting all other projects. More than 55,200 dolphin group sightings since 1970 have yielded more than 168,000 identifications of more than 5,600 individually distinctive dolphins. In support of these identifications, more than 950,000 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 2,722 follows on 225 individual dolphins from 27 projects dating back to 1989. This database now also includes current and historic opportunistic respiration data taken on potentially compromised individuals. We will begin integrating our dolphin health database in the near future as well. Many thanks to NOAA's Jeff Adams for his continued support as our database guru!

We have been able to continue our year-round, monthly monitoring of the Sarasota bottlenose dolphin community thanks to support from the Charles and Margery 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.

1316 and her first calf, 1361, surfacing together near Palma Sola Bay.

Human interactions in Sarasota Bay

Katie McHugh, Chicago Zoological Society's Sarasota Dolphin Research Program

After the losses of several long-term resident dolphins to human-related injuries in 2020, we are happy to report that 2021 has been a much quieter year (so far) for Sarasota dolphins relative to human impacts, with no human-related deaths and relatively low human interaction (HI) rates compared to recent years. In many ways this is surprising, given multiple environmental disturbances in our area over the past year (see articles on Piney Point and Red Tide) and the COVID-19 pandemic continuing to hamper our ability to conduct in-person outreach activities focused on reducing vessel disturbance and adverse interactions with fishing activities (although we have continued virtual efforts). We hope to be back up and running soon with our community engagement and outreach activities, supported by the Disney Conservation Fund, as we focus on initiatives that have been on hold during the pandemic. In particular, we are seeking involvement from local fishing guides, commercial fishermen, and recreational anglers willing to share their observations via a mobile web app available at https://dolphin.report. We also hope to expand some of our education and outreach efforts in conjunction with our Sarasota Bay Listening Network, and have begun working with Mote Education on lessons related to sound in underwater ecosystems and the impacts of noise from boat traffic.

While we remain cautiously optimistic about recent HI-trends, our long-term analyses have shown some of the largest past increases in HI rates during the recovery periods from red tides, so we will be closely monitoring the situation moving into the new year and we will be conducting targeted outreach as needed. While we have previously explored some of the factors contributing to continued HI in Sarasota Bay and documented a higher likelihood of human-related injuries for dolphins who engage in unnatural foraging behaviors, we are still working to understand many longer-term HI dynamics and consequences. As part of this, current master's student Kylee DiMaggio has begun exploring the short and long-term fitness consequences of engaging in HI-related foraging techniques by comparing reproductive success and calf survivorship of females who engage in HI related foraging versus those that forage naturally. This study will provide important context to help us better understand whether HI behavior by mothers puts their calves at higher risk during and after dependency.

F227 surfacing as a boat quickly approaches

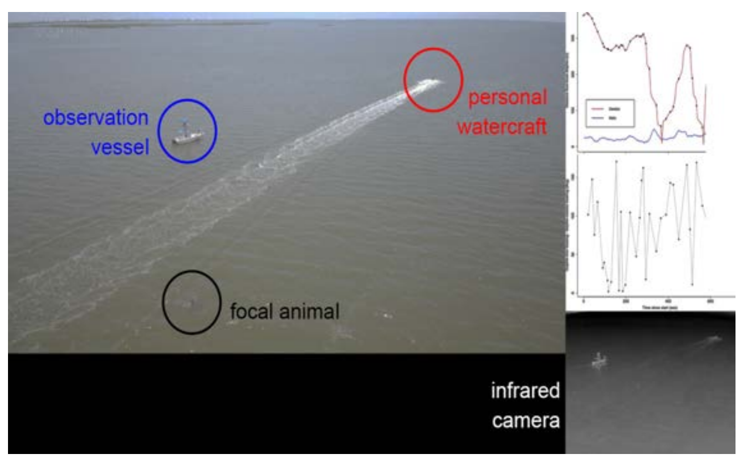
If a dolphin is not healthy, is it more at risk of colliding with a vessel?

Peter Tyack, University of St Andrews

This is a question about how different stressors interact. The early days of marine mammal conservation focused on reducing the number of animals killed as a consequence of hunting or activities such as fishing that involved setting nets around dolphins. Today we need to worry also about the chronic and cumulative effects of many stressors such as chemical or noise pollution, disease organisms, reduction of prey, and changes in habitat due to climate change. It was relatively simple to count the number of animals killed by hunting or in fishing nets, but these other effects are unintentional so special studies are required to understand their effects.

For example, the US Navy and National Marine Fisheries Service (NMFS) have sponsored studies on the effect of naval sonar on marine mammals, effects that range from lethal strandings of beaked whales to disruption of foraging behavior. These studies have helped to define the acoustic dosage required to elicit different kinds of response. However, environmental regulations also require the estimation of the cumulative effects of the sound from sonar along with effects of similar stressors such as noise from vessels and seismic surveys, along with effects from very different stressors such as disease from pathogens or chemical pollution. A recent report from the National Academy of Sciences concludes that we do not have either the data nor the analytical methods to predict the cumulative effects from multiple stressors.

The DOD's Strategic Environmental Research and Development Program is funding a large 5-year study to help find ways to address this difficult question. This project



Controlled vessel approach in Barataria Bay in June 2021. Researchers on the observation vessel conduct focal follows, operate the drone, record underwater sounds, and guide the personal watercraft during an approach. Superimposed graphs indicate vessel distances from the dolphins, and dolphin headings over time. We also looked at whether the infrared camera on the drone would provide improved abilities to monitor dolphins in the murky waters of Barataria Bay.

has formed a working group to develop new modeling approaches and is testing these approaches with two primary case studies: the effect of multiple stressors on North Atlantic Right Whales and testing how the risk of vessel collision may vary with varying health of common bottlenose dolphins. This latter project focuses on dolphins in Barataria Bay, LA, many of whom have compromised health due to exposure to oil and dispersants from the *Deepwater Horizon* disaster. The goal is to develop an experiment where we can quantify avoidance behavior of dolphins to a controlled approach of a personal watercraft.

This year in Sarasota we tested a method that involves focal animal behavioral follows of individually identified dolphins, using a drone to observe how dolphins react to controlled approaches of a personal watercraft. The health of these dolphins is known from health assessments, but most of the Sarasota dolphins are healthy. To study responses of dolphins with compromised health, we also started testing our approach with dolphins in Barataria Bay. The initial field work in Sarasota and Barataria Bay was delayed by COVID, but we managed safely to conduct initial experiments in June. Now the destruction of Grand Isle, LA by Hurricane Ida raises questions about when we will be able to continue this research, but our fingers are crossed for an early recovery.

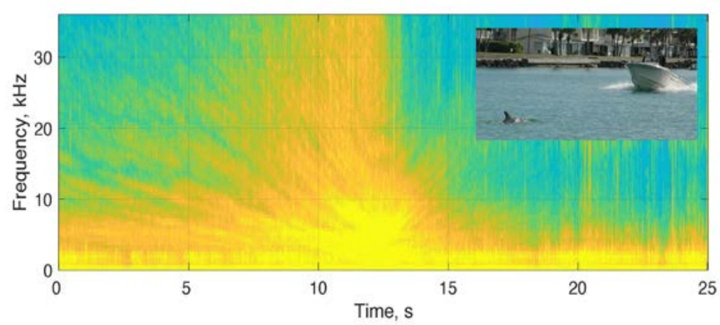
Using digital acoustic tags to quantify the energetic costs of avoiding boats

Austin Allen, Andrew Read, Douglas Nowacek, Duke University; Katie McHugh, Reny Tyson Moore, Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program; Peter Tyack, University of St Andrews; Frants Jensen, Woods Hole Oceanographic Institution; Andreas Fahlman, Global Diving Research

Previous work has shown that dolphins in Sarasota Bay are exposed to high levels of boat traffic. This can result in direct injury and mortality, in addition to interfering with navigating, socializing, foraging, and maintaining social contact. Dolphins sometimes swim faster and maneuver energetically to avoid oncoming boats, and because these evasive maneuvers use more calories, we wondered whether boat approaches might have an overall impact on their daily energy budget. If they eat the same amount of prey but spend more energy on avoiding boats, they will have less energy available for other activities.

To address this, we relied on a unique dataset of suction-cup-attached digital-acoustic tag (DTAG) deployments from Sarasota Bay. DTAGs stay on tagged dolphins for up to a day and provide high-resolution activity and acoustic data. We analyzed 130 hours from 10 individuals (seven females and three males), using some of the the longest DTAG deployments we had in our database. After identifying 746 boat approaches, we labeled each 10-second period as 'boat' or 'control' based on whether a boat was audible on the tag record. We converted tag accelerometry data to energy expenditure using correlations from experiments with dolphins in human care - dolphins swam laps while wearing movement tags and breathed into a respirometer after each lap to measure oxygen consumption. This allowed us to calculate how much more energy dolphins spent during periods with boat noise compared to other periods, relative to each individual's estimated daily energy budget. Individually, this difference ranged from +3% to -1%. However, the average was only +0.3%, suggesting that at a broad scale, these dolphins appear not to be spending significant amounts of extra energy avoiding boats.

This does not mean that boats do not impact their energy budgets. Future work should examine whether boat traffic affects their foraging and thus energy intake. As noted earlier, there are a host of other impacts boats have on dolphins. The long-term datasets collected by SDRP allowed us to quantify the energetic costs of avoidance behavior and provide a baseline to compare to other populations with different levels of boat traffic, health conditions, and avoidance responses.



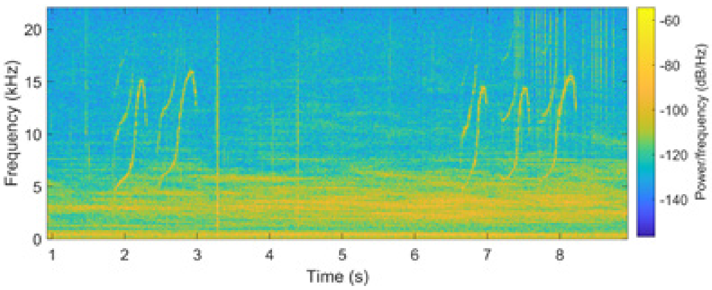
Spectrogram of a boat approaching female F213 and calf, showing an increase in noise (increased brightness) as the boat gets closer. Frequency in kHz is on the y axis, and time in seconds on the x axis.

Changes in vessel traffic associated with the pandemic

Emma Longden, University of St Andrews

During the Spring of 2020, as COVID-19 spread across the globe, human activity declined, leading to a slowing of trade and travel. Analysis of data from shipping vessels and cruise ships has shown a huge reduction in large vessel traffic which consequently led to a reduction in underwater noise. However, anecdotal evidence from Sarasota Bay suggested that use of small recreational boats in the area was high during the lockdown period.

In this project, carried out during my master's degree at the University of St Andrews, Scotland, I aimed to measure the change in recreational boat use during the pandemic. I then investigated whether this led to a change in underwater noise levels in the bay and detection rate of bottlenose dolphin whistles. The project took advantage of the Sarasota Bay Listening Network, using data collected at Palma Sola Bay, Longboat Key and Siesta Key passive acoustic listening



The spectrogram shows an underwater recording containing dolphin whistles (the repeated bright, rounded sloping vertical lines) from Palma Sola Bay. Frequency in kHz is on the y axis, and time in seconds is on the x axis. The intense noise in the lower frequencies is from a vessel passing the hydrophone station, potentially masking part of the whistle.

stations. In the absence of visual sightings data, sounds recorded by the hydrophones allowed monitoring of the numbers of boats passing by, and the noise levels in the vicinity. Preliminary analysis suggests a small decrease in recreational boat traffic at Palma Sola Bay and Siesta Key during the lockdown, but on a much smaller scale than that found in other locations across the globe. At the Tarawitt station on Longboat Key, near the Intracoastal Waterway, recreational boat traffic remained as high during the lockdown as previous years. Unlike most areas in the world where noise levels decreased, we found no change in underwater noise levels in Sarasota Bay during the lockdown. Detection of dolphin whistles in the area largely remained the same from 2018 to 2020, but whistle detection increased with increasing number of boats. This was unexpected as increased anthropogenic noise has the potential to mask sounds from marine animals or cause disturbance leading to avoidance of an area. This potentially highlights the importance of whistles as a social signal that leads to the response by dolphins to approaching vessels, such as forming tighter groups, increasing fluking rate, and diving deeper.

I offer my sincere thanks to my supervisors at the University of St Andrews – Prof Peter Tyack and Dr Douglas Gillespie – as well as the large team of researchers at the SDRP that I have worked with over the past year.

The passive listening station outside of Palma Sola Bay.

The epidemiology of phthalate exposure in Sarasota Bay bottlenose dolphins

Miranda Dziobak and Leslie Hart,
College of Charleston

Phthalates are a class of chemicals commonly added to personal care products (such as shampoo, lotions), cleaning solutions, pesticides, cosmetics, and plastic. Phthalates are not strongly bound to the products to which they are added, so they easily leach into the surrounding environment. As a result, humans and wildlife can be exposed through skin absorption, ingestion, or inhalation. Exposure to these chemicals is concerning because of their association with endocrine disruption, reproductive impairment, and developmental anomalies. We can measure exposure to phthalates by screening for metabolites in urine samples, and we recently detected exposure in approximately 75% of dolphins sampled in Sarasota Bay (2010-2019; n=51). Phthalate exposure was detected in males, females, adults and juveniles, suggesting that all Sarasota dolphins may be vulnerable to exposure. Also, our analyses of sighting data from photo-identification surveys conducted during 2010-2019 demonstrated some spatial clustering of exposed dolphins and differences in the magnitude of phthalate exposure across the years. Finally, the most commonly detected metabolite was mono (2-ethylhexyl) phthalate (MEHP), which is a derivative of the parent compound di-2-ethylhexyl phthalate (DEHP). DEHP is a common constituent of plastic, and concentrations of MEHP detected in Sarasota Bay dolphins exceeded those in human reference populations. While the source of phthalate exposure is currently unknown, our findings suggest a plastic origin and widespread vulnerability among Sarasota dolphins. Continued work is planned to compare exposure to other bottlenose dolphin populations, as well as studies to uncover potential sources of phthalate exposure in the Sarasota Bay study area. This work was 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 Hart and Miranda Dziobak processing dolphin samples for phthalate research at health assessments in 2019.

International conservation efforts

Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

The pandemic has precluded in-country international conservation work by our team, but we have participated in virtual workshops and meetings around the world to further conservation efforts. As part of a recent initiative within the IUCN's Cetacean Specialist Group, named Integrated Conservation Planning for Cetaceans, we continue to engage in planning for expansion of conservation research for Atlantic humpback dolphins and franciscana dolphins, identified as among the highest priority conservation situations for small cetaceans. We consulted on dolphin rescue operations in Egypt, Australia, and Peru and conducted a virtual training session on disentanglement of river dolphins for members of the South American River Dolphin Initiative, involving six countries in South America.

We received funding from the Disney Conservation Fund in 2018 to apply satellite-linked tags to franciscana dolphins in open coastal waters off Argentina, between the bays where we have worked previously, in an area where the dolphins are caught by artisanal gillnet fishermen, to learn about population structure and their behavior in the vicinity of fishing operations. This project also includes outreach efforts to increase awareness of threats to franciscanas. The field component of the project has been delayed, first due to the need to regroup following the loss of our Argentinian principal investigator, Pablo Bordino, and subsequently because of the pandemic. We now hope to conduct this work in October 2022, with Leo Berninsone stepping in as our Argentinean principal Investigator, and a team of veterinary and small cetacean experts from Argentina, Brazil, Denmark, Mexico, and the U.S. A peer-reviewed publication summarizing our telemetry work with franciscanas during 2005-2013 was published in September 2021, in the journal Marine Mammal Science, entitled “Tagging, ranging patterns and behavior of franciscana dolphins (*Pontoporia blainvillei*) off Argentina and Brazil: Considerations for conservation.”

SDRP staff members in Bahia Babitonga, Brazil in 2013 for the Franciscana tagging project.

Ionian Dolphin Program Director Joan Gonzalvo and SDRP Director Randall Wells engage in photographic identification of bottlenose dolphins in Greece during a site visit in 2018.

With the support of a generous donor through the Chicago Zoological Society, we plan to conduct collaborative research on bottlenose dolphins in Greece during summer 2022. The semi-enclosed Gulf of Ambracia, on the west coast of Greece, has one of the highest observed densities of bottlenose dolphins in the Mediterranean Sea. This population has been studied by Tethys Research Institute's (Tethys) Ionian Dolphin Project (IDP) for many years. The main threat to the survival of the bottlenose dolphin subpopulation in the Gulf, considered by the IUCN to be Critically Endangered, is the increasingly degraded condition of the Gulf's water quality. There is an urgent need for research to better understand the issues these dolphins are facing, and the SDRP has been asked by IDP Director Joan Gonzalvo to provide biopsy dart sampling expertise to help collect needed samples for analysis of health and life history parameters and environmental contaminant concentrations. In collaboration with the Greek Ministry of Environment, Energy and Climate Change, Tethys is actively involved in the development of the Conservation Management Plan for the Gulf of Ambracia Nat 2000 site and also on the Greek National Action Plan for the Conservation of *Tursiops truncatus*. The evidence and information provided from analyses of samples from this project will help to define and propose the most appropriate and effective actions for the conservation of the species in this increasingly fragile coastal ecosystem.

Discoveries about paternity in the Sarasota Bay bottlenose dolphin community

Debbie Duffield, Portland State University, and Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

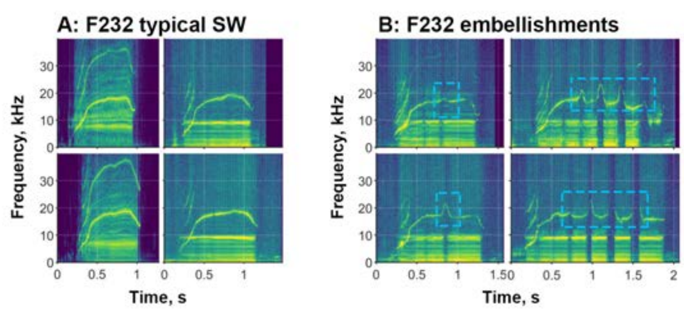
We have been running paternity tests for dolphins born in the Sarasota Bay bottlenose dolphin community since 1984. These tests have been possible because of the years of observational data on this community from which we could identify mothers and calves, but also because DNA samples were available from both the catch-and-release program and remote biopsy dart sampling efforts. This field study has provided us with an especially unique opportunity to assess the relationships of the dolphins within this community. Over the years we have brought a diverse array of genetic tools to the investigation of this community, initially using chromosomal and protein electrophoretic techniques, moving to DNA microsatellites as that technique became popular and available. To-date, we have developed DNA microsatellite profiles for more than 475 bottlenose dolphins of the Sarasota Bay dolphin community and the project promises to continue into the future as we add more of the young dolphins that are being born into this community. Based on the current 275 paternity tests completed, we have found the following:

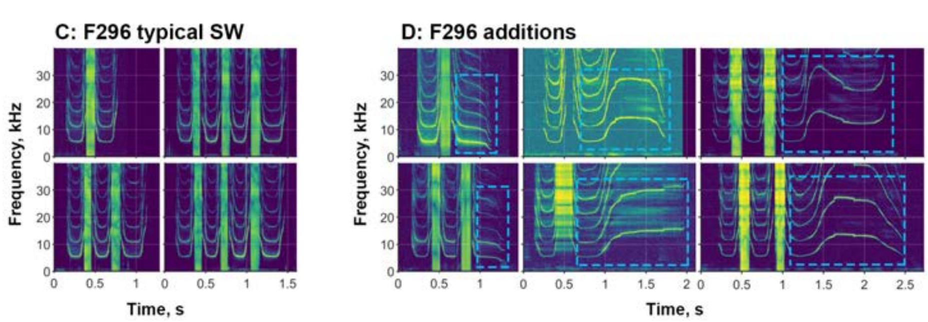
- 53 of the 200 known males in the Sarasota Bay have sired calves, so not all males sire calves. In other words, most of the calves were sired by a limited number of males.
- The average age at which males sire calves is 21 years, but sires range from 10 to 43 years old.
- Four males have sired 6-7 calves each, with one male siring calves in the community for more than 20 years. Another 19 males have each sired 3-5 calves and the remaining 30 males sired 1-2 calves.
- A number of older males were still present in the community for more than 10 years after their last identified calf.
- Both males known to be in pairs and males that were non-paired have sired calves: paired males sired 74.6% of calves and single/non-paired males sired 25.4%.
- For 152 of the calves (74%), sires were identified within the community but for the remaining 26% of the calves, all males associated with the community were excluded. It is clear that a contribution of paternity to the Sarasota Bay dolphin community comes from outside that community and that there is reproductive exchange among bottlenose dolphin communities.

Sarasota Signature Whistle Database

Laela Sayigh and Frants Jensen, Woods Hole Oceanographic Institution; Vincent Janik, University of St Andrews

For some 35 years, we have been collecting whistle recordings from bottlenose dolphins in Sarasota during health assessments, using suction-cup hydrophones. These recordings allow us to identify each dolphin's individually distinctive signature whistle. This year we have been working on extracting these whistles in a systematic, verifiable manner, in order to build a curated database. With support from the Allen Institute for Artificial Intelligence, Dolphin Quest, and the Link Foundation, our goal is to construct a database of hundreds of verified examples of signature whistles from as many dolphins as possible, along with examples of non-signature whistles and signature whistle copies, so that we can start to train algorithms to automatically classify signature whistles. The image shown on the cover of this issue shows the scope of this dataset, by illustrating the time-frequency pattern, or contour, for a representative signature whistle from each of 269 individuals. This image gives a sense of the enormous diversity of signature whistle contours in the Sarasota community. However, it doesn't fully capture this variability, as many dolphins produce whistles with varying numbers of repetitive elements. Also not shown is a new category called 'signature whistle variants', which are whistles that include variations in the form of additions or deletions to the typical contour (see figure below). This "deep dive" into signature whistle





Examples of signature whistle additions and simultaneous pulsed components in two animals. A: Typical dolphin F232 signature whistle; note simultaneous whistle and burst pulse components. B: Signature whistle additions ranging from 1-4 inflections, all concurrent with gaps in burst pulse component (marked by blue boxes). C: Typical dolphin F296 signature whistle; note again concurrent burst-pulses. D: Various additions (marked by blue boxes) differ from the typical terminal loop.

structure is opening doors to many new research directions, including the range of variability contained in signature whistles. These findings will have important implications for researchers in other areas who are using signature whistles as a means of identifying and tracking individual animals.

In collaboration with Athena Rycyk and Katie McHugh, we used the database this past summer while working with interns on data from the Sarasota Bay Listening Network (see page 31). We anticipate expanding this work as the database progresses and we continue to work on data from the listening stations.

We also identified several exciting new research directions, including the first-ever evidence for "third party" whistle usage – that is, a dolphin producing a whistle of an individual who was not present at the time. In this case, F246 was found to repeatedly produce the signature whistle of his sister, F133, during a health assessment in 2018. We are excited to delve more deeply into this and other aspects of the data, to expand our understanding of the dolphin communication system.

Allied males F242 and F164 surfacing next to each other.

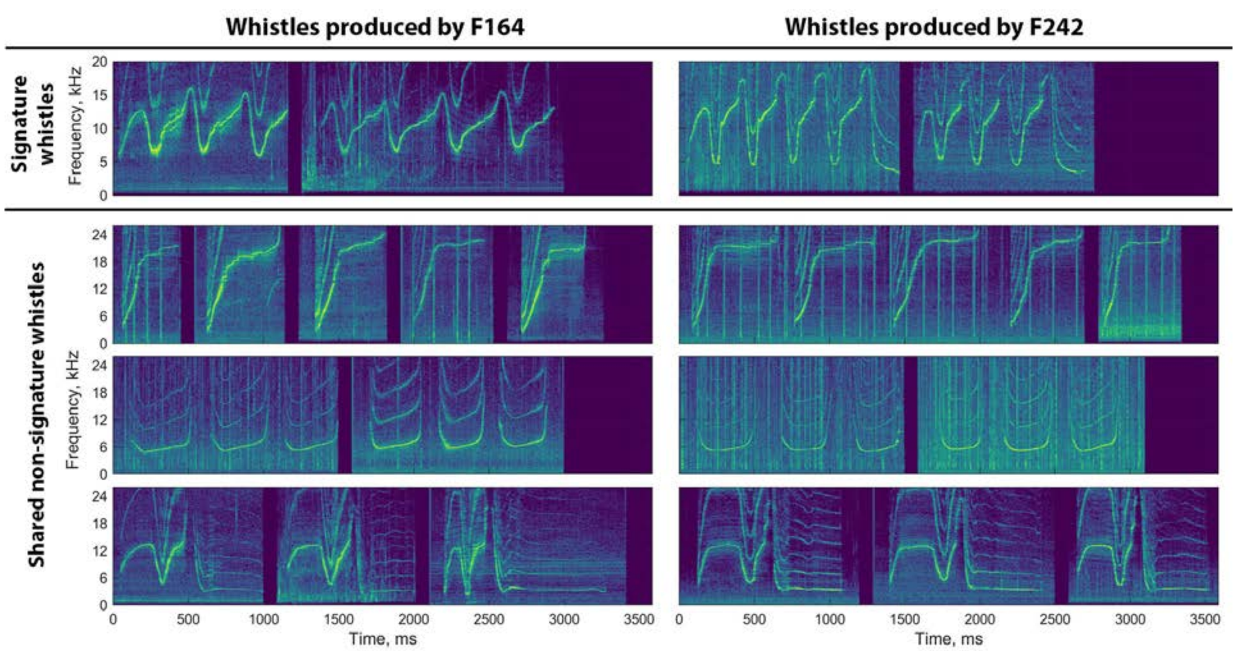
Shared whistle repertoires in allied male bottlenose dolphins

Frants Jensen, Syracuse University; Matthew Hyer, Middlebury College; Laela Sayigh, Woods Hole Oceanographic Institution; Peter Tyack and Vincent Janik, University of St Andrews

Male bottlenose dolphins form close-knit social bonds with one or two other males in their juvenile years, and these alliances can persist throughout the life of the allied males. Allied males are almost always seen together, and the formation of these long-term social bonds may help them secure mating opportunities. While we know that males produce individually distinctive signature whistles, they also produce many non-signature whistles, and we know very little about if, or how, they are used to help mediate cooperation in closely bonded males.

Over the past decade, we have been instrumenting bottlenose dolphins opportunistically with acoustic- and movement-logging suction-cup tags in conjunction with health assessments. After animals are released, these tags help us track movement, foraging activity, and social interactions with conspecifics, including which animals emit signals and how tagged animals respond to sounds from nearby dolphins. For 3 pairs of simultaneously tagged allied males that we have studied so far, all produced stereotyped non-signature whistles that were different from their known signature whistles. Some of these non-signatures were shared between both males in an alliance and were often exchanged back and forth between animals. These whistles often seem to be produced immediately preceding social interactions, suggesting that this often-overlooked part of dolphin whistle repertoires may be particularly important for alliance coordination or for mediating interactions. However, more work is needed to differentiate between these two possible functions.

Whistle use in a single male alliance showing examples of their individually distinct signature whistles (top) and examples of 3 different non-signature whistle types shared within this alliance (bottom).



Causes of death of Sarasota Bay dolphins: 1985-2020

Gretchen Lovewell, Mote Marine Laboratory's Stranding Investigations Program, and Deborah Fauquier, NOAA Fisheries Marine Mammal Health and Stranding Response Program

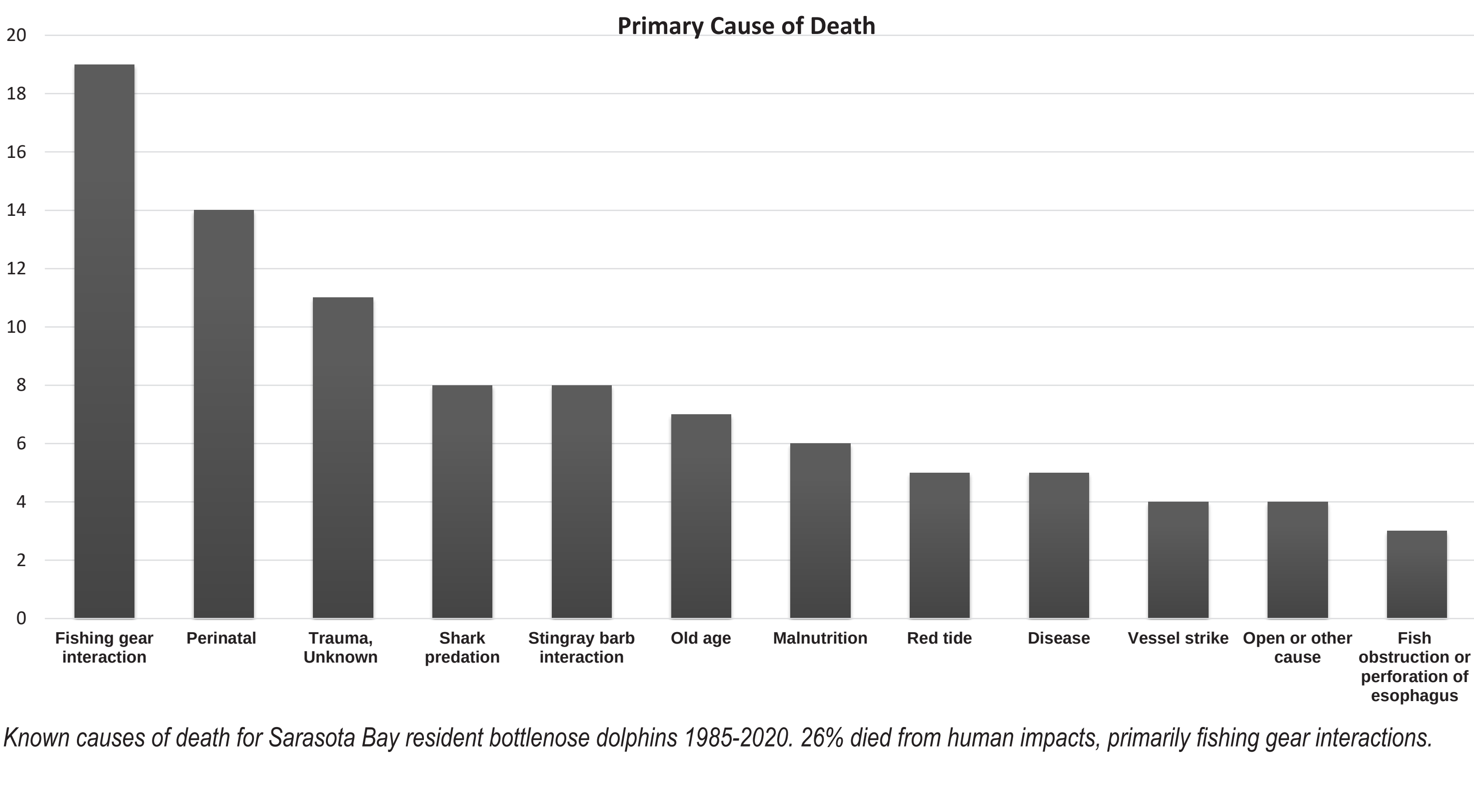
Since 1985, the Stranding Investigations Program at Mote Marine Laboratory has partnered with the Sarasota Dolphin Research Program to identify and analyze the cause of death for Sarasota Bay resident dolphins. Examining the different causes of death in well-studied populations and communities can be a powerful tool for conservation. Stranding network members use necropsies (animal autopsies) as a tool to learn how the animal spent its life, what led to the cause of death, the health of an individual or population, and the threats they may face. The depth and breadth of the information known about the multi-generational Sarasota Bay bottlenose dolphin community affords a unique opportunity for a cradle-to-grave look at an individual dolphin's life. Beyond each individual, we can also investigate changes across time and help monitor for emerging diseases, human-caused (anthropogenic) impacts or environmental stressors, and look at individual lineages for trends in mortalities or life history traits.

From 1985-2020, 115 stranded bottlenose dolphins from the Sarasota Bay population have been documented throughout the home range of the population. For all of the animals we recover, our goal is to learn as much as we possibly can from each animal and to determine what caused their death. We are able to recover carcasses for about one third of dolphins that are lost from the community. In some cases, we were unable to recover a carcass, it was too decomposed, or there was not a definitive cause of death. Even when we are unable to determine why the animal dies, we still gain valuable life-history information from those individuals. We were able to determine the cause of death in approximately 82% of the resident dolphins we recovered (94 of 115).

Strandings were most frequent in the summer months, with 58% (67 of 115) of the dolphins recovered during the months of June, July and August. Summer can be a hard time for a bottlenose dolphin as there are many newborn calves, also known as perinates, and an influx of humans sharing their home. Of the 94 individuals for whom we could determine the cause of death, nearly all perinates that died (12 of 14) were recovered in the summer, which coincides with peak birthing season; this perinatal mortality is considered a natural cause of death.

Sadly, 26% (24 of 94) of the resident dolphins examined died due to impacts from humans and nearly half of those occurred in the summer. Interactions with fishing gear are the most common human related mortality and accounted for 79% (19 of 24) of all human interactions. These fishery interactions accounted for the highest overall number of any known cause of death. Dolphins typically died when they became entangled in, hooked by, or ingested fishing gear. Additionally, four animals were killed by vessel strikes. So, remember when you are a guest in their home, slow down, especially in shallow areas when dolphins are present, stow your fishing gear and trash, and never feed or approach wild dolphins.

After perinatal mortality, the most common natural causes of death that were determined were from stingray barb interactions and shark predation. In eight cases, the



Known causes of death for Sarasota Bay resident bottlenose dolphins 1985-2020. 26% died from human impacts, primarily fishing gear interactions.

stingray barb was the cause of death and an additional ten had stingray barbs present that may have contributed to their demise. Sarasota Bay dolphins have not been observed eating stingrays; they have been seen playing with them or swimming in shallow sandy areas where stingrays reside. Sharks are a main predator in the area and were determined to be the cause of death in eight individuals, or about 9% of dolphins for whom cause of death could be determined. Studies like those conducted by the SDRP's Krystan Wilkinson have shown that approximately 36% of Sarasota Bay dolphins have at least one shark bite during their life. We do not know how many of the animals that disappear from the Sarasota community and are not recovered for examination were prey to sharks.

Another common phenomenon that happens in the home range of Sarasota Bay dolphins is red tide. Florida red tide is a harmful algal bloom caused by the microorganism *Karenia brevis* that produces toxic chemicals that can cause widespread mortality in fish and other vertebrates. We know that many of the resident dolphins have survived red tides throughout their lifetimes. However, five resident dolphins are known to have died from high levels of the toxin in their system. Those animals were all recovered in 2018 when an Unusual Mortality Event caused by a red tide bloom was declared for bottlenose dolphins along the central Gulf coast.

In spite of all the natural and anthropogenic threats that Sarasota Bay dolphins face, there were seven dolphins that died due to natural geriatric processes, or "old age." There were 11 individuals that died due to trauma from an unknown origin. This determination was made though findings of broken bones, collapsed lungs and/or large areas of bruising, but there were no signs to indicate what caused the trauma or if it was natural or anthropogenic. Natural disease, such as lung worm, bacterial infections and viruses can affect dolphins and led to the death of five dolphins. A detailed breakdown of the primary causes of death can be seen in graph on the previous page. While this figure details the main cause of death, for many of the dolphins there were multiple contributory factors that led to their demise.

The Stranding Investigations Program is fortunate to partner with the Sarasota Dolphin Research Program. The information that is gleaned and shared about the dolphins' lives through observations, health assessments, and remote sampling gives us a unique perspective to look at trends and ask questions that are not possible anywhere else in the world. We can see how certain lineages like "Vespa's" are prone to fishing interactions, or how many of the resident dolphins have survived in times of prolonged red tides. We can even provide a baseline for what is "normal" with regards to natural mortalities to help track how large-scale disasters like oil spills can affect a population. None of this work would be possible without the unique collaboration and countless hours of work from both programs' staff, volunteers, students, and interns.

Aaron Barleycorn, Deirdre Semeyn, Gretchen Lovewell, and Deb Fauquier examine trauma found on FB13.

Gretchen Lovewell teaching students how to perform a necropsy while examining a longtime Sarasota Bay resident Riptorn.

Veterinary Expert System for Outcome Prediction (VESOP): A model to predict dolphin population survival rates from measures of individual health

Lori Schwacke and Cynthia Smith, National Marine Mammal Foundation, Len Thomas, University of St Andrews

Successful wildlife management requires timely detection of changes in populations. Traditional dolphin population monitoring methods, such as photo-identification with capture-mark-recapture analyses, can require intensive survey effort to detect changes in population size and multiple years to obtain robust estimates of survival rates. Measures of health from individual dolphins collected through temporary capture-release assessments can offer insight into the status of the population and may provide more rapid detection of changes. It is sensible that the dolphins' health condition would be predictive of their survival probability, however quantitative prediction of population survival rates from health data has been elusive until now.

Sponsored by the US Navy Office of Naval Research, our project involved a collaboration with dolphin health and photo-ID researchers from NOAA, Georgia Aquarium, Dolphin Census Inc, and Ecological Programs at Kennedy Space Center. Our project used health assessment and photo-ID data collected from the Sarasota Bay dolphin population over 20 years, as well as similar data from 6 other U.S. sites, but collected over shorter time periods. Using this information, we developed a computer-based expert system, the Veterinary Expert System for Outcome Prediction (VESOP), to predict survival rates from health assessment data. We have found that indicators of chronic disease, such as biomarkers of inflammation and anemia, are good predictors of 1- and 2-year survival. Integrating data for these biomarkers into the VESOP model and averaging across dolphins sampled in a given area, we are able to predict an annual survival rate for the various bottlenose dolphin populations. The survival rates based on health measures correlate well with survival estimates from traditional capture-mark-recapture analyses using photo-ID data.

Forrest Townsend, Cynthia Smith, Jay Sweeney at the Sarasota health assessment in 2018.

While this quantitative model for interpreting health data is a major step forward, the biomarkers identified require hands-on health assessments to collect blood. This limits its applicability for some bottlenose dolphin populations, as well as other cetacean species that are less tractable to hands-on sampling (*e.g.*, large whales!). Therefore, our future research will be focused on determining surrogate biomarkers that can be measured in skin or blubber (samples which can be obtained using current remote sampling techniques), and new technologies for remote sampling to collect blood without requiring hands-on sampling. Our ultimate goal is to have the tools to assess population health of free-swimming dolphins and whales solely through remote sampling techniques.

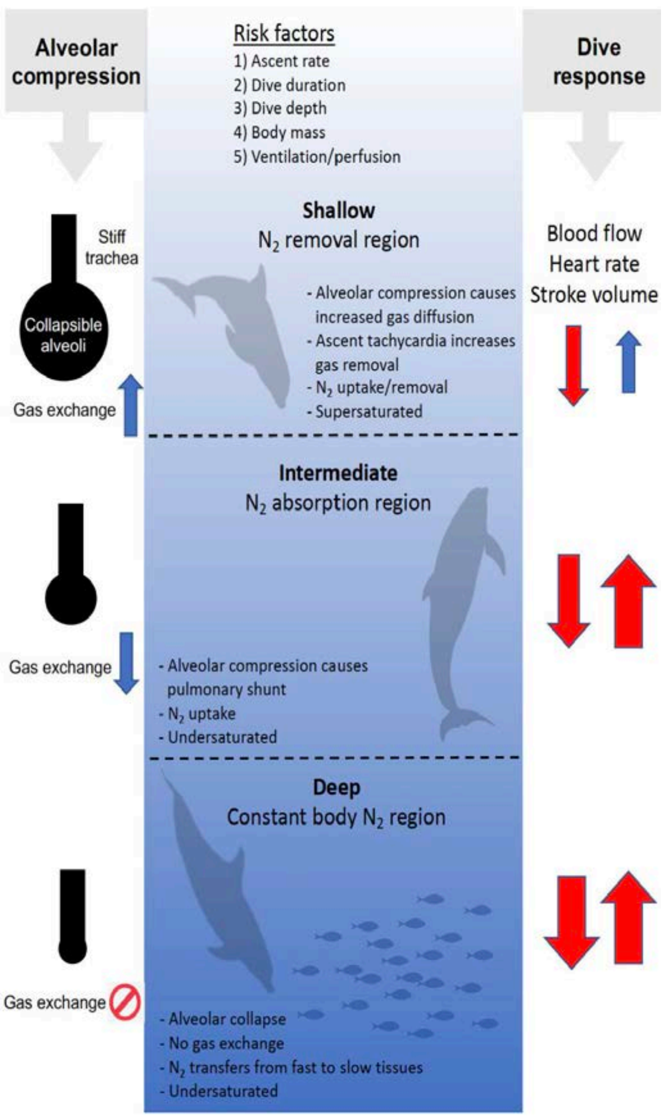
Lori Schwacke in the field during wild dolphin health assessments in Barataria Bay, LA.

Cynthia Smith performing an ultrasound exam during a health assessment.

How do marine mammals manage and usually avoid gas emboli formation and gas embolic pathology? Critical clues from studies of wild dolphins

Andreas Fahlman, Fundación Oceanográfic de València; Michael Moore, Woods Hole Oceanographic Institution; Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

Over the past two decades, concerns over the effects of man-made sound on cetaceans have increased. Several reports have related mass-stranding events of deep-diving whales to the use of sonar, where the stranded whales exhibited symptoms similar to those seen in human divers experiencing decompression sickness (if you want to read more, see this article: https://kids.frontiersin.org/articles/10.3389/frym.2017.00062). A number of studies have tried to better understand how stress and sound affect behavior and physiology, and recently a new hypothesis was developed that suggested that marine mammals have physiological adaptations that allow them to minimize uptake of nitrogen. Nitrogen is part of the air we breathe and when the pressure increases during a dive, more gas goes into the blood and tissues. During ascent, as the pressure decreases, the gas comes out of solution, and if the reduction in pressure is too rapid it can form bubbles, which may cause blockage of blood flow. This new hypothesis suggests that dolphins, and other marine mammals, are able to vary their heart rate and blood flow depending on the planned dive and a recent study confirmed this ability (for more information, see this video: https://www.youtube.com/watch?v=666zieqGv0A). In addition, the anatomical architecture of the lung of dolphins is very different from those of humans, which allows them to divide the lung into two compartments, one that is open for gas exchange and the other which is collapsed and does not allow gas exchange. By varying the blood flow to these two regions, and because of the very different solubility of oxygen, carbon dioxide and nitrogen in the blood, the dolphins are able to select which gas to exchange. When the dolphins, or other cetaceans, are exposed to man-made sound, or any other stressful event, this mechanism fails and blood flow to the lung is distributed so that excessive nitrogen is taken up. This may result in the formation of gas bubbles. If this hypothesis is true, this provides simple methods to mitigate the effect of sound on cetaceans and to prevent mass-strandings caused by human interaction. Our work with the Sarasota Dolphin Research Program has been integral to better understanding how cetaceans can dive to extreme depths, for long durations. If you want to read more, the review article can be found here: https://www.frontiersin.org/articles/10.3389/fmars.2021.598633/full



Risk factors for gas bubble formation in a deep diving dolphin within 3 hypothetical depth regions [Shallow (0–˜30 m), Intermediate (˜30–˜200 m), and Deep (beyond ˜200 m)]. In the Shallow region, tissue and blood nitrogen levels begin to exceed ambient nitrogen levels, and nitrogen is removed. In the Intermediate region, ambient nitrogen levels exceed tissue and blood nitrogen levels and nitrogen is taken up until the alveoli collapse due to the increasing pressure in the Deep region. Following alveolar collapse, nitrogen, which is not used by the body, is redistributed from tissues with high blood flow, such as the heart, to tissues with minimal blood flow during diving, like fat. On the left-hand side, the balloon/pipe model of the respiratory system is shown where the flexible alveoli, where gas exchange occurs, are shown to compress due to the increasing pressure with depth, while the stiffer trachea resists compression. The alveoli continue to compress as shown by the decreasing volume of the balloon, until the alveoli collapse, at which time gas exchange stops. As the alveoli compress, the pressure inside also increases which increases the rate at which gas is moving from the alveoli into the blood. As the alveoli compress more, this eventually also reduces the ability for gas exchange in a way called shunt, and eventually this gas exchange stops as the alveoli collapse. On the right side the arrows illustrate how diving alters blood flow by changes in heart rate, which is called the dive response. During descent (arrow down) the blood flow is reduced which is indicated by the red color and with a greater reduction shown by a thicker arrow. The reduced blood flow is maintained during ascent (thick red arrow pointing up) until the animal is close to the surface, where blood flow increases again (blue arrow pointing up).

Status of fish populations in Sarasota Bay

Elizabeth Berens McCabe, Chicago Zoological Society's Sarasota Dolphin Research Program

The Sarasota Dolphin Research Program explores the relationships between wild dolphins and their prey by conducting seasonal multispecies fish surveys to monitor fish abundance, diversity, and size structure in Sarasota Bay, Florida. Data from this project enable us to investigate fine-scale habitat and prey selection by 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, supporting development of fatty acid analysis techniques to examine the diet of bottlenose dolphins (see page 28). Based on our 2021 fish survey data and *K. brevis* cell concentrations, seagrass loss and red tide in Sarasota Bay appear to be having an effect on the bay's fish community!

Our standardized multi-species fish survey consists of a winter and summer fishing season (10 sets per month; Jan-Mar; Jun-Sept), during which we catch, measure, count, and release fish from the *R/V Flip* using a 183 m purse seine in seagrass habitats. Last winter we caught a total of 2,745 fish of 51 different species, an average of 91.5 fish per set and 47.7 dolphin prey per set. This summer yielded 28,479 individuals of 65 different species, averaging just over 711 fish per set and 564 dolphin prey per set. To put these numbers into perspective, we caught our third lowest winter fish abundances since sampling began in 2004. Our summer fish abundances were highly variable, ranking tenth overall. Preliminary analyses of our summer data indicate ecological response patterns to red tide that are similar to those seen during past red tide events (see next article), namely sudden and dramatic declines in fish abundance, as well as declines in species density and diversity, and shifts in community structure. Once again, small schooling fish (clupeids) were the only species to increase in abundance (+1,094%) during bloom conditions. Excluding clupeids, the average number of fish and dolphin prey caught per set dropped 36% and 63%, respectively, following the onset of red tide bloom conditions within the Bay on July 9th 2021 (see red tide article).

Christina Toms pulls in the purse seine net during winter fish surveys, which documented our 3rd lowest winter fish abundances since sampling began in 2004.

Based on our previous work, we expect the overall fish and dolphin prey fish abundance to recover within 1 year following the current bloom event, however the recent increase in bloom frequency (red tide: June 2018 to January 2019, July 2021 to the present) combined with substantial seagrass loss may further influence community recovery. The full repercussions of nutrient inputs on seagrass beds, wildlife, and water quality will not be understood for some time. Ongoing efforts seek to examine the effects of red tide on fish, dolphins, rays, and sharks in Sarasota Bay, as well as community recovery post-bloom.

We thank the many interns and dedicated volunteers who have worked on this project. The work would not be possible without you! Funding for this project was provided by the Charles and Margery Barancik Foundation.

Effects of multiple red tide blooms on a bottlenose dolphin prey fish assemblage: Patterns of resistance and resilience in Sarasota Bay, Florida

Elizabeth Berens McCabe, Chicago Zoological Society's Sarasota Dolphin Research Program

Red tide harmful algal blooms caused by the toxic alga *Karenia brevis* occur regularly along Florida's west coast, often resulting in massive fish kills and marine mammal, seabird, and sea turtle mortalities. The catastrophic nature of red tides suggests they have the potential to play an important role in structuring ecosystem dynamics and regulating communities, however their specific effects on prey populations and potential alterations to predator-prey interactions are unknown. To explore these aspects, we examined the effects of multiple red tide events of varying intensity, timing (season), and frequency on common bottlenose dolphin prey fish populations using the Sarasota Dolphin Research Program's long-term fish monitoring dataset (see previous article).

Across eight distinct red tide bloom events from 2004 through 2019, an assemblage of prey fish commonly consumed by resident dolphins showed varying degrees of resistance to bloom events, resilience following bloom events, and effects on prey assemblage structure, depending on bloom intensity, timing (season), and frequency. Prey fish community structure was strongly influenced by *K. brevis* density, showing distinct short-term shifts during bloom conditions. In general, the abundance of dolphin prey recovered within one year following a bloom event. This study is a first step in identifying differences in resistance, resilience, and the ecological effects of multiple red tide bloom events of various temporal scales

An unlucky striped mullet becomes a dolphin meal.

and intensity on a dolphin prey assemblage. Improved understanding of the influence of red tides on estuarine structural dynamics and function can better inform management, and potentially guide mitigation efforts post-bloom.

Thank you to the many staff members, interns, and volunteers who made this work possible over the years. Thank you to Mote Marine Laboratory's Phytoplankton Ecology Lab for their expertise, use of their equipment, and access to long-term data. Primary funding for long-term fish surveys and data collection in Sarasota Bay is currently provided by the Charles and Margery Barancik Foundation. The Batchelor Foundation, Mote Scientific Foundation, NOAA's Fisheries Service, Harbor Branch Oceanographic Institution's Protect Wild Dolphins Program, Florida's State Wildlife Grants Program, and Florida's Fish and Wildlife Research Institute provided earlier funding.

Shark research in Sarasota Bay

Krystan Wilkinson, Chicago Zoological Society's Sarasota Dolphin Research Program

Sharks and dolphins play critical roles in coastal marine environments as top predators. Identifying shared diet and habitat resources between sharks and dolphins can help disentangle complex predator-prey and competitive interactions, which are vital to understanding ecosystem structure and function. Bull sharks are thought to be the most frequent predator of the nearshore Sarasota Bay dolphin residents, although other shark species are also found in the Sarasota area and may have predatory or competitive interactions with the resident dolphins. In collaboration with Mote Marine Laboratory's Shark and Ray Conservation Research Program, we acoustically tagged 19 bull sharks during 2020/2021 to identify movement patterns and shared habitat resources between dolphins and their primary shark predators, as these can drive the frequency of interactions between these species. Currently the Sarasota Coast Acoustic Network (SCAN) consists of 60 passive acoustic receiver stations which detect tagged sharks in the Sarasota area. These receivers are strategically placed in each pass connecting Sarasota Bay to the Gulf of Mexico, at

This 7-ft female bull shark, nicknamed "Dona," was acoustically tagged, sampled, and released in July 2020.

select coastal sites, and at select Bay sites (see page 30 for a map of receiver stations) allowing us to assess seasonality and residency patterns of large bull sharks in the estuary. Additionally, regional collaborative networks, such as iTAG in the Gulf of Mexico and FACT along the US Atlantic coast and The Bahamas, allow researchers to share detection data of tagged animals in neighboring acoustic receiver arrays. Eight of the tagged bull sharks were detected in the nearshore SCAN array between the last download in spring 2020 and spring 2021. The sharks were detected at many of the offshore reef locations during spring and fall months and three of the sharks were detected less than half a mile from the Sarasota coastline, overlapping the ranging area of the Sarasota Bay dolphin community.

One of our more interesting movement stories comes from a female bull shark we tagged in Dona Bay, just inside Venice Inlet, on July 2nd 2020. This shark was given the nickname "Dona" and was detected on the SCAN receivers leaving Venice Inlet around 7 pm that evening. She made a return trip back to the inlet on July 5th 2020, but appears to have stayed near the coast as her tag was not detected on receivers placed inside the inlet. This shark was also picked up on the Silvertooth Reef receiver (one of the offshore reef sites) on July 5th 2020. In late August, she spent another 2 days inside Venice Inlet before she cruised up the coast towards Siesta Key. The SCAN array picked her up again late September at M1, one of the offshore reef sites, before she headed to Charlotte Harbor, where she was detected on a collaborator's array. In mid-October, she was back in the SCAN array at M8, another offshore reef site before she left the Sarasota area. One of our collaborators in the iTAG/FACT community detected this shark in the St. Petersburg, Florida area – near artificial reefs and ship wrecks – on July 6th 2020, only 18 hours after she was detected at Silvertooth Reef, a distance of approximately 40 kilometers. She was detected in the St. Petersburg area again in late August and September 2020. In 2021, "Dona" has been detected in Charlotte Harbor in March and April and was just east of Anna Maria Island in May 2021.

Several of the other tagged sharks have been detected in Tampa Bay, Charlotte Harbor, Ten Thousand Islands and near the Florida Keys. One shark was detected near Tequesta and Fort Pierce along the east coast of Florida. All of the sharks were tagged with acoustic tags lasting 7-9 years so we look forward to seeing how this story comes together as we gather additional data over the next several years.

In addition to shark tagging efforts, we have collected blood samples and fecal swabs from four coastal shark species (bull, tiger, sandbar, and blacktip) to understand the dietary overlap between sharks and the Sarasota Bay bottlenose dolphin community. These samples are currently being processed and we look forward to sharing our results in Nicks'n'Notches 2023! Results from shark dietary and movement analyses will be integrated with information of dolphin diet and movement from CZS-SDRP to provide a better understanding of the role top predators play in the marine environment.

Funding for this research is provided by an anonymous donation to the Chicago Zoological Society, Mote Scientific Foundation, and Women's Board of the Chicago Zoological Society. Special thanks go to Jack Morris, Val Hagan, Dr. Bob Hueter, Capt. Dean Dougherty, Capt. Greg Byrd, Dr. Demian Chapman, (Mote Marine Laboratory) and Dr. Jayne Gardiner (New College of Florida) for their unmeasurable assistance with shark tagging and sampling.

GoMDIS (Gulf of Mexico Dolphin Identification System) - What's in a name?

Carolyn Cush and Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

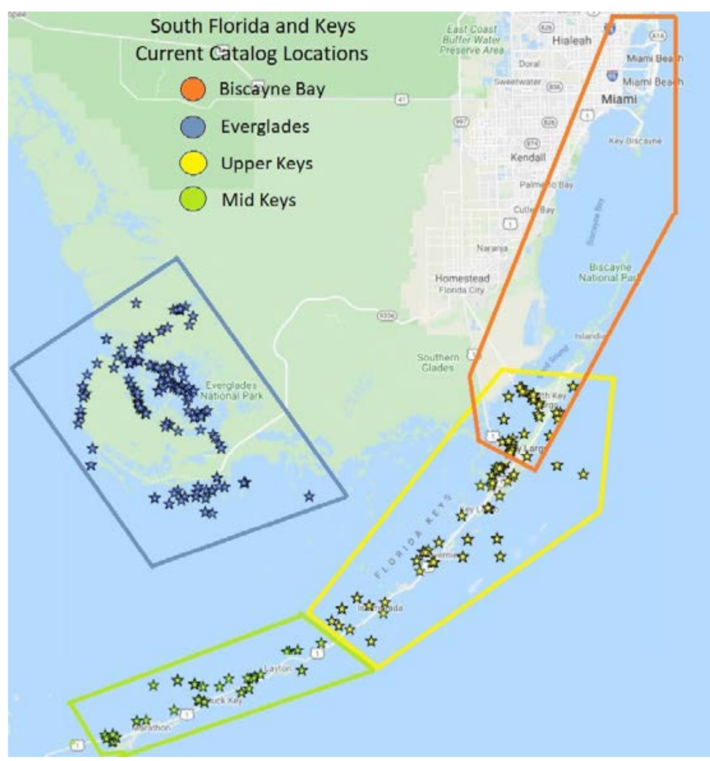
The Gulf of Mexico Dolphin Identification System (GoMDIS) is a collaborative effort between photo-identification (photo-ID) and stranding groups in the Gulf of Mexico to standardize and archive bottlenose dolphin fin catalogs in one location, accessible online through the OBIS-SEAMAP photo-ID portal, thus allowing for ease of matching between projects. Now, in its ninth year, GoMDIS holds 42 catalogs with approximately 26,700 animals and more than 47,000 images. Gulf-wide, more than 1,965 matches between projects have been made to date, strengthening and stitching together data from individual research groups.

We have made recent progress in South Florida and the Florida Keys region, with several catalog contributions from our collaborators. This includes the Florida International University's coastal Everglades catalog, the Dolphin Research Center (DRC) catalog in the mid Keys, Dolphins Plus Marine Mammal Rescue (DPMMR) photo-ID catalog in the upper Keys and the NOAA SEFSC Biscayne Bay photo-ID program. This brought us to an interesting point. Biscayne Bay is technically not within Gulf waters, but the Atlantic region. Being a "Gulf-wide" collaboration, do we include this dataset? Or animals observed on the Atlantic side of the Keys? Or if interested collaborators are located to the north of Biscayne Bay?

Just as in the Gulf, where our collaborators have necessary boundaries for their survey areas based on numerous factors such as logistics, distance-from-base and human-defined bodies of water, we understand we had arbitrarily defined our GoMDIS borders, not by the animals' movements, but by a human-defined body of water. Being able to follow animal movements or shifts was one of the main reasons GoMDIS was created and while we were trying to think on a broad scale, it was not broad enough. The animals seen in the Gulf can easily be documented in the Atlantic or the Caribbean Sea, just by crossing an invisible line.

The concept of being inclusive and having the powerful modified FinBase database behind us, with the ability to filter based on specific needs or questions far outweighs being exclusive. So while our collaborative effort denotes 'Gulf of Mexico' by name, we recognize this does not tell us what the "border" dolphins may be doing or where they are going. We'll continue to welcome additional photo-ID groups to collaborate that might be able to further our collective knowledge on dolphin movements and offer them a safe and secure location to house their valuable data. This might lead to a more expansive network but time will tell. For the foreseeable future, we won't lose GoMDIS as a name or acronym, it's grown on us!

We know preliminarily of at least 17 matches between the DRC and the DPMMR photo-ID catalogs. Some of these animals have more than 50 miles between their sightings. We are excited to see how many animals from the Biscayne Bay and Everglades catalogs have matches elsewhere and how widely they are traversing this region.



New catalogs for GoMDIS being processed from South Florida.

Florida RESTORE Act Centers of Excellence Program: Health and movements of Florida's Gulf dolphins

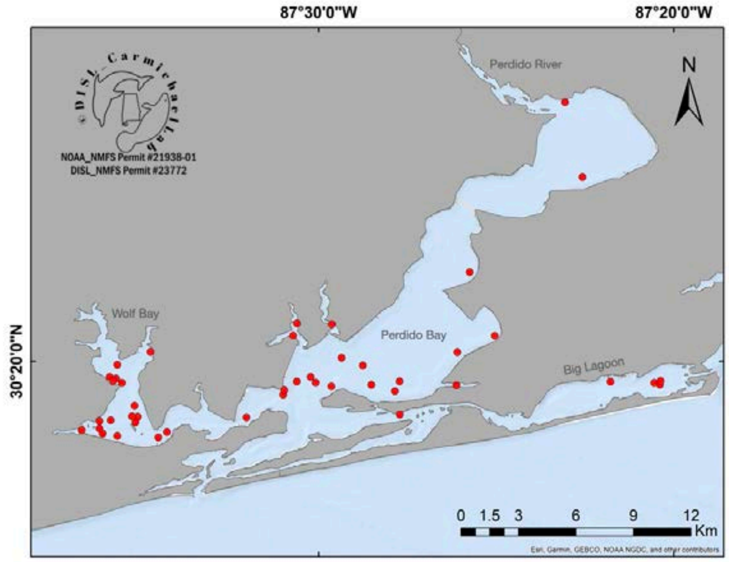
Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

In 2020, we received three years of support through the Florida Institute of Oceanography to initiate studies of bottlenose and Atlantic spotted dolphins over the West Florida Shelf. The project, administered by Mote Marine Laboratory, involves hoop-netting individual dolphins offshore of Sarasota, Florida, performing health assessments, and tagging them with satellite-linked transmitters before releasing them on-site. The grant also covers the operating costs of our Gulf of Mexico Dolphin Identification System (GoMDIS) for three years. Work on GoMDIS has been ongoing, but we have not yet been able to begin fieldwork due to COVID-19. We came within five days of initiating field work on September 10th, 2021, but severe spikes in COVID cases in Florida and concerns about 25% of the team members traveling from out-of-state led to a decision to postpone. In preparation, we arranged for bow pulpits for both of Mote's offshore research vessels, satellite-linked tags, hoop-nets, and permit modifications, we obtained and prepared all of the necessary sampling supplies, and we finalized our field protocols. We have obtained and rigged a 24-ft twin-engine vessel (*R/V Norris*) that is capable of working offshore and assisting with searches for dolphins and tags. We hope to begin field work in spring 2022, depending on the pandemic situation.

Perdido Bay Remote Biopsy Sampling

Jason Allen, Chicago Zoological Society's Sarasota Dolphin Research Program; Thibaut Bouveroux, Dauphin Island Sea Lab; Carrie Sinclair, National Marine Fisheries Service

The National Marine Fisheries Service and Dauphin Island Sea Lab (DISL) are conducting a multi-year research project "Assessment of Alabama Estuarine Bottlenose Dolphin Population and Health". This project includes photo-identification surveys, environmental monitoring, remote biopsy sampling, and prey studies. With COVID-19 guidelines in place, Jason Allen traveled to Josephine, AL to join Carrie Sinclair (NMFS) and Joseph Hansen (DISL) for the second half of one of the remote biopsy sampling sessions in Perdido Bay on the border of Alabama and Florida. The trip was cut short by the arrival of Tropical Storm Fred, but not before the team was able to acquire the remaining samples needed to meet and exceed the overall project goal of forty unique samples from the inshore waters of Perdido Bay. The samples will be analyzed for genetics, sex, stable isotopes, trace metals, and microbiome. Samples/data were collected under NOAA NMFS MMHSRP permit #21938-01 and were funded with *Deepwater Horizon* natural resource damage settlement funds provided by the Alabama Trustee Implementation Group with funding support by the Alabama Department of Conservation and Natural Resources.



Map showing the biopsy sampling locations (red dots) collected in Summer 2021 in Perdido Bay on the border of Alabama and Florida.

Dolphins of Bermuda

Robyn Trainor, Dolphin Quest, Jason Allen, Chicago Zoological Society's Sarasota Dolphin Research Program

Bermuda Cetacean Research work was placed on hold due to the pandemic during 2021. During the year, however, Bermuda locals sent opportunistic sightings of dolphins on five occasions. The data are banked and will be processed as the project recommences. Bermuda Cetacean Sightings looks forward to resuming the field efforts and catalog updates in 2022.

Cataloged dolphins Tt0124, Tt0052, and Tt0004 surface close to Bermuda's north east shoreline. Photo credit - Andrew Stevenson, Bermuda Cetacean Sightings photographer

Dolphin Rescues, Releases, and Follow-up Monitoring

Sarasota Dolphin Research Program involvement in interventions and stranding response

Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

We have worked in partnership with Mote Marine Laboratory's Stranding Investigations Program (SIP) for decades, helping to investigate reports and recover stranded dolphins to try to better understand the threats to Sarasota Bay's long-term resident dolphins, and leading rescue efforts for those for which interventions are recommended. We also receive support from two NOAA John H. Prescott Marine Mammal Rescue Assistance Grants to provide tags and tracking services to stranding response programs around the country, for follow-up monitoring of rescued and/or rehabilitated dolphins. As a new service, the SDRP serves as a repository for loaner satellite-linked tag tracking equipment made available by the U.S. Animal Telemetry Network. The equipment consists of a goniometer for tracking and receiving data from Argos transmissions, and hand-held receiver systems for tracking pingers on Wildlife Computers SPOT tags.

The pandemic has continued to reduce the number of interventions and rehabilitation cases requiring follow-up monitoring. However, six dolphins were rescued since September 2020 from out-of-habitat situations in southwestern Louisiana following Hurricanes Delta and Laura, and another was rescued in southeastern Louisiana in September 2021 following Hurricane Ida, as described on page 26. The SDRP tracked five of these dolphins as part of its Prescott grant.

As part of another Prescott Grant, through SIP, we are working with a team of veterinarians to try to develop capabilities for sedating free-swimming dolphins in need of intervention. This capability, which already exists for pinnipeds and large whales, would allow rescuers to save many more dolphins when they are in situations where traditional capture-release techniques are not feasible or safe. Currently, a new and improved dart system for delivering drugs to dolphins is in development by Dan-Inject.

Updates on previously rescued dolphins

Aaron Barleycorn and Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

Our monthly photographic identification surveys, sponsored by the Charles and Margery Barancik Foundation, provide opportunities to conduct long-term monitoring of rescued dolphins in the Sarasota Bay area, and our NOAA Prescott grants and reports from colleagues allow us to keep up with some of our other rescue cases from outside of Sarasota Bay. The following are updates on some of these animals:

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 anterior insertions of his pectoral fins. On August 3rd 2006, we briefly caught Scrappy, and removed the suit. Now 22 years old, he and C835 have formed an adult male alliance. They have been seen together repeatedly in 2021.

Ginger: In December 2008, Ginger, a recently independent juvenile female dolphin stranded on Siesta Beach. She was taken to Mote Marine Laboratory, treated for complications from the stranding, and released two months later. We tagged her with a VHF transmitter and closely monitored her for two months post-release, until the tag transmissions ceased. She has since been seen regularly during our monthly population monitoring surveys, now with her yearling calf. Ginger's story inspired SDRP volunteer Cathy Marine to write a children's book about her time at Mote's hospital, called "No Dead Fish for Ginger."

Nellie: In February 2010, the 9-month-old calf of resident dolphin FB25 was seen with multi-fiber plastic twine and a metal hook (not a fish hook) tightly wrapped around her head, with tissue growing around and embedding it. We caught her briefly, removed the gear, and released her on-site on March 1st 2010. She was named "Nellie" in honor of Dr. Nelio Barros, a great friend and colleague and former manager of Mote's Stranding Investigations Program, who had recently passed away. We see Nellie regularly during our monthly surveys. Unfortunately, her yearling calf died on September 16th, 2021, and we worked with the Stranding Investigations Program to recover the fresh carcass. A necropsy was performed and we are waiting on lab results to see if a cause of death can be determined.

Lizzie: One of our long-term Sarasota residents, Lizzie, had an eventful 2012. We attached a satellite-linked tag during our 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 and cutting deeply into 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 caught briefly on July 20th to remove the fishing line and the tag. Her calf, F274, is now an independent juvenile. Lizzie has had several calves since, including a new one in 2021 (her 8th!).

Lizzie with her eighth newborn calf in 2021.

Skipper: On September 4th, 2014, we led a rescue of an entangled a yearling female calf near Marco Island, Florida. The calf was the sister of a dolphin we had helped to disentangle several years before, Seymour. We removed heavy leader wire, probably from a trolling rig, that was deeply embedded in the top and bottom of the peduncle and the left fluke blade, and gave the calf a long-lasting antibiotic before releasing her and her mother on-site. In September 2021, we received a report that Skipper was seen with her own calf.

F314: On March 11th, 2019, CZS let a team to rescue an entangled dolphin calf near Stump Pass in Englewood, Florida. We were able to catch him (now F314) and his mom, and remove the line. They were both released immediately after disentanglement. Despite their distance from Sarasota, we have been able to make occasional trips down to the area to check up on them. Both appear to be in good shape, but they still spend a lot of their time around fishing boats.

F316: On April 1st, 2019 we rescued F199's calf (now F316) who had fishing line around and cutting deeply into his fluke, and was incredibly emaciated. Honestly, we did not have high hopes that he would survive, but veterinarians determined his best chance was to be released to recover in the wild. Fortunately, F316 proved us wrong. We tracked him as he steadily put on weight, his fluke healed, and he became more active. His mom has since had a new calf, but F316 appears to be doing well on his own. He was seen most recently on July 12th 2021.

Remote disentanglement of a dolphin calf in Tampa Bay

Aaron Barleycorn and Jason Allen, Chicago Zoological Society's Sarasota Dolphin Research Program

During our Piney Point survey on April 7th, we found a young dolphin, known to the Florida stranding network as CMA1917, entangled in fishing line near the Skyway Bridge in Tampa Bay. There appeared to be several different lines, hooks, and weights entangled around and trailing behind its torn and bent dorsal fin. An initial entanglement can often create potential attachment points for other lines and hooks to attach to the dolphin, creating even more attachment points, eventually leading to the severe disfigurement or death of the dolphin. The weight of the combined entanglements was creating drag and slowly cutting through the dolphin's dorsal fin. We informed the local stranding/rescue network and learned that this dolphin was first reported entangled in the same area in 2019. Typical rescues require briefly catching the dolphin in shallow water in order to remove the line, treat the injury, and release. This is all but impossible in the 40-feet-deep water where CMA1917 tends to spend its time. We were given permission by the National Marine Fisheries Service to attempt a remote disentanglement. This involves a using hooked cutting tool at the end of a long pole to try to get a hold of, and cut the gear from the dolphin. We outfitted our Piney Point survey boat with the tools necessary and found CMA1917 on our April 9th survey. Using the cutting tool, we were able to remove a large amount, but not all, of the entanglement from the dolphin, including several different fishing lines, a weight, a swivel, and a piece of a hook. Following removal of the gear, the dolphin made long dives. Subsequent surveys located the dolphin, but it was much more evasive around our boat. At the very least, removing even some of the gear will reduce the drag on the little dolphin and reduce the number of potential attachment points for future entanglements. We will continue to keep an eye out for it with the hope of removing the rest of the line.

Disentanglement efforts with dolphin CMA1917 on April 9th, 2021.

Fishing gear removed from dolphin CMA1917.

Out-of-habitat rescues of dolphins in Louisiana following hurricanes

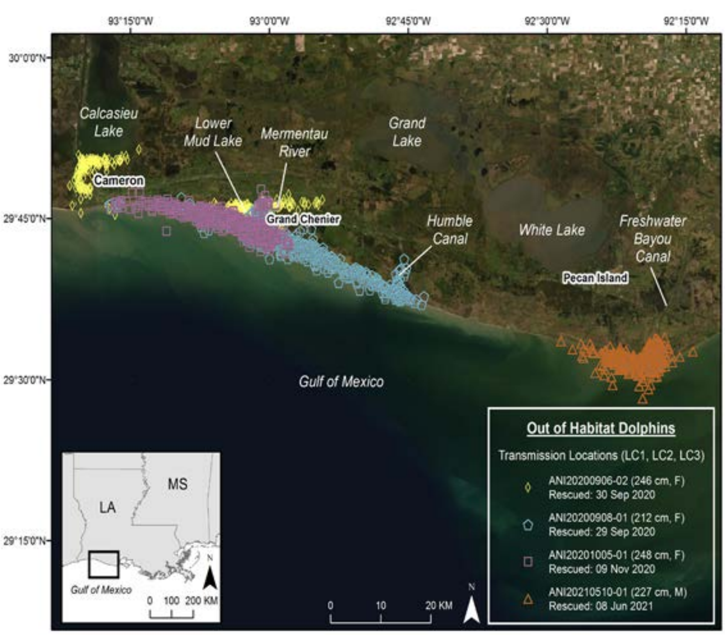
Gabriella Vazquez, Audubon Nature Institute, and Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

When a powerful hurricane passes through Louisiana, there are often reports of out-of-habitat bottlenose dolphins deposited inland in creeks, ponds, canals, and ditches. Hurricanes Laura and Delta in 2020, and more recently Ida in 2021, were not exceptions. In southwestern Louisiana, three dolphins (mom, calf, subadult) were rescued from such situations in September 2020, two more (mom, calf) in November 2020, and one more (subadult) in June 2021. The rescues, led by the Audubon Nature Institute, SeaWorld Orlando, and the National Marine Mammal Foundation with collaborating institutions, on September 29th and 30th, and November 9th 2020, moved trapped dolphins from isolated bodies of water, and returned them to nearby dolphin habitat. The SDRP provided satellite-linked tags and tracking services for the three non-calves, two in September and one in November. On June 8th 2021, another dolphin was caught in a pond, tagged and released. Tracking of all four of these dolphins continued for 59-84 days, well beyond the threshold of 42 days defining success for interventions. The animals moved through small ranges in marsh, river, and coastal waters near their rescue sites (see map on page 27). These are the first tracking data for bottlenose dolphins

A mother and calf pair is transported after being rescued from a landlocked canal system in Grand Chenier, LA, a month after Hurricane Laura made landfall. Photo credit: Audubon Nature Institute.

in this part of Louisiana, so it is difficult to assess whether these patterns are normal for dolphins in this area, but the general consistency across individuals was interesting.

Following Hurricane Ida, a young male bottlenose dolphin was reported from a drainage ditch near the Louisiana-Mississippi border. On September 5th 2021, a team including staff from Audubon Nature Institute, SeaWorld, Institute of Marine Mammal Studies, National Marine Mammal Foundation, and others caught the dolphin, transported it to Waveland, MS, tagged it with a satellite-linked tag, and released it. The dolphin was tracked for five days before signals ceased. Among the possibilities for why transmissions stopped is the idea that the animal moved into very low salinity water closer to where it had originated, where the satellite-linked tag's seawater switch would not be able to function properly.



Update on Bahamian Atlantic spotted dolphin Lamda

Kelly Melillo Sweeting, Dolphin Communication Project; Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

Nearly three years post-release, an Atlantic spotted dolphin in the Bahamas, known by the Wild Dolphin Project as "Lamda," appears to be doing well. On October 29th, 2018, this ~10-yr-old male was released off Bimini, near where he had been observed since 2013. He was reported to the Bahamas Marine Mammal Stranding Network/Bahamas Marine Mammal Research Organisation as being in distress near Great Stirrup Cay on August 24th, 2018, and after he was stabilized by Atlantis Animal Rescue Team, he left the bay on August 25th, 2018. He stranded on Great Stirrup Cay on August 26th, 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) before being released off Bimini. Tracking continued through February 14th, 2019. 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. He has been subsequently seen repeatedly near Bimini, as recently as September 2021, and he continues to appear to be in good condition. This case was published in the journal *Aquatic Mammals* (https://doi.org/10.1578/AM.46.6.2020.633).

Above: Lamda was observed in the Bahamas in September 2021. Photo courtesy of Atmoji Photography.

Left: Dolphin locations as determined from satellite-linked tags. Only the highest quality locations are shown, within an estimated error radius of 1,500 m.

Elucidating bottlenose dolphin diet variation and vulnerability to disturbances using quantitative fatty acid signature analysis

Theresa Tatom-Naecker, University of California, Santa Cruz

Disturbances, including harmful algal blooms, fishing, and climate change, increasingly disrupt common bottlenose dolphin access to prey, with consequences that range from changes in prey choice and feeding behaviors to decreased fitness and even death. To understand dolphin vulnerability to disturbances and decrease the consequences, it is critical to study what dolphins eat under normal (undisturbed) conditions, including how diet might vary when dolphins are part of different demographic groups (*e.g.*, different sexes, ages, and maternal lineages), and how disturbances impact that diet. However, studying diet in a predator like the bottlenose dolphin, which feeds almost entirely underwater in a murky estuarine environment, is not straightforward. Fortunately, there are several methods for determining diet, including quantitative fatty acid signature analysis, or QFASA. QFASA relies on fatty acids, chains of carbon, hydrogen, and oxygen atoms that serve as the building blocks of fat in animal bodies (including in humans!). By comparing the fatty acids found in predators and their potential prey items, we can determine what prey species the predator ate over the previous several months. Accessing this kind of long-term, detailed diet information is exciting because it makes it possible to answer many different questions, including around diet variation and disturbance. However, though QFASA has been used in pinnipeds and other marine mammals, it has not yet been validated or applied in cetaceans. My dissertation focuses on validating and applying QFASA for Sarasota Bay bottlenose dolphins, to better understand how their diet varies in normal and disturbed conditions and how vulnerable they may be to the consequences of disturbances. This research would not be possible without the SDRP and its collaborators providing access to critical samples and expertise.

Validating and applying QFASA requires fatty acid data from four kinds of samples – prey fish and blubber from dolphins under human care and prey fish and blubber from free-ranging dolphins. The first kinds of fatty acid data, from prey fish and blubber of dolphins under human care, are used to calculate calibration coefficients, correction factors that account for minor structural changes in prey fatty acids when they are incorporated into predators. The National Marine Mammal Foundation, long-time SDRP collaborators who manage common bottlenose dolphins under Navy care, generously donated dolphin blubber and prey fish samples from their archives, allowing me to calculate calibration coefficients in spring 2021. The next sample type, prey fish from free-ranging dolphins, form a “library” of fatty acid profiles of potential prey species, to compare to the predator fatty acid values. I acquired these samples thanks to the SDRP scientists and interns, who collected 449 prey fish across 43 species during seasonal purse seine net fishing surveys in winter and summer 2020. This past winter and spring, I processed these samples with assistance from collaborators at Dalhousie University, yielding a preliminary prey fish “library.” The final kind of fatty acid data, from blubber of free-ranging dolphins, is analyzed to investigate diet variation and disturbance vulnerability. From the 2019 health assessment in Sarasota Bay and the hard work of the SDRP’s biopsy darting team, blubber samples were collected from 66 free-ranging dolphins in Sarasota Bay, during both normal (non-disturbed) and harmful algal bloom red tide (disturbed) conditions. I have determined the fatty acid profiles of a subset of these samples and will continue to process the remainder through fall 2021 and winter 2022.

While I do not yet have all the fatty acid data needed for applying the QFASA model, preliminary analyses of the current data are promising. I have confirmed significant differences between the fatty acid signatures of Navy and Sarasota Bay dolphins, as expected given their significantly different diets, and am determining which fatty acids are key distinguishers, information which can be linked back to key fatty acids in the different prey items. Furthermore, there are also variations in the fatty acid signatures of different Sarasota Bay dolphins, though further analyses are needed to elucidate any patterns (*e.g.,* differences between demographic groups, as described above) and links to the prey fish.

Once all the pieces - calibration coefficients, prey library, and fatty acid signatures from dolphins who did and did not recently experience harmful algal bloom disturbances - are in place, I will be able to validate and apply the QFASA model. By comparing QFASA diet results to existing Sarasota dolphin diet estimates from stomach content, fecal matter, and stable isotope analyses, I will confirm that QFASA diet estimates resemble previous findings. With that validation, I can use the detailed, long-term diet estimates that QFASA provides to investigate the relationship between diet, sampled dolphin demographics, and harmful algal bloom severity in the weeks and months before sampling. This will elucidate diet variation and vulnerability to disturbances in Sarasota Bay common bottlenose dolphins, making it possible to better predict and mitigate the impacts of future disturbances.

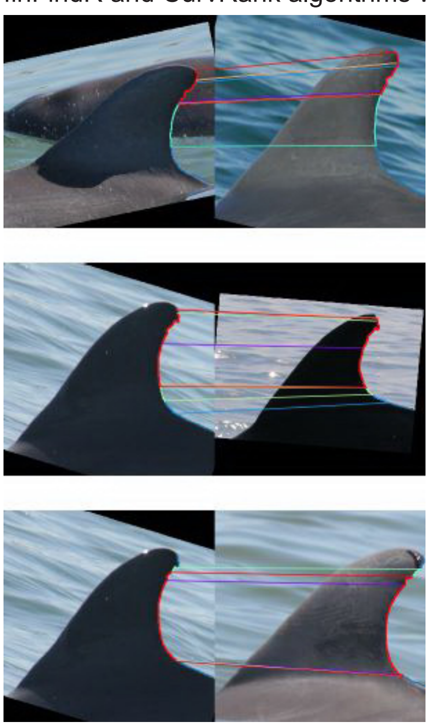
Theresa Tatom-Naecker processing bottlenose dolphin fatty acid samples at UC Santa Cruz.

Rise of the Machines: Advances in automated dorsal fin matching

Reny Tyson Moore, Jason Allen, and Carolyn Cush, Chicago Zoological Society's Sarasota Dolphin Research Program

The use of computer vision for examining wildlife data has rapidly expanded in recent years. For researchers studying marine mammals, these advances have the potential to decrease the amount of time spent manually comparing images of individuals to one another while simultaneously maintaining a high level of accuracy and precision in match success during the photo-ID process. Recently, several approaches to automated comparisons of dorsal fin images via computer vision processes have been developed that rely on computer vision techniques such as Convolutional Neural Networks and machine learning. We have been working with several algorithm developers to refine and test some of these systems for use with bottlenose dolphins using our extensive photo-ID database and catalog. Recent tests have included examining the performance and accuracy of updates to the finFindR and CurvRank algorithms. Both algorithms are available within Flukebook, a freely available cloud-based photo-ID tool for marine animal research, while finFindR is also available as an open-source desktop application.

Results from our recent tests suggest that both algorithms perform extremely well. For example, match success was over 98% for the latest versions of the finFindR and CurvRank algorithms when good to excellent quality images of fins with average to high distinctiveness were compared to our database of known individuals. In addition to this high performance, the correct image was on average in either the first or second returned result, suggesting that researchers would only need to look at a small number of possible matches before finding the correct match. These results could represent substantial time savings for researchers who may otherwise be manually comparing a single image to upwards of several thousand possible image matches.



Fin tracings of matched images using the CurvRank algorithm (From Weideman et al. 2017). For all rows, we show the query (left) and database (right) images that contribute most to the match score.

Given these results, our lab has been using these algorithms to assist in our photo-ID process, particularly when we obtain images of individual dolphins that we do not readily recognize. For example, we routinely use the finFindR application when looking for matches within the Sarasota Bay catalog as well as between study areas as part of our Gulf of Mexico Dolphin Identification System protocol. We examine potential matches to expedite the process, finding matches that would have remained unknown without human eyes examining the whole catalog. We are very excited about these advancements and are currently preparing a manuscript for peer-review detailing our results from these tests and some ideas for best practices when using computer vision for dorsal fin photo-ID. Stay tuned!

Sarasota Coast Acoustic Network (SCAN): Tracking fish in Sarasota Bay and coastal waters

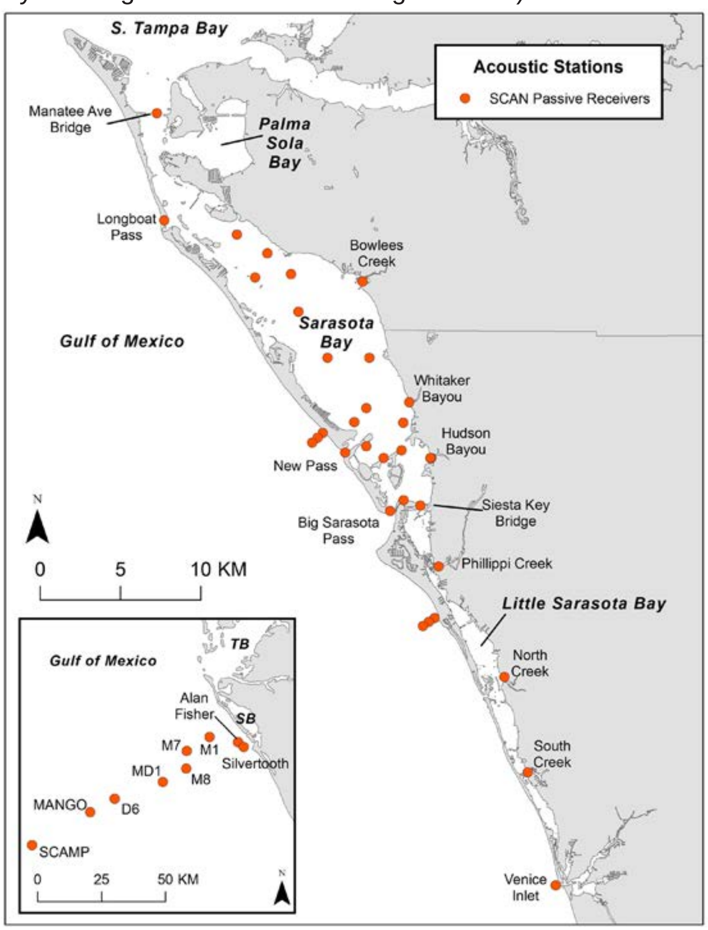
Kim Bassos-Hull and Krystan Wilkinson, Chicago Zoological Society's Sarasota Dolphin Research Program

Acoustic monitoring of animals in aquatic environments is a useful method to help researchers understand animal movements and what physical and biological factors might drive these movements. Acoustic data allow researchers to examine how animals interact with their habitat, with other individuals of the same species, and other species including predators and prey. In 2015, the Chicago Zoological Society, Mote Marine Laboratory and New College of Florida initiated a collaborative study using a network of passive acoustic receivers (Innovasea Vemco Inc.) to better understand the movement dynamics of multiple marine species in Sarasota Bay, specifically marine rays, sharks and fish. We named this acoustic receiver network the Sarasota Coast Acoustic Network, or SCAN, and the network has made many important contributions to understanding fish movements over the years!

The receiver network works as follows: a uniquely coded tag is placed on an individual animal. Passive acoustic receivers are strategically placed in select locations and if/when that animal 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. We must periodically retrieve the receiver and download the data obtain the animal detection history. At the start of SCAN, receivers were primarily placed in passes connecting Sarasota Bay to the Gulf of Mexico; these acted as "gates" to capture patterns of movements into and out of Sarasota Bay. We also set up gates in major creek mouths feeding into the bay which are important habitat for fish in the area, especially snook. Over the years, we have increased the network to include receivers within the bay, at offshore artificial reef locations, and along the beach, totaling 60 stations. In 2020-21, we added six stations within the bay, four of which are at locations where Sarasota Bay Watch is implementing clam restoration. This will allow us, along with our colleagues at

Florida Atlantic University, to monitor possible clam predator presence at these locations. We also added four stations at offshore artificial reef sites, increasing our receiver coverage from 11 nautical miles from shore to 50 nautical miles! These offshore locations will help us better understand shark, ray and fish movements from the coast to further offshore areas where regional receiver coverage is lower. In the near future, we are looking to expand the array inside the bay and CZS Research Associate Elizabeth Berens McCabe will be tagging dolphin prey fish to better understand their movements and response to environmental changes and disturbances (*e.g.*, harmful algal blooms).

Regional collaborative networks, such as iTAG in the Gulf of Mexico and FACT along the US Atlantic coast, allow researchers to share detection data of tagged animals in neighboring acoustic receiver arrays. Tampa Bay (to the north of Sarasota) and Charlotte Harbor (to the south of Sarasota) have been areas frequently visited by our tagged rays and sharks. SCAN also has fish visitors from other areas including tarpon, nurse sharks, crevalle jacks and a variety of other fish species. The iTAG network, including many of its collaborators, published a paper this year documenting general trends in species movements along the west Florida shelf as well as highlighting the importance of these regional networks in expanding our knowledge of marine animal movements (see Friess et al. 2021, "Regional-scale variability in the movement ecology of marine fishes revealed by an integrative acoustic tracking network").



SCAN receiver station locations.

In October 2021, we welcomed colleagues working along the Mesoamerican Reef to Sarasota for an acoustic telemetry workshop. The Mesoamerican Reef is the largest barrier Reef in the Western Hemisphere. Colleagues working in Mexico, Guatemala, Honduras and Belize have formed a collaborative working group and plan to establish an acoustic receiver network along the Mesoamerican Reef to aid in our understanding of shark and ray movement in this important area. During the workshop, colleagues were able to participate in ray and shark tagging as well as learn about acoustic receiver deployment, downloading and maintenance.

We would like to thank Mote Scientific Foundation for providing the initial funding for SCAN as well as several years of support for network maintenance and animal tags. We would also like to thank Jayne Gardiner, Ryan Schloesser, Breanna DeGroot, Capt. Dean Dougherty, Capt. Greg Byrd, Andy Deitsch, Cody Cole, Bri Cahill and numerous interns and volunteers for their assistance with deploying and maintaining the acoustic array. A special thanks to an anonymous donation to the Chicago Zoological Society for supporting the future expansion of SCAN within Sarasota Bay and for providing tags to assess dolphin prey fish movements.

Gaining insights into whitespotted eagle ray feeding behavior and movement patterns using acoustic and suction-cup accelerometer tags

Kim Bassos-Hull, Chicago Zoological Society's Sarasota Dolphin Research Program

Whitespotted eagle rays are loud eaters…crunching molluscan prey such as clams and snails as they scoop them off the seafloor bottom. This behavior, called "durophagy," provides researchers with the ability to monitor when and where these rays are eating by listening and recording these "cracks" and "crunches" on acoustic monitors placed in marine habitats. In a collaborative project with Mote's Sharks and Rays Conservation Research Program, FAU Harbor Branch's Fish Ecology and Conservation Lab, and Sarasota Bay Watch we have been monitoring clam restoration sites in Sarasota Bay with Loggerhead Instruments Cyclops and SNAP passive acoustic monitoring recorders (PAMs) and Innovasea Vemco receivers that detect tagged animals (see SCAN article on page 29). Several of our tagged eagle rays were detected in these clam restoration areas (along with tagged hammerhead and blacktip sharks). In addition, eagle ray feeding sounds (first characterized in tank experiments in 2018) were recorded on the PAMs at these sites and FAU Harbor Branch researchers were able to build and use machine-learning techniques to automate extracting these feeding events from the large acoustic datasets. Sarasota Bay Watch will be expanding to new clam restoration sites in the near future and we plan to additionally monitor at these new locations.

Eagle rays (and others such as cownose rays) have been implicated in the depredation of shellfish in aquaculture sites and destruction of the gear that holds and anchors the shellfish to the seafloor bottom. To study this depredation behavior in more detail we placed whitespotted eagle rays in a 30-foot diameter tank at Mote Marine Lab and tested interactions with various gear types used for shellfish aquaculture (see image below). We tested materials commonly used for bag planting and bottom planting, including polyester mesh clam bags (latex dipped and not dipped), high density polyethelene (HDPE) plastic cover netting, and chicken wire cover netting. These treatments were deployed in plastic utility trays filled with sediment and 50 clams each. The highest clam mortality was observed with dipped bags, suggesting that adding cover netting, whether HDPE or chicken wire, helps to reduce mortality rates. While we had rays in the tank we were also able to test suction-cup-mounted accelerometer tags to look at fine-scale movements. We tried three different tag designs with three different suction cups. Tag retention ranged from 30 mins to 22 hours. We will continue to test the tag attachment methods to fine tune best fit and deploy on eagle rays in the bay to learn more about movements and feeding behavior. Support for these projects was provided by Mote Scientific Foundation, Harbor Branch Oceanographic Institute Foundation, Florida SeaGrant and an anonymous donor.

Left: Matt Ajemian (FAU Harbor Branch) tests a suction cup accelerometer tag on an eagle ray.

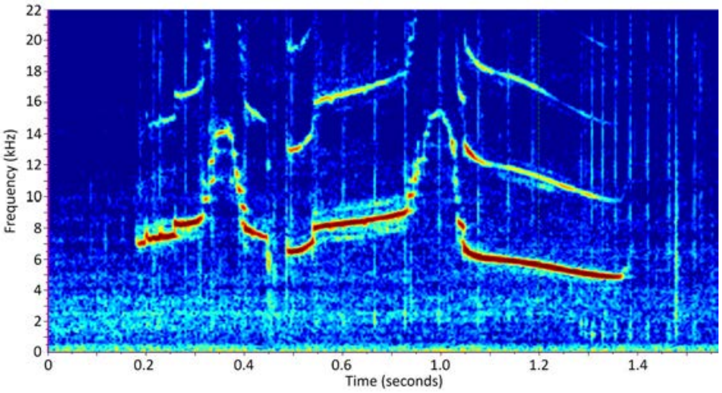
Right: Locations of acoustic listening stations in the Sarasota Bay Listening Network.

Below: Eagle ray interacts with aquaculture gear during tank trials at Mote Marine Lab.

Sarasota Bay Listening Network: Dolphin signature whistles, manatees, and boats

Athena Rycyk, New College of Florida, Katie McHugh, Chicago Zoological Society's Sarasota Dolphin Research Program, Laela Sayigh, Woods Hole Oceanographic Institution, and David Mann, Loggerhead Instruments

The Sarasota Bay Listening Network (SBLN) has grown to ten passive acoustic stations (see map) with an 11th sister station at Eckerd College. We evaluated two different sampling schemes: event-based which stores sound clips of dolphin whistle detections and continuous sampling that stores all sound. This has guided us towards a continuous sampling scheme to ensure we maintain flexibility in future analysis methods. Using continuously sampled data, seven interns from five different institutions joined us remotely during summer 2021 to explore temporal patterns in signature whistle use of common bottlenose dolphins at the Palma Sola Bay mouth (Cortez) acoustic monitoring station. Athena Rycyk, Laela Sayigh, and Katie McHugh shared their knowledge of acoustics, dolphin communication, and the Sarasota Bay dolphin population to help each student develop an understanding of signature whistle use in the Sarasota Bay dolphin community and the ability to



Signature whistle of dolphin F197 recorded at the Palma Sola Bay mouth passive acoustic listening station. F197 is an 18 year old female, who is frequently observed seawall feeding near this listening station along with her calves (and 2021 grandcalf!). Their family's whistles are some of those most commonly heard at the site.

identify dolphin and manatee sounds. With the signature whistle catalogue that has been developed over decades of research, we were able to match some of the whistles to specific dolphins (see above)! Our description of temporal patterns in signature whistle use can be used to refine the existing SIGID method to identify signature whistles from single hydrophone recordings, and this method can then be applied to less-well-studied populations.

Recordings from the SBLN were also applied to the problem of Florida manatee mortality from boat collisions. Sarasota Bay is an acoustically complicated place with variations in sound level and type across time and space. These differences can affect a manatee's ability to detect the sound of an approaching boat. Using sound level calculations from four locations in the SBLN, sound recordings of controlled boat approaches, and hearing detection thresholds from studies of manatee hearing with animals under human care, we found that a manatee's ability to hear an approaching boat varies drastically among locations. Additionally, boat speed, time of day, and season impact detectability of an approaching boat. With this information we can better understand how the risk of manatee-boat collisions varies.

Developments in remote tag attachment: TADpole update

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

Building on last year's successful tagging of two great white sharks off Massachusetts, and with new support from the NOAA RESTORE Science Program in collaboration with the National Marine Mammal Foundation, ongoing efforts are refining our pole-mounted Tag Application Device (TADpole). This approach for tagging small cetaceans, and now sharks, at the bow of a vessel, was conceived and developed by us initially for dolphin tagging, with prototypes designed and built by engineers Tom Lanagan and Jason Kapit at Woods Hole Oceanographic Institution, through initial support from Dolphin Quest, and Dolphin Biology Research Institute. The TADpole is designed to pneumatically apply and secure a satellite-linked tag to the dorsal fin with a single attachment pin, in a fraction of a second.

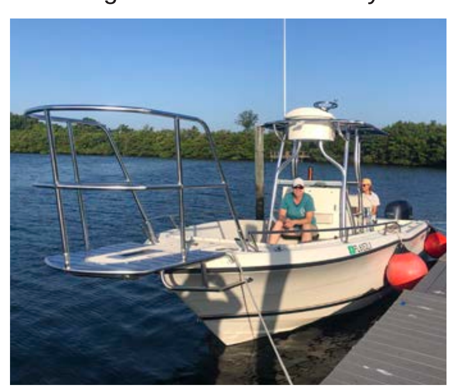
The tool has yet to successfully tag a dolphin. Field tests in spring 2021 with bottlenose, Atlantic spotted, and rough-toothed dolphins off Sarasota, Florida, led to design modifications that will hopefully lead to success with dolphins. In part, the design modifications are trying to address the challenge of extremely fast reaction times of dolphins. Videos obtained during tagging attempts show that dolphins are able to respond to touch within milliseconds, which may be faster than the tagging system can function. Planned September 2021 field tests of the modifications were postponed due to the pandemic.

TADpole tagging attempt with rough-toothed dolphin off Sarasota, Florida in May 2021.

A welcome addition to our research fleet – the *R/V Norris*

Aaron Barleycorn and Randall Wells, Chicago Zoological Society's Sarasota Dolphin Research Program

We greatly appreciate the donation by Bill Kunkler and Susan Crown of a 24 ft Pursuit boat for our research fleet. With its deep-V hull and twin outboard engines, it is a great and safe boat to use for work in more open waters, such as offshore in the Gulf and in Tampa Bay. In order to make the boat even more versatile, we worked with Abaco Skiff Co. to add a bow pulpit, a tower with controls, and additional seating and shade, thanks to an anonymous donor. The boat has been named *R/V Norris* in honor of Dr. Ken Norris, one of the pioneers of marine mammal science and one of the guiding forces behind the creation of the federal Marine Mammal Protection Act (and Randy Wells' major professor for his doctoral work at UC Santa Cruz). We have already used the boat with great success for Piney Point photographic identification surveys, partial removal of fishing gear from an entangled calf, and biopsy dart sampling, and plan to also use it for radio-tracking, hoop-netting, focal dolphin behavioral follows, drone operations, and remote tag attachment (TADpole) testing.



The R/V Norris, prior to heading out for a day of biopsy dart sampling.

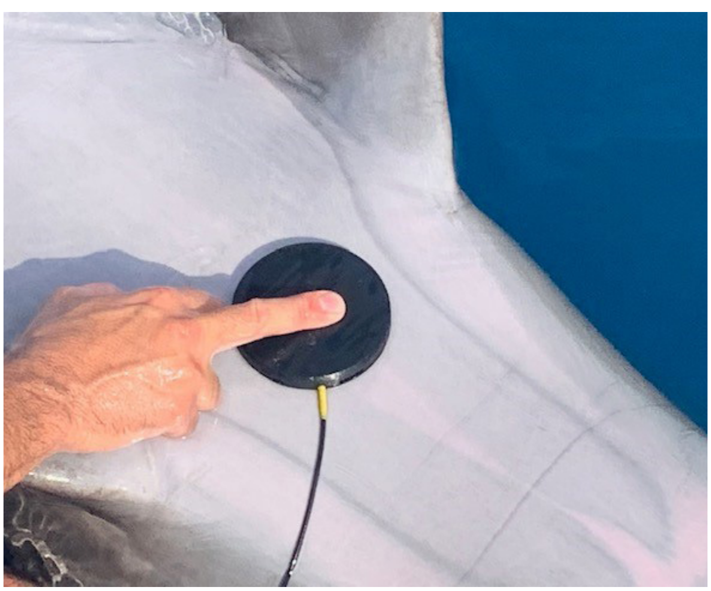
Near infrared spectroscopy, the future of diving physiology and a tool to understand physiological adaptations in dolphins

Chris McKnight, Peter Tyack, University of St Andrews; Alexander Ruesch, Jana Kainerstorfer, Barbara Shinn-Cunningham, Neuroscience Institute/ Department of Biomedical Engineering, Carnegie Mellon; Bogdan Popa, Alex Shorter, University of Michigan; Andreas Fahlman, Fundación Oceanografic

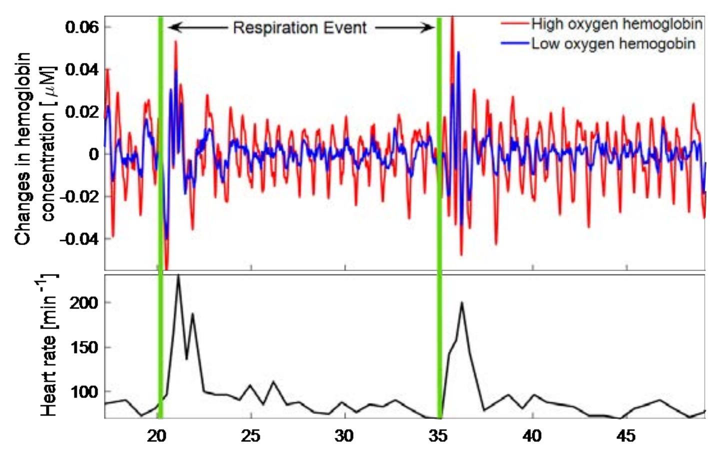
Oxygen is the currency by which dolphins pay for their food. Conserving a limited oxygen supply while diving and hunting for food determines foraging efficiency. Measuring the rate at which oxygen is consumed (also called the metabolic rate) while diving is difficult. A number of indirect methods, or proxies, have been proposed to measure metabolic rate, such as measuring activity (biomechanics) with movement sensors, heart rate, or breathing frequency, but these proxies all have limitations and require validation and calibration for each species.

Recently, a new device has been used in freely diving seals and breath-hold diving humans that uses light emitted from LEDs in contact with the skin (much like a smartwatch). Because the optical characteristics of tissues and blood differ, these measures can be used to estimate blood and tissue blood oxygen saturation (0-100%). You may have seen or used a similar device on your finger to measure the pulse and arterial oxygen saturation, commonly called a pulse oximeter. Over the past 2 years, our team has been developing this tool, called near-infrared spectroscopy (NIRS) for use in dolphins. We are now able to measure the oxygen content and heart rate using this device. The next step is to waterproof the device and test it on free swimming dolphins. As such, we will be able to measure directly the metabolic cost of swimming and diving in dolphins in the wild. This tool can then be used to evaluate the effects that climate change, noise pollution and disturbance, or overfishing have on dolphins. Such information is vital for conservation efforts of wild populations to make sure that they have an environment supporting their survival. We plan to field test this device with Sarasota Bay bottlenose dolphins during the next health assessment project.

To measure and identify tissue and blood oxygenation, NIRS takes advantage of the different color blood takes on when it exchanges carbon dioxide (darkish red to blue) for oxygen (brighter red) inside the lungs. The color of the blood changes because the hemoglobin inside the red blood cells now favors the absorption of a different range of light wavelength (color). This predictable color change can be measured by shining two different light colors in the red and near-infrared range of the light spectrum into the body through use of LEDs. The two wavelengths of light are absorbed differently, according to the presence of oxygenated and deoxygenated hemoglobin. Because some of the light is scattered back into a photo detector, we can measure the change in light intensities and calculate the underlying change in hemoglobin carrying or not carrying oxygen. As the heart pumps blood through the body, the blood volume and hemoglobin concentrations vary with every stroke of the heart, which can give us vital information about heart rates and the changes in oxygen concentration in the blood. Note how oxygenated blood (red line in the figure below) pulsates stronger than not oxygenated blood. This is because only arteries, which are oxygen rich, pulsate in the body. This pulsation in arteries is what gives rise to the field and name of "pulse-oximetry."



Recording of near-infrared spectroscopy on the chest of a dolphin.



Data showing variation in oxygenated (red line) and deoxygenated (blue line) hemoglobin before and after two breaths (green vertical lines) in a bottlenose dolphin. The changes in the red and blue lines independently indicate changes in oxygen rich and oxygen poor blood volume as the heart beats. Oxygenated blood is more common in the arteries, which shows stronger pulses from each heart stroke. Each peak is therefore a heartbeat. The black line below is changes in heart rate with time and it can be seen that the heart rate changes drastically after each breath, the so-called respiratory sinus arrythmia which is thought to improve gas exchange.

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 and displays at the Chicago Zoological Society's Brookfield Zoo, Mote Marine Laboratory and Aquarium, and elsewhere, articles and interviews, and through volunteering and citizen scientist 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: https://sarasotadolphin.org/videos-and-downloads/

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 https://sarasotadolphin.org/videos-and-downloads/

We are now participants in the Science and Environment Council of Southwest Florida's Watershed Audio Tour. This program features stops at sites across Sarasota and Manatee Counties, where stands with interpretive materials provide phone numbers that lead to more detailed descriptions. Each stop delivers watershed highlights, interesting facts, and suggestions for easy ways to help protect watersheds. While the tour can be accessed free from anywhere, visiting the featured locations at outdoor sites provides listeners an up-close and personal experience. Stops describing the dolphins of Sarasota Bay have been installed at Nora Patterson Park at the north end of Siesta Key, and at Historic Spanish Point. More information is available at: http://watershedtour.org/

Watershed Audio Tour stop at Nora Patterson Park, on Siesta Key, overlooking a channel used extensively by Sarasota's dolphins.

If you have not visited our website sarasotadolphin.org recently, you should take a look. The website has a number of new features. Links to our publications are now provided (sarasotadolphin.org/publications). The dolphins that have been featured as "Fin of the Month" in our e-newsletters over the years are compiled on the website, and in addition to photos and background information, recordings of their signature whistles have also been provided by our collaborator, Laela Sayigh (sarasotadolphin.org/meet-dolphins). Check out sarasotadolphin.org/learn/fun-facts!

Sharing Scientific Findings and Participation on International and Government Panels

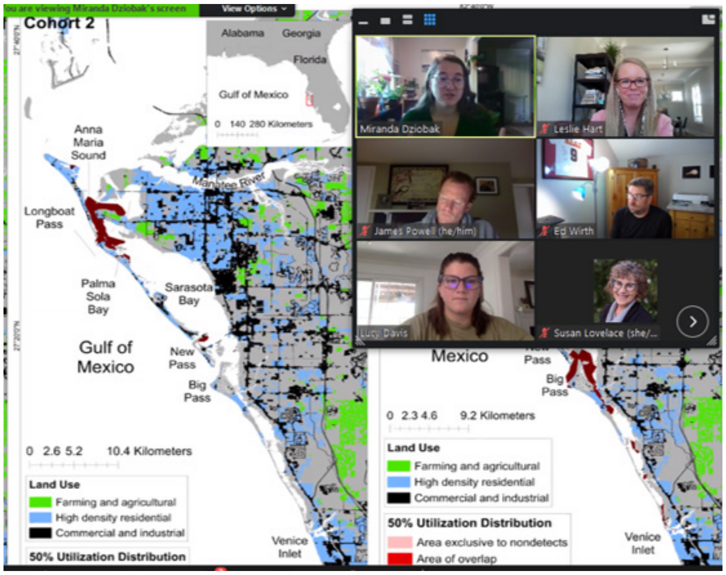
Our efforts to provide information to our colleagues and wildlife management agencies continues, through publication of numerous peer-reviewed scientific articles, through invited presentations at various scientific conferences, and through participation in national/international working groups and panels such as the U.S. Marine Mammal Commission Committee of Scientific Advisors on Marine Mammals, the NOAA/USFWS Atlantic Scientific Review Group, the NOAA/NMFS Bottlenose Dolphin Take Reduction Team, the U.S. Animal Telemetry Network, the Florida Marine Debris Research & Data Work 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 the past year, opportunities for foreign colleagues to come to Sarasota were limited due to the pandemic. However, graduate students from Argentina, the U.K., and Italy worked with our program.

Graduate Students

As described throughout this newsletter, graduate students from a variety of institutions, especially the University of California-Santa Cruz, Duke University, and the University of Florida, involve the resources of our program as they conduct their thesis or dissertation research. To date, 50 doctoral dissertation and 44 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 eight doctoral students and three Master's students have been making use of resources provided by the SDRP:



Miranda Dziobak's masters defense presentation.

Masters Theses - Completed

Dziobak, Miranda. 2021. Characterizing phthalate exposure in common bottlenose dolphins (*Tursiops truncatus*) from Sarasota Bay, Florida, 2010-2019. Master's thesis. College of Charleston, Charleston, SC.

Longden, Emma. 2021. The anthropause in Sarasota Bay, Florida: a comparison of the marine soundscape before and during the COVID-19 lockdown. Master's thesis. University of St Andrews.

Masters Research Projects - Underway

DiMaggio, Kylee. In progress. Impacts of human interactions on bottlenose dolphin reproductive success. Master's thesis. University of Florida.

Undergraduate Research Projects - Completed

Daniels, Elayna. 2021. Dolphin-seabird feeding associations in Sarasota Bay, Florida. Senior Honors Thesis. Davidson College, Davidson NC.

Doctoral Dissertations – Underway

Adamczak, Stephanie. In progress. A dynamic state model for assessing the population-level consequences of acoustic disturbance on oceanic dolphins. Doctoral dissertation. University of California, Santa Cruz.

Allen, Austin. In progress. Developing an activity/energetics proxy for common bottlenose dolphins to estimate energetic costs of avoiding vessels. Doctoral dissertation. 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. Doctoral dissertation. Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales, Departamento de Ecología, Genética y Evolución.

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

Shearer, Jeanne. In progress. Foraging kinematics of three cetacean species. Doctoral dissertation. Duke University.

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

Young, Jordann. In progress. Maternal bioenergetics and reproductive success in bottlenose dolphins. Doctoral dissertation. University of California, Santa Cruz.

Kim Bassos-Hull, Krystan Wilkinson and Mote's Shark and Ray Conservation Research Program Director, Demian Chapman, co-hosted colleagues and students from Mexico, Honduras, Guatemala and Belize who are working along the Mesoamerican Reef for collaborative project discussions and training opportunities in October 2021.

Grad Student Update – Where are they now?

Erin Fougères – UNC Wilmington (M.S. 2001; Ph.D. 2008), NOAA Fisheries Southeast Region Marine Mammal Stranding Program Administrator (2008-present)

I have been fortunate to work with supportive, encouraging, and collaborative mentors and advisors throughout my academic and professional career, including Dr. Randy Wells at the Sarasota Dolphin Research Program (SDRP). Fresh out of college and after a move to North Carolina, I began volunteering with Dr. Ann Pabst and Bill McLellan at the University of North Carolina Wilmington's (UNCW) Marine Mammal Stranding Program. At the time, their lab (the Vertebrate Anatomy and Biomechanics Lab, or VABLAB) had a number of different, ongoing research projects, including investigating marine mammal strandings and examining the anatomy and physiology of cetaceans (whales, dolphins and porpoises). It was as a UNCW volunteer in 1998 that I first participated in Sarasota dolphin health assessments with the SDRP. At those first health assessments, I helped the VABLAB collect data on dolphin thermal biology by measuring core temperatures from dolphins temporarily held in the water awaiting their veterinary exams. Those health assessments and my VABLAB stranding experiences looking at dolphin anatomy, led to my UNCW Master's project under Dr. Pabst investigating the relationship between heat flow and vasculature in the dolphin dorsal fin, as well as my doctoral research on dolphin thermoregulation, including seasonal patterns of heat loss in wild bottlenose dolphins resident to Sarasota Bay, FL. For both my Master's and Ph.D. I was lucky enough to have Dr. Wells as an advisor on my committee and to continue participating in Sarasota dolphin health assessments to collect the heat flux and other thermal biology data needed for my thesis and dissertation.

After completing my Ph.D. in 2008, I moved to Florida to work for NOAA's Southeast Regional Office in St. Petersburg. Here, I have been fortunate to continue working with Dr. Wells and the SDRP in my role as NOAA's Southeast Region Marine Mammal Stranding Program Administrator. I oversee the Marine Mammal Stranding Network, made up of volunteer organizations, including the SDRP, from North Carolina through Texas, Puerto Rico and the U.S. Virgin Islands. The SDRP, with their extensive experience developing safe capture techniques for free-swimming wild dolphins, has been a key partner in the Stranding Network assisting with rescuing entangled and out-of-habitat marine mammals across the Southeast. The SDRP has also assisted with evaluating the post-release success of our interventions for these animals and for dolphins released after rehabilitation through satellite-linked tagging and satellite-linked tracking of individual animals. The data collected by the SDRP from these tagging activities are critical for improving and refining decisions made by the Stranding Network in the field. As NOAA's Southeast Region Marine Mammal Stranding Program Administrator, I also help to develop and implement marine mammal injury assessment and restoration plans related to chemical and oil spills. After the *Deepwater Horizon* Oil Spill in 2010, I was able to work with Dr. Wells and the SDRP to help evaluate the extent and type of injuries sustained by dolphins in the northern Gulf of Mexico. The long-term health data collected by the SDRP on resident Sarasota bottlenose dolphins were critical for those studies.

I am so grateful for the experiences and support I have received from the SDRP throughout my academic and professional career. The SDRP is truly collaborative in its approach to research. Whether I was a volunteer, graduate student with a research idea, or professional scientist and manager, I have always been treated as member of the team, and the experiences and knowledge I've gained through my work with the SDRP have been critical to my development and success.

Erin Fougères coordinating a dolphin disentanglement near Clearwater, Florida, in 2018.

Erin Fougères working with UNCW's "Team Thermal" during health assessments in Sarasota Bay in 2004.

During 2021, 10 full-time interns contributed over 5,800 hours towards our research in Sarasota Bay, while learning field and lab techniques for monitoring dolphins and their prey via photographic-identification, purse seining, and passive acoustic methods. We also collaborated with colleagues from New College of Florida to provide four part-time paid internships to students from local Cross College Alliance institutions through the Environmental Discovery Awards Program (CCA-EDAP).

2021 Intern Perspective

Experiences with SDRP during the COVID-19 pandemic

India Haber, Duke University

I've always been lucky in the sense that, from a young age, I knew I wanted to spend the rest of my life immersed in marine science. The ocean has played a major role in my life and I've always felt a connection with the sea. My mother was born in the Philippines and grew up in Hawaii, where I spent many happy summers playing in the waves and exploring the ocean's splendor. Despite my fascination with the ocean, I didn't know where my passion for marine sciences would take me until I started college. After my first formal marine biology class, I was hooked on research. I've since spent three semesters at Duke's marine lab conducting research and taking as many marine science classes as I could jam into my schedule. During my time at the Duke Marine Lab, I developed a strong interest in marine mammals and bioacoustics. As a result, I focused my search for a summer 2021 internship on programs with an emphasis on marine mammals and acoustics. I was extremely fortunate to be offered an internship at SDRP. I was especially ecstatic because most of my classes and two of my advisors, Doug Nowacek and Andy Read, had mentioned the incredible research accomplished at SDRP. Doug and Andy always spoke fondly about the time they had spent in Sarasota and now I understand why!

India Haber during a fish monitoring survey, with a tiny Gulf toadfish.

Working at SDRP was both a major milestone in my academic career and a turning point for my future plans. Over the course of the three months I spent in Sarasota, I learned how good science is done. The staff at SDRP are wonderful mentors whose patience and passion guide their teaching. Not only did I learn about and practice important marine science tools, such as Photo-ID, I also developed some niche skills, like handling a hardhead catfish. Spending the majority of the summer on survey boats helped me to dramatically improve my photography skills and advanced my knowledge of dolphin behavior. And while everyone loves observing the dolphins, days spent purse-seining for dolphin prey were among my favorites of the summer. Some of my most important takeaways from SDRP came from simply observing lab interactions. Being in a lab setting every day taught me about the critical role funding plays in science and how it drives research. Though it may not be the most thrilling lesson, it is certainly a vital one for me to understand, especially as I consider graduate school and a career in marine science. While I did sustain some sunburns and toadfish bites, SDRP helped me develop important field and lab skills that made me a much stronger marine mammal researcher. During my time in Sarasota, I developed meaningful relationships that I will carry with me into the next chapter of my career. I'm very grateful to everyone at SDRP and thankful for the opportunity to take part in a truly impactful and impressive project!

Cassidy Renninger, University of Miami

Sometime between walking the paths at the Atlanta Zoo as a toddler and moving to Florida as a five-year-old, the ocean became a place of comfort and adventure for me. Eyeing the horizon for any sign of movement and playing in the tide pools created by a recent storm were my hobbies at a young age. As I grew and learned about the marine world, I only wanted to explore more and more. Throughout my education, I always gravitated towards the sciences and took any environmentally related course I could. By the time I was a senior in high school it was clear to me that I would pursue a degree in the environmental sciences at the University of Miami. Through UM, I have been able to conduct research on staghorn corals, study abroad in the Galapagos Islands, and explore my research interests. In the Spring of 2020, I interned with Zoo Miami working with their African carnivores and primates. After learning about so many amazing terrestrial species at Zoo Miami, I wanted to explore my lifelong passion for marine mammals.

Once I discovered the Sarasota Dolphin Research Program's internship, I knew that this was the program I was looking for. I was fortunate enough to be one of the few interns selected for the summer 2021 internship program. The summer was full of surprises and new experiences that challenged me to grow as a scientist. Each day out on the water allowed me to practice my photography and observation skills, all while watching (and thoroughly enjoying) the Sarasota Bay dolphins in their natural habitat. To my surprise, learning to set a purse seine and sample the fish communities in the bay was an unexpected highlight. Each time we put the net in the water, anything could happen. Scallops, red fish, and bonnethead sharks were just some of the exciting species found and quickly returned to their home. Back in the lab, I learned the importance of data management, teamwork, and photo identification. The many hours spent hunting for a fin match in the SDRP catalog with the staff and other Summer 2021 interns provided as much learning as our time in the field. I will cherish the experiences and skills gained from my SDRP internship for the rest of my life. After I graduate in May 2022, I intend to enroll in graduate school to continue learning more about the world's ecosystems and how I can make an impact. From the day I found out about my acceptance to the program to now, my excitement about the research performed by the SDRP has only grown. I am so grateful for my time spent in Sarasota and the connections I have made with the SDRP staff and fellow interns, and I hope that our paths cross again!

Cassidy Renninger on R/V Flip during a fish monitoring survey.

Where are they now?
Former Intern Perspective - 1999

Todd Speakman, National Marine Mammal Foundation

Where has the time gone? It is hard to believe that more than two decades have passed since I was a fresh-faced kid from landlocked Georgia interning with the SDRP at Mote Marine Laboratory. I moved to Sarasota in January 1999 to begin my first of two SDRP internships and primarily worked in the lab with Kim Bassos Hull updating the various dorsal fin catalogs by taking still photographs of old slides. Even though I had just finished a brief internship the previous fall in Galveston, TX, it was in Sarasota where I truly learned how to match a dolphin's dorsal fin, what fin features are important when searching for individuals, and the quality control required to maintain catalogs. Fortunately, at the end of my first internship, a couple of Randy's PhD students were looking for some field assistants during their summer fieldwork so I was able to stick around for another few months, this time largely working on the boat. It was during this period that I learned to drive around dolphins, identify fins in the field, and conduct focal follows on adult male dolphins. In addition, I had great mentors in Edward Owen and Stephanie Watwood who showed me how to conduct a field project and more importantly, how to treat (feed) your field crew, especially with bagels. We had some great times out in Sarasota Bay and beyond on good ole *R/V Hobo* following Blackstripe and Pair O' Nicks and rescuing folks from sinking boats. After that field internship, Randy must've realized I wasn't going away on my own so he decided to hire me as a research assistant that fall. I worked with Stephanie Nowacek and Sue Hoffman for the next couple of years helping with Earthwatch volunteers, participating in various field efforts including temporary capture/release projects, and assisting with the Beggar dolphin docent project near Nokomis. During one of the captures, I met Eric Zolman for the first time while we both were hand-pumping water from the bilge of NOAA's *R/V Monsoon*. Fast forward to today, he has remained my closest colleague and we have worked together for almost 20 years. It has been fun looking back on the many eye-opening experiences from those early years and remembering all the people I met and learned from.

Since then, I have worked in Charleston, SC for NOAA's National Ocean Service from 2002-2018 continuing to conduct research on dolphins, mostly in the surrounding Charleston area as well as follow-up damage assessment work in the Gulf of Mexico after the *Deepwater Horizon* oil spill. It was during the early portion of my NOAA job that our team created FinBase, a photo-id database management system now used by many programs across the world, including SDRP. In 2018, I started as a senior research associate with the National Marine Mammal Foundation's Conservation Medicine division. I have been able to utilize the foundational skills I learned in Sarasota in my current position as we curate dorsal fin catalogs from multiple sites in the Gulf of Mexico and the Atlantic coast to support investigations of bottlenose dolphin health, population parameters, movement and association patterns, and life-history.

In looking back on the past 20+ years, the technological advancements in photo-id are remarkable. In Galveston, I started by learning to develop our field slides in a darkroom. In Sarasota, we would mail off the Kodachrome color slide film and wait weeks for the slides to come back before hand-labelling them and matching with a slide loop. I can recall several afternoons using a projector in Randy's office to trace potential changed fins while he was out of town. Now, we have a program in finFindR that not only detects the dorsal fin edge automatically but assists in finding matches as well. It has been rewarding to see this technology come full circle as finFindR is now being used to assist with matching the large Mid-Atlantic and Gulf of Mexico-wide dorsal fin catalogs.

Fortunately, I've been able to continue to work with some of the SDRP staff while conducting dolphin health assessments in the southeastern US. I am forever grateful for the opportunity to start my marine mammal career in Sarasota and glad to see the SDRP continue to bring on interns that will carry on marine mammal research well into the future.

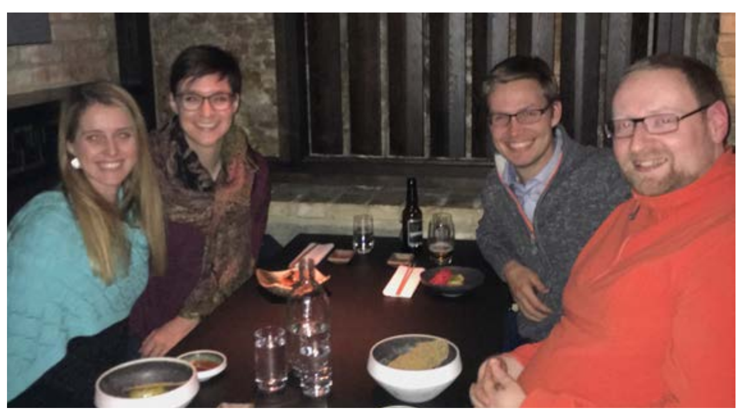
Todd Speakman obtaining identification photographs during a health assessment project.

Where are they now?
Former Intern Perspective - 2010

Kate Sprogis, Aarhus University, Denmark,

Wow! My memories of being an SDRP intern are fond ones. I was an intern for two months in Sarasota in 2010. I got to ride my bike from Lido Key to the office at Mote to work on dolphins….it was a dream. I had dreamt about this sort of experience since growing up as a kid in Australia. Whilst in the field we went on the boat, and I always wanted to find dolphins in a small inlet past the Palma Sola Causeway for some reason and see the dolphins chasing fish against the seawalls. I also found it odd when Jason Allen told me, "Kate, under this bridge ahead there is going to be a dolphin" and low and behold there was a dolphin! The team knew these dolphins so well, but this time it was a sad tale, as it was a dolphin that was a 'famous' begging dolphin called 'Beggar' as people fed it food. Whilst in the office, I did photo-identification of dolphin dorsal fins and ended up learning so much about how nicks and notches can change over time and was given the task to find the more difficult transient dolphin dorsal fins. I felt like a detective!

After my internship ended, boom(!), the Gulf of Mexico oil spill occurred. As I was trained up by SDRP staff, I was able to help Jason Allen and Brian Balmer with SDRP dolphin research in Port St. Joe in northwest Florida. I remember the large storms that rolled through in the afternoons, and the floating oil booms that were to keep out the encroaching oil. Overall, I learnt so much about common bottlenose dolphins, fieldwork and data processing with SDRP that I was able to apply this knowledge for my own PhD. I began my PhD the year after on Indo-Pacific bottlenose dolphins in Australia. Dr. Wells became my PhD co-supervisor, and we examined the sex-specific differences in dolphins in abundance and movement patterns, home ranges and habitat use. Our habitat use paper shows that male and female bottlenose dolphins use their habitats differently, apart from during the breeding season when the sexes come together and socialise



At SDRP you make connections, and during my time as an intern I met René Byrskov, a long-term loyal volunteer from Denmark. Rene came all the way to Western Australia to assist me on my PhD research on Indo-Pacific bottlenose dolphins. Years later, here we had an SDRP meet up in Denmark in 2019, with Julie van der Hoop and Frants Jensen who are also connected to SDRP (small world!).

a lot (see Sprogis et al. 2018. Sex-specific differences in the seasonal habitat use of a coastal dolphin population).

Since my PhD, I was awarded a prestigious European post-doctoral fellowship, the Marie Skłowdowska Curie Fellowship, and became a National Geographic Explorer. I have continued researching whales and dolphins off Australia, with my latest dolphin project in Exmouth Gulf. Exmouth is a remote, relatively pristine location with Indo-Pacific bottlenose dolphins and humpback dolphins, however, there are anthropogenic pressures in the region with coastal construction plans looming (deep-water port, oil and gas facilities). My knowledge gained from SDRP and my PhD are being put into action to try and protect these marine mammal species.

Kate Sprogis in Port St. Joe in 2010 with oil booms in the background from the Gulf of Mexico oil spill, where Kate was assisting with SDRP monitoring of the bottlenose dolphin population as the Deepwater Horizon oil encroached.

Volunteer Perspective
James Thorson

For more than 50 years Randy Wells and the SDRP team have been gaining valuable scientific insights into the Sarasota dolphin community. But while studying a community they might not have noticed that they were also creating one; a vast, worldwide human community that has participated in the research over the years. While the size of the local dolphin community fluctuates around 170 members or so, the human community connected to their study is many times that size. For years that community has grown not just with new graduate students and visiting researchers, but also with countless volunteers who've contributed to the research for a day or two, or a week, or in some cases years. We've come from all over the world to participate in the work and become

Pablo Bordino, Randy Wells, and James Thorson searching for franciscana dolphins in Argentina in 2005.

Members of the SDRP extended family, including James Thorson (2nd from left) at dinner in Barcelona, during the Society for Marine Mammalogy biennial conference in 2019.

part of the community, and then gone back to our regular lives until we get a chance to do it again or get together elsewhere with all the friends we've made in the process. (Our own fission/fusion society if you will.) For added connection some of us who've taken a greater interest in the more serious science have started to attend the biennial Society for Marine Mammalogy conferences that take place all over the world.

And for me, on a personal level, being a part of that extended community has been one of the most rewarding and enjoyable aspects of my life for the past 35 years. I'm not a scientist or professional biologist but I've found that now some of my very best friends are. The depth and breadth of this community is awe-inspiring. It's given me some of my best friends, taken me to weddings in the midwest and on both coasts of the US, a baptism in Argentina, and, sadly as happens in all large communities, a couple funerals. At my own wedding 26 years ago I was thrilled to have many of my SDRP friends in attendance at the ceremony. A ceremony, by the way, conducted by Dr. Randy Wells, who isn't just a world class scientist but also an ordained minister who has performed dozens of weddings for folks in the SDRP community.

One way you know you are truly part of a community is when you don't just get to know the people you work with in that community, but also get to know their families. I'm very proud that I've gotten to know so many of the parents, spouses, and children of the people I've worked with in Sarasota over the years. I'm also thrilled that my own kids (who weren't even born when I first started working with SDRP) consider some the folks I work with to be not just my friends but their friends as well. To continue the tradition one of my daughters is herself studying marine science in college at the moment. My grandest wish for her is that she eventually finds herself in a community as welcoming and supportive as the one I've found in SDRP.

So thank you Randy and SDRP for letting me be a part of this community for over 30 years. And thank you to the entire SDRP community simply for being there to be a part of.

Conservation Leadership in Action: Long-time volunteer Edward McCormick Blair, Jr

In his day-to-day life, Edward McCormick Blair, Jr. is most likely to be found buttoned up behind a desk as a Managing Director of the investment banking firm William Blair, co-founded by his grandfather. But whenever possible, he has taken the opportunity to shrug off his coat and tie, replace it with swim trunks and sunglasses and jump into the world of dolphin conservation in Sarasota Bay. Blair, one of the longest-serving trustees on the Chicago Zoological Society's Board, is also one of the Sarasota Dolphin Research Program's longest-serving volunteers.

"The Chicago Zoological Society was always a very important charity in the Chicago area," says Blair. "When we moved back to Chicago in the mid-1970s, I was asked to get involved. I remember going to Brookfield Zoo when I was a child and I always enjoyed animals and the natural world. In 1989, George Rabb (the Society's long-time leader who died in 2017) introduced me to Randy Wells."

Ed Blair receiving the Chicago Zoological Society's Corwith Hamill Lifetime Conservation Achievement Award from Randy Wells in October 2021.

Not long after, Wells offered Blair an invitation to join the team during a dolphin health assessment in Sarasota Bay. He's volunteered almost every year since. During those early days, there were about 35 participants in the health assessments. Today, the team includes 90 or more researchers, handlers and veterinarians — and Blair is always there helping out. "Ed is one of our most knowledgeable volunteers," says Wells. "No matter what needs to get done, he just jumps right in. He's been serving as a crewmember with me on the *R/V Bobmako* for decades, and today I really rely on his help and expertise. He's always one of the first people in the water to help with the dolphins, no matter the circumstances. And his experience really helps to keep the team and animals safer."

Blair's experience on the water goes back to childhood, when he and his family spent summers in Maine, where he and his brother taught themselves to scuba dive in the 1950s. "We taught ourselves in the pool at the club. Then we started a salvage business in the summers. We did things like repairing underwater sewer lines. My parents didn't necessarily think it was so cool."

That was followed by time in the Navy as a Communications Officer where his scuba skills were also put to work on the destroyer the *USS Benner*. Volunteering with the Sarasota Dolphin Research Program was a new opportunity to get back to the water.

"It was a chance for somebody living in a highly regimented business life to take a week or a couple of days to go back to being a healthy teenager or 20-year-old jumping in the water in strange places and dealing with issues," says Blair. "It's always fun jumping in the water and dealing with things, but in this case, you're doing it for a reason, as part of gaining a long-term understanding of the dolphins, of their health, how they change during the year. So it's also a chance to do well by doing good.

"The other thing that is always fascinating is in the evening when everybody is sitting around just talking. You're sitting with some of the major research scientists studying dolphins… you are there with the cream of the crop in dolphin biology, dolphin psychology."

In October 2021, on behalf of CZS, Wells presented Blair with the Corwith Hamill Lifetime Conservation Achievement Award during a ceremony in Chicago. "I was so honored to be the one to present the award to Ed," says Wells. "He's one of our program's greatest advocates and ambassadors, as well as one of our core field team members, and we can't thank him enough for his support and all he's done for animal conservation over the years."

Ed Blair (center, gray shirt, red shorts) assists with a dolphin health assessment in Sarasota Bay.

Products

Professional Activities Summary: November 2020 through October 2021

One accepted measure of the productivity of a research and conservation 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 are available through our website (sarasotadolphin.org) or they can be obtained upon request, as electronic pdf files. It should be noted that the pandemic precluded most in-person presentations after March 2020, leading us to add a category for virtual presentations.

Published Peer-Reviewed Journal Articles and Book Chapters

Adamczak, S. K., R. R. Holser, D. P. Costa, E. Berens McCabe and R. S. Wells. 2021. Body composition of common bottlenose dolphins in Sarasota Bay, Florida. Frontiers in Marine Science, Marine Conservation and Sustainability, Special Topic: The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation 8: 615773. https://doi.org/10.3389/fmars.2021.615773

Ajemian, M. J., C. Lamboy, A. Ibrahim, B. C. DeGroot, K. Bassos-Hull, D. A. Mann and L. Chérubin. 2021. Capturing shell-crushing by large mobile predators using passive acoustics technology. Journal of Experimental Marine Biology and Ecology 535: 151497. https://doi.org/10.1016/j.jembe.2020.151497

Berens McCabe, E. J., R. S. Wells, C. N. Toms, A. A. Barleycorn, K. A. Wilkinson and V. I. Palubok. 2021. Effects of multiple *Karenia brevis* red tide blooms on a common bottlenose dolphin (*Tursiops truncatus*) prey fish assemblage: Patterns of resistance and resilience in Sarasota Bay, Florida. Frontiers in Marine Science, Marine Conservation and Sustainability, Special Topic: The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation 8: 711114. https://doi.org/10.3389/fmars.2021.711114

Cloyed, C. S., B. C. Balmer, L. H. Schwacke, R. Takeshita, A. Hohn, R. S. Wells, T. Rowles, J. Saliki, C. Smith, M. Tumlin, E. Zolman, D. Fauquier and R. Carmichael. 2021. Linking morbillivirus exposure to individual habitat use of common bottlenose dolphins (*Tursiops truncatus*) between geographically different sites. Journal of Animal Ecology 90: 1191-1204. https://doi.org/10.1111/1365-2656.13446

Cloyed, C. S., B. C. Balmer, L. H. Schwacke, R. S. Wells, E. J. Berens McCabe, A. A. Barleycorn, J. B. Allen, T. K. Rowles, C. R. Smith, R. Takeshita, F. I. Townsend, M. C. Tumlin, E. S. Zolman and R. H. Carmichael. 2021. Interaction between dietary and habitat niche breadth influences cetacean vulnerability to environmental disturbance. Ecosphere 12: e03759. https://doi.org/10.1002/ecs2.3759

Cloyed, C. S., R. M. Wilson, B. C. Balmer, A. A. Hohn, L. H. Schwacke, E. S. Zolmann, M. C. Tumlin, R. S. Wells, A. A. Barleycorn, J. B. Allen and R. H. Carmichael. 2021. Specialization of a mobile, apex predator affects trophic coupling among adjacent habitats. Scientific Reports 11: 19611. https://doi.org/10.1038/s41598-021-99017-1

Cronin, M.R., S. H. Alonzo, S. K. Adamczak, D.N. Baker, R.S. Beltran, A.L. Borker, A.B. Favilla, R. Gatins, L.C. Goetz, N. Hack, J. G. Harenčár, E.A. Howard, M. C. Kustra, R. Maguiña, L. Martinez-Estevez, R.S. Mehta, I.M. Parker, K. Reid, M. B. Roberts, S.B. Shirazi, T.M. Tatom-Naecker, K.M. Voss, E. Willis-Norton, B. Vadakan, A.M. Valenzuela-Toro and E.S. Zavaleta. 2021. Anti-racist interventions to transform ecology, evolution and conservation biology departments. Nature Ecology & Evolution 5: 1213-1223. https://doi.org/10.1038/s41559-021-01522-z

DeGroot, B.C., K. Bassos-Hull, K.A. Wilkinson, S. Lowerri-Barbieri, G.R. Poulakis, M.J. Ajemian. 2021. Variable migration patterns of whitespotted eagle rays, *Aetobatus narinari*, along Florida's Coastlines. Marine Biology 168:18. https://doi.org/10.1007/s00227-021-03821-2

DeGuise, S., M. Levin, L. Jasperse, J. Herrman, R. S. Wells, T. Rowles and L. Schwacke. 2021. Long-term immunological alterations in bottlenose dolphin a decade after the *Deepwater Horizon* oil spill in the northern Gulf of Mexico: Potential for multigenerational effects. Environmental Toxicology and Chemistry 40: 1308-1321. https://doi.org/10.1002/etc.4980

Dulvy, N.K., J. Carlson, P. Charvet, M. J. Ajemian, K. Bassos-Hull, M.P. Blanco-Parra, E. Chartrain, D. Derrick, M. Dia, M. Diop, P. Doherty, J. Dossa, G. De Bruyne, K. Herman, G.H.L. Leurs, P.A. Mejia-Falla, A.F. Navia, N. Pacoureau, J.C. Pérez Jiménez, J.D. Pires, I. Seidu, A. Soares, A. Tamo, W.J. VanderWright and A.B. Williams. 2021. *Aetobatus narinari*. The IUCN Red List of Threatened Species 2021:e. T42564343A201613657. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T42564343A201613657.en

Dunn, C., D. Claridge, D. Herzing, C. Volker, K. Melillo-Sweeting, R. S. Wells, T. Turner and K. O'Sullivan. 2020. Satellite-linked telemetry study of a rehabilitated and released Atlantic spotted dolphin in The Bahamas provides insights into broader ranging patterns and conservation needs. Aquatic Mammals 46: 633-639. https://doi.org/10.1578/AM.46.6.2020.633

Dziobak, M. K., R. S. Wells, E. C. Pisarski, E. F. Wirth and L. B. Hart. 2021. Demographic assessment of mono (2-ethylhexyl) phthalate (MEHP) and monoethyl phthalate (MEP) concentrations in common bottlenose dolphins (*Tursiops truncatus*) from Sarasota Bay, FL, USA. GeoHealth 5: e2020GH000348. https://doi.org/10.1029/2020GH000348

Fahlman, A., M. J. Moore and R. S. Wells. 2021. How do marine mammals manage and usually avoid gas emboli formation and gas embolic pathology? Critical clues from studies of wild dolphins. Frontiers in Marine Science, Marine Conservation and Sustainability, Special Topic: The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation 8: 598633. https://doi.org/10.3389/fmars.2021.598633

Fire, S. E., G. A. Miller, E. R. Sabater and R. S. Wells. 2021. Utility of red tide (*Karenia brevis*) monitoring data as a predictive tool to estimate brevetoxin accumulation in live, free-ranging marine mammals. Frontiers in Marine Science, Marine Conservation and Sustainability, Special Topic: The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation 8: 611310. https://doi.org/10.3389/fmars.2021.611310

Friess, C., S. K. Lowerre-Barbieri, G. R. Poulakis, N. Hammerschlag, J. M. Gardiner, A. M. Kroetz, K. Bassos-Hull, J. Bickford, E. C. Bohaboy, R. D. Ellis, H. Menendez, W. F. Patterson III, M. E. Price, J. S. Rehage, C. P. Shea, M. J. Smukall, S. Walters Burnsed, K. A. Wilkinson, J. Young, A. B. Collins, B. C. DeGroot, C. T. Peterson, C. Purtlebaugh, M. Randall, R. M. Scharer, R. W. Schloesser, T. R. Wiley, G. A. Alvarez, A. J. Danylchuck, A. G. Fox, R. D. Grubbs, A. Hill, J. V. Locascio, P. M. O'Donnell, G. B. Skomal, F. G. Whoriskey and L.P. Griffin. 2021. Regional-scale variability in the movement ecology of marine fishes revealed by an integrative acoustic tracking network. Marine Ecology Progress Series 663: 157-177. https://doi.org/10.3354/meps13637

Gulland, F. M. D. 2021. How to work on a non-endangered species and contribute to cetacean conservation: An example by the Sarasota Dolphin Research Program. Frontiers in Marine Science, Marine Conservation and Sustainability, Special Topic: The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation 8: 648957. https://doi.org/10.3389/fmars.2021.648957

Products

Herrman, J. M., J. S. Morey, R. Takeshita, S. De Guise, R. S. Wells, W. McFee, T. Speakman, F. Townsend, C. R. Smith, T. Rowles and L. Schwacke. 2020. Age determination of common bottlenose dolphins (*Tursiops truncatus*) using dental radiography pulp:tooth area ratio measurements. PLoS ONE 15(11): e0242273. https://doi.org/10.1371/journal.pone.0242273

Hooper, L. K., R. B. Tyson Moore, K. McHugh, N. Boucquey and M. Fuentes. 2021. Compliance of dolphin ecotours to marine mammal viewing guidelines. Journal of Sustainable Tourism. https://doi.org/10.1080/09669582.2021.1900206

Hosegood, J., E. Humble, R. Ogden, M. de Bruyn, S. Creer, G. Stevens, M. Abudaya, K. Bassos-Hull, R. Bonfil, D. Fernando, A. Foote, H. Hipperson, R. Jabado, J. Kaden, M. Moazzam, L. Peel, S. Pollett, A. Ponzo, M. Poortvliet, J. Salah, H. Senn, J. Stewart, S. Wintner and G. Carvalho. 2020. Phylogenomics and species delimitation for effective conservation of manta and devil rays. Molecular Ecology 29: 4783-4796. https://doi.org/10.1111/mec.15683

Lowerre-Barbieri, S., C. Friess, L. Griffin, D. Morley, G. Skomal, J. Bickford, N. Hammerschlag, M. Rider, M. Smukall, M. vanZinnicq Bergmann, T. Guttridge, A. Kroetz, D. Grubbs, C. Gervasi, J. Rehage, G. Poulakis, K. Bassos-Hull, J. Gardiner, G. Casselberry, J. Young, M. Perkinson, D. Ambercrombie, D.T. Addis, B. Block, A. Adams, A. Acosta, A. Danylchuk, S.J. Cooke, F. Whoriskey and J. Brownscombe. 2021. Movescapes and eco-evolutionary movement strategies in marine fish: Assessing a connectivity hotspot. Fish and Fisheries. https://doi.org/10.1111/faf.12589

McBride-Kebert, S. and C. N. Toms. 2021. Common bottlenose dolphin, *Tursiops truncatus*, behavioral response to a record-breaking flood event in Pensacola Bay, Florida. Journal of Zoological and Botanical Gardens 2: 351-369. https://doi.org/10.3390/jzbg2030025

McHugh, K. A., A. A. Barleycorn, J. B. Allen, K. Bassos-Hull, G. Lovewell, D. Boyd, A. Panike, C. Cush, D. Fauquier, B. Mase, R. C. Lacy, M. R. Greenfield, D. I. Rubenstein, A. Weaver, A. Stone, L. Oliver, K. Morse and R. S. Wells. 2021. Staying Alive: Long-term success of bottlenose dolphin interventions in southwest Florida. Frontiers in Marine Science 7: 624729. https://doi.org/10.3389/fmars.2020.624729

Modest, M., L. Irvine, V. Andrews-Goff, W. Gough, D. Johnston, D. Nowacek, L. Palin, A. Read, R. Tyson Moore, and A. Friedlaender. 2021. First description of migratory behavior of humpback whales from an Antarctic feeding ground to a tropical breeding ground. Animal Biotelemetry 9:42. https://doi.org/10.1186/s40317-021-00266-8

Perry, C. T., Z. A. Pratte, A. Clavere-Graciette, K. B. Ritchie, R. E. Hueter, A. L. Newton, G. C. Fischer, E. A. Dinsdale, M. P. Doane, K. A. Wilkinson, K. Bassos-Hull, K. Lyons, A. D. M. Dove, L. A. Hoopes and F. J. Stewart. 2021. Elasmobranch microbiomes: emerging patterns and implications for host health and ecology. Animal Microbiome 3: 61 (2021). https://doi.org/10.1186/s42523-021-00121-4

Secchi, E. R., A. N. Zerbini, R. S. Wells and R. Bastida. 2020. Is the franciscana (*Pontoporia blainvillei*) a candidate for *ex situ* conservation? Pp. 72-78 in: B. L. Taylor, G. Abel, P. Miller, F. Gomez, L. von Fersen, D. DeMaster, R. R. Reeves, L. Rojas-Bracho, D. Wang, Y. Hao and F. Cipriano (eds.), *Ex situ* options for cetacean conservation. Report of the 2018 Workshop, Nuremberg, Germany. Occasional Paper of the IUCN Species Survival Commission No. 66. Gland, Switzerland: IUCN. https://doi.org/10.2305/IUCN.CH.2020.SSC-OP.66.en

Sherman, K. K., N. E. Beaulieu-McCoy, E. L. Wurster, R. S. Wells, C. R. Smith, A. A. Barleycorn, J. B. Allen and N. M. Kellar. 2021. Serum correlation, demographic differentiation, and seasonality of blubber testosterone in common bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, FL. Scientific Reports 11: 8941. https://doi.org/10.1038/s41598-021-88602-z

Takeshita, R., B. C. Balmer, F. Messina, E. S. Zolman, L. Thomas, R. S. Wells, C. R. Smith, T. K. Rowles and L. H. Schwacke. 2021. High site-fidelity in common bottlenose dolphins despite low salinity exposure and associated indicators of compromised health. PLoS ONE 16(9): e0258031. https://doi.org/10.1371/journal.pone.0258031

Toms, C. N., T. Stone, and T. Och. 2021. Skin lesion and mortality rate estimates for common bottlenose dolphins (*Tursiops truncatus*) in the Florida Panhandle following a historic flood. PLoS ONE 16(10): e0257526. https://doi.org/10.1371/journal.pone.0257526

Wells, R. S., M. J. Cremer, L. G. Berninsone, D. Albareda, K. A. Wilkinson, M. A. Stamper, R. L. Paitach and P. Bordino. 2021. Tagging, ranging patterns and behavior of franciscana dolphins (*Pontoporia blainvillei*) off Argentina and Brazil: Considerations for conservation. Marine Mammal Science 1-35. https://doi.org/10.1111/mms.1279

Würsig, B., T. A. Jefferson, G. S. Silber and R. S. Wells. 2021. Vaquita: Beleaguered porpoise of the Gulf of California, Mexico. Therya 12: 187-206. https://www.doi.org/10.12933/therya-21-1109

Technical Reports and Datasets

Cunha, H. A., C. P. Dias, L. C. Alvarenga, R. S. Wells and M. J. Cremer. 2020. Microscale population structure and kinship analyses suggest philopatry of both sexes in franciscanas (*Pontoporia blainvillei*). International Whaling Commission Scientific Committee Meeting, May 2020 SC/68B/SDDNA/04. 22 pp.

Gardiner, J. M., T. R. Wiley, S. K. Lowerre-Barbieri, K. Bassos-Hull and K. A. Wilkinson. 2021. Residency and movements of juvenile great hammerheads, *Sphyrna mokarran*, in the Tampa Bay area: preliminary results. Project Technical Report submitted to the Southeast Data, Assessment and Review (SEDAR).

Taylor, B.L., G. Abel, D. Bader, J. Barlow, G. Braulik, F. Cipriano, T. Collins, D. DeMaster, von Fersen, L., Gomez, F., Hao, Y., Miller, P.S., Minton, G., Reeves, R.R., Rojas-Bracho, L., E. Secchi, C. R. Smith, R. Suydam, D. Wang, R. S. Wells and A. Zerbini. 2021. An introduction to Integrated Conservation Planning for Cetaceans, including areas of potential collaboration with IWC to advance small cetacean conservation. Document presented to the Scientific Committee of the International Whaling Commission SC/68C/SM/03: 1-14.

Wells, R., L. Berninsone and M. Cremer. 2020. Franciscana movements from satellite-linked telemetry in Argentina and Brazil, 2006-2013. Dataset. https://doi.org/10.24431/rw1k47h

Virtual Presentations at Professional Meetings

Allen, J. B., J. Adams, S. Phay, L. Porter and R. S. Wells. 2020. FinBase overview and application to the Mekong River Irrawaddy dolphin dataset. Tri-National Workshop for the Irrawaddy Dolphin. 4 December 2020.

Bassos-Hull, K. 2021. Marine wildlife entanglements in Florida waters: Connecting with stakeholders to make a difference. Barrier Island Parks Society (BIPS) Marine Pollution Symposium - virtual presentation. 23 March 2021.

Bassos-Hull, K., D. Henderson, and K. McHugh. 2021. Sounds in the sea: Lessons from listening. Florida Marine Science Educators Association Conference. 30 April 2021.

Dziobak, M.K., Wells, R.S., Pisarski, E., and E. Wirth, and L.B. Hart. 2021 Phthalate exposure in bottlenose dolphins (*Tursiops truncatus*) and the potential for endocrine disruption. Joint OHH Annual Meeting, 4-6 October, 2021. (poster, virtual)

Fuentes, M., Piniak, W., and R. Tyson Moore. 2021. Advances in bio-logging techniques and their application to study the behavioral response of sea turtles to disturbances. The 7th International Bio-logging Science Symposium. Honolulu, Hawaii. 18 October 2021.

Henderson, D., K. McHugh and K. Bassos-Hull. 2021. Sounds in the Sea: Listening to Learn. Florida Association of Science Teachers Conference, October 21-23, 2021, St. Augustine, FL. 22 October 2021.

Rycyk, A., G. Bauer, R. Wells, J. Gaspard and D. Mann. 2021. Florida manatee (*Trichechus manatus latirostris*) hearing, boat noise, and variations in background noise. 4th Annual Manatee Research Symposium. 9 September 2021.

Smith, C. R. et al. 2021. Marine mammals and respiration: Evidence of poor pulmonary health in bottlenose dolphins following the *Deepwater Horizon* Oil Spill. International Oil Spill Conference. 13 May 2021.

Wells, R. S. 2020. Cetacean stranding fin mount tag training with Dr. Randy Wells. Hawai'i Stranding Network. 17 December 2020.

Wells, R. S., M. Cremer, L. G. Berninsone, D. Albareda, A. Stamper, D. Fauquier and P. Bordino. 2021. Responses of franciscanas to capture and handling. Workshop on Capture Myopathy in Marine Mammals. February 1-3, 2021. 2 February 2021.

Wells, R. S. 2021. 50 years of learning from the bottlenose dolphins of Sarasota Bay. Invited presentation, European Cetacean Society Webinar. 17 March 2021.

Wells, R. S. 2021. Small cetacean disentanglement: Changing knotty to nice. Virtual training for disentanglement of river dolphins for members of SARDI (South American River Dolphin Initiative www.river-dolphins.com) that includes six countries in South America. 14 May 2021.

Wells, R. S. 2021. How wild animal population research helps to guide welfare standards. Invited presentation in special session: Current and Future Welfare Considerations of Aquatic Species- Not Just For “Dolphins.” International Association for Aquatic Animal Medicine 2021 Virtual Conference. 23 May 2021.

Wilson, K., Tyson Moore, R. B., Barleycorn, A., Wells, R. Wells, and E. Bryant. 2021. LocSolve 2.0: Improved Location Processing for Fastloc GPS-enabled Tags. The 7th International Bio-logging Science Symposium. Honolulu, Hawaii. 18 October 2021.

Public, University, School Lectures (in person)

Bassos-Hull, K. and A. Boggio-Pasqua. 2021. “Ray”sing Awareness on Rays - How Citizen Scientists Help with Ray Conservation Efforts. Sea and Learn Series presentation at Elder Life Center, Saba Island, Dutch Caribbean. 18 October 2021.

Bassos-Hull, K. 2021. Ray and Dolphin Research and Conservation in Florida (with associated classroom activities). Saba Island Middle School classes grades 5, 6A, 6B and High School grades 9-12. Saba Conservation Foundation after-school youth snorkel club. 18, 19,and 21 October 2021. (6 presentations)

Bassos-Hull, K. and A. Boggio-Pasqua. 2021. “Ray”sing Awareness on Rays - How Citizen Scientists Help with Ray Conservation Efforts. Sea and Learn Series public presentation, Saba Island, Dutch Caribbean. 19 October 2021.

McHugh, K. 2021. The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation. Manatee Youth Environmental Action Committee, Bradenton, FL. 06 October 2021.

Wells, R. S. 2021. Panel member for premiere of film: “Stranded - A whale rescue tale.” Clearwater Marine Aquarium, Clearwater, FL. 16 September 2021.

Virtual Presentations

Allen, J. B. 2021. Dolphins! Why are they important, how does SDRP study them, and how can people protect them. SEA Trek virtual summer camp hosted by Mote Marine Lab, Loggerhead Marinelife Center, and FPL Manatee Lagoon. 29 July 2021.

Barleycorn, A. A. 2021. The dolphins of Sarasota Bay and transitioning from a college student to a professional. Junior Marine Biology Seminar, Eckerd College. 24 March 2021.

Barleycorn, A. A. 2021. Vaquita CPR overview. Marine Mammals class, New College of Florida. 10 May 2021.

Bassos-Hull, K. 2020. Ocean inspiration. Youth Ocean Conservation Summit. Host -Mote Marine Laboratory, Sarasota FL. 5 December 2020.

McHugh, K. 2021. The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation. Florida Master Naturalist Program Monthly Friends Group Webinar Series. 09 February 2021.

McHugh, K. and G. Lovewell. 2021. Help protect our wildlife. Joint CZS-SDRP and Mote SIP presentation to Sarasota County Lifeguards. 23 & 25 March 2021.

McHugh, K. 2021. The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation. Marine Resources Council, Palm Bay, FL. 06 April 2021.

McHugh, K. 2021. A Wild PODcast episode with Katie McHugh of the Sarasota Dolphin Research Program. Rossifari Podcast - Zoos, Aquariums, and Animal Conservation. Aired 05 October 2021. https://www.rossifari.com/podcast/

McHugh, K. 2021. The dolphins of Sarasota Bay: Lessons from 50 years of research and conservation. Mote Endless Oceans: Marine Science 101 - Florida Marine Mammals Class, Sarasota, FL. 11 October 2021.

Tatom-Naecker, T.M. 2021. Fatty acid analysis for diet determination in marine mammals. Guest lecture, BIOE 129 Marine Mammal Biology Lab, UC Santa Cruz. 21 April 2021.

Tatom-Naecker, T. 2021. You are what you eat: investigating diet and vulnerability to disturbance in common bottlenose dolphins. The Seymour Marine Discovery Center’s Science Sunday. 17 October 2021.

Toms, C. 2021. Invited panelist for virtual “STEMpossible Biology Bash” Valencia College, Orlando, FL. 16 April 2021.

Wells, R. S. 2020. The Chicago Zoological Society’s Sarasota Dolphin Research Program: Celebrating 50 years of conducting the world’s longest-running study of a wild dolphin population. Chicago Zoological Society’s Women’s Board. 10 November 2020.

Wells, R. S. 2020. Factors influencing wild bottlenose dolphin health and survival. University of Illinois Zoological Medicine VCM501 graduate student course. 18 November 2020.

Wells, R. S. 2020. Panel Discussion: The next wave – charting a course for a new decade of ocean conservation. Youth Ocean Conservation Summit. 4 December 2020.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Chicago Zoological Society’s Winter Lecture Series. 26 January 2021.

Wells, R. S. 2021. Whale Tales Global Check-In: Sarasota, Florida. Whale Tales – A Virtual Experience. 13 February 2021

Wells, R. S. 2021. Wild dolphin health assessments. Podcast #24, Aquadocs. 2 March 2021.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Marine Mammal Biology Class, New College of Florida. 4 March 2021.

Wells, R. S. 2021. A virtual inside look at the Sarasota Dolphin Research Program. CZS Associates Young Professionals Group. 8 March 2021.

Wells, R. S. 2021. Changes in the neighborhood: What’s happening with Sarasota’s dolphins? Suncoast Cosmos Club. 19 March 2021.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Marine Mammal Biology Class, University of Florida. 23 March 2021.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Introduction to Wildlife Population Ecology, University of Florida. 19 April 2021.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Rotary Club of Sarasota. 27 April 2021.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Greater Pine Island Civic Association. 4 May 2021.

Wells, R.S. and K. A. McHugh. 2021. Sarasota Dolphin Research Program update. CET Manager Meeting, Chicago Zoological Society. 19 May 2021.

Wells, R. S. 2021. Factors influencing wild bottlenose dolphin health and survival. SEAVET, U. of Florida, College of Veterinary Medicine, Gainesville, FL. 30 June 2021.

Wells, R. S. 2021. The dolphins of Sarasota Bay - Lessons from 50 years of study. Chicago Zoological Society’s Advanced Inquiry Master’s Program: Carnivores. 8 July 2021.

Wilkinson, K., R. Johnston, and R. Robertshaw. 2021. Animals are picky eaters too? Feat. Dr. Lisa Hoopes. Women in STEM series. February 22, 2021. https://sarasotadolphin.org/students/

Wilkinson, K., R. Johnston, and R. Robertshaw. 2021. In danger of becoming endangered. Feat. Jasmin Graham. Women in STEM series. 23 February 2021. https://sarasotadolphin.org/students/

Wilkinson, K., R. Johnston, and R. Robertshaw. 2021. ID, more like IDK! Feat. Ximena Arvizu. Women in STEM series. 24 February 2021. https://sarasotadolphin.org/students/

Wilkinson, K., R. Johnston, and R. Robertshaw. 2021. Making music with marine mammals. Feat. Dr. Katie McHugh Women in STEM series. 25 February 2021. https://sarasotadolphin.org/students/

Wilkinson, K., R. Johnston, and R. Robertshaw. 2021. Say “Bye” to bioaccumulation. Feat. Laura Garcia Barcia. Women in STEM series. 26 February 2021. https://sarasotadolphin.org/students/

Program Operations

Chicago Zoological Society Staff

Jason Allen, BS, Lab Manager
Aaron Barleycorn, BS, Field Coordinator
Elizabeth Berens McCabe, MS, Research Associate
Jonathan Crossman, BA, Research Assistant
Carolyn Cush, BS, Research Assistant
Allison Honaker, MPS, Research Assistant
Katie McHugh, PhD, Staff Scientist
Christina Toms, PhD, Postdoctoral Scientist
Reny Tyson Moore, PhD, Staff Scientist
Randall Wells, PhD, Program Director
Krystan Wilkinson, PhD, Postdoctoral Scientist

Affiliated Mote Marine Laboratory Staff

Kim Bassos-Hull, MS, Research Associate

Dolphin Biology Research Institute Officers

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

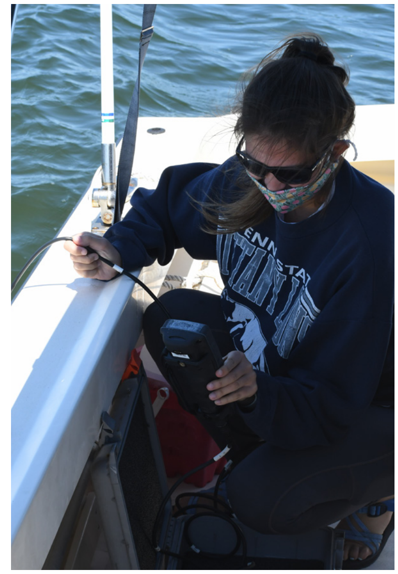
Interns and Post-Graduate Trainees

Julia Fishman (CCA-EDAP)
Marquis Gonzalez
India Haber
Eliza Ledbetter (CCA-EDAP)
Juliette Lee
Ansley Levine
Stefanie Maxin
Jess McCoppin
Vi Nguyen (CCA-EDAP)
Lea Palm
Alyssa Quackenbush
Cassidy Renninger
Josie Slaathaug
Angelika Ziegler (CCA-EDAP)

Local and Returning Volunteers

Dee Allen
René Byrskov (Denmark)
Michael Duranko
Kristi Fazioli
Mark Fishman
Sondra Fox
Ramsey Frangie
John Hamilton
Jeff Hollway
Pete Hull
Chuck Isselee
Renee Jones
Cathy Marine
Caryl Mason
Charlie Mericle
Nigel Mould
Cecilia Mould
Nikki Shaw
Bryan Spaulding
Jeff Stover
James Thorson
Bill Tiffan
Robyn Trainor
Martha Wells

CZS-SDRP interns (left to right): Juliette Lee, India Haber, and Cassidy Renninger.



CZS-SDRP intern Stefanie Maxin checking the temperature and salinity of the water.

CZS-SDRP interns during a biopsy dart survey in the Gulf of Mexico (left to right): Alyssa Quackenbush, Jess McCoppin, and Lea Palm.

Some of our Cross College Alliance Environmental Discovery Awards Program interns on their first dolphin survey (left to right): Julia Fishman, Vi Nguyen, and Angelika Ziegler.

Opportunities for You to Help Dolphin Research and Conservation

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

The Sarasota Dolphin Research Program depends on partnerships to ensure the continuation of the world's longest running study of a wild dolphin population and to make a critical difference for dolphins and their ecosystems. Each year, it costs about $1 million to fund our scientists and our internationally recognized research. Your support will enable our team to continue the development of an unparalleled base of knowledge about wild dolphin populations and ensure that the SDRP continues to serve as a unique dolphin conservation resource worldwide. For more information on how you can help, please contact Cindy Zeigler, Chief Advancement Officer, at (708) 688-8263.

Special Thanks

The Chicago Zoological Society is honored to recognize the following donors and funding organizations for their generous contributions from October 15, 2020 – September 30, 2021 to its Sarasota Dolphin Research Program through donations, research grants, and/or contracts.

Research Grants / Contracts

Charles & Margery Barancik Foundation
The Batchelor Foundation
Disney Conservation Fund
Dolphin Biology Research Institute
Mote Scientific Foundation
National Marine Mammal Foundation
National Oceanic and Atmospheric Administration
Texas State Aquarium Association
The Walt Disney Company

Donations

Anonymous (2)
Ms. Denise L. Bartolotta
Mr. and Mrs. Stephen P. Bent
Mr. and Mrs. Edward McCormick Blair, Jr.
Ms. Nancy Colcord
Ms. Vicky Czech
Allison and Rick Elfman
Mr. and Mrs. Kenneth J. Fedesna
Mr. and Mrs. David Gladstein
Hamill Family Foundation
Nancy and Jonathan C. Hamill
Lee Helbert
Mr. and Mrs. Peter S. Hellman
Linda R. Kahn
Ms. Stacey Kapushy
Keeley Family Foundation
Ms. Diane A. Ledder
Ms. Anne Lynch-Hall
Mr. and Mrs. Michael A. Mason
The McComb Family Foundation
Mr. and Mrs. Ira Mirochnick
Moller Family Foundation
Edwina M. Nelon
Mr. and Mrs. Carl Pignotti
Mr. and Mrs. Jack Shaffer
Ms. Suzana Spivak
Melissa and Stuart Strahl
Nancy C. Tameling
Joan M. Tameling
JoAnnGrace Tameling Schaeffer
Mr. and Mrs. Brent Wauterlek
Dr. Randy and Martha Wells

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 continuing our 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 cash or in-kind donations of $100 or more over the past year, from November 2020 through September 2021:

Anonymous
Victor Benaroya
Cannons Marina
Boyd Carnal
Joel Cohen
The Conserve *Forever* Foundation
David and Sonila Cook
John and Ronnie Enander
Erik Frick and Pam Salaway
William Goell
Don and Lee Hamilton
Carol Bell Hawkins
Frances Hollaway
Blair and Barbara Irvine
Barbara Janssen
Olvy and Fran Johnson
Cathy Marine
Patricia Mehler
Marilee Menard
The M. Elizabeth Moore Fund
Kara Moore
Rick and Nancy Moskovitz
Keith Mullin
Fred Murphy
Erich Nell
Jim and Dianne Ochiltree
Michele Paskiewicz
Ralph and Jan Piland
Lindsay Porter
William Puchalski
The George and Mary Rabb Conservation Fund
Valerie Rowland
Michael and Pamela Scott
Nadine Slimak
Leonard Tavormina
Josephine Theakos
James Thorson
Lark Tringas
Karen Venner
Mike Walsh
Kit Weinrichter
Randy and Martha Wells

People and Partners Make the Program

Dolphin Quest

Charles & Margery Barancik foundation

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Chicago Zoological Society
Inspiring Conservation Leadership

The Walt Disney Company

Florida Wild 1 Protect Wild Dolphins

National Marine Mammal Foundation

Cannons Marina

Disney Conservation Fund

State of Florida Institute of Oceanography FIO

M. Elizabeth Moore Fund

New College of Florida
The Honors College

Mote Scientific Foundation

SERDP
DOD • EPA • DOE

University of St Andrews

The Batchelor Foundation, Inc.

Mote Marine Laboratory

Chicago Zoological Society

Inspiring Conservation Leadership

The Sarasota Dolphin Research Program

Celebrating more than 50 years of dolphin research, conservation, and education