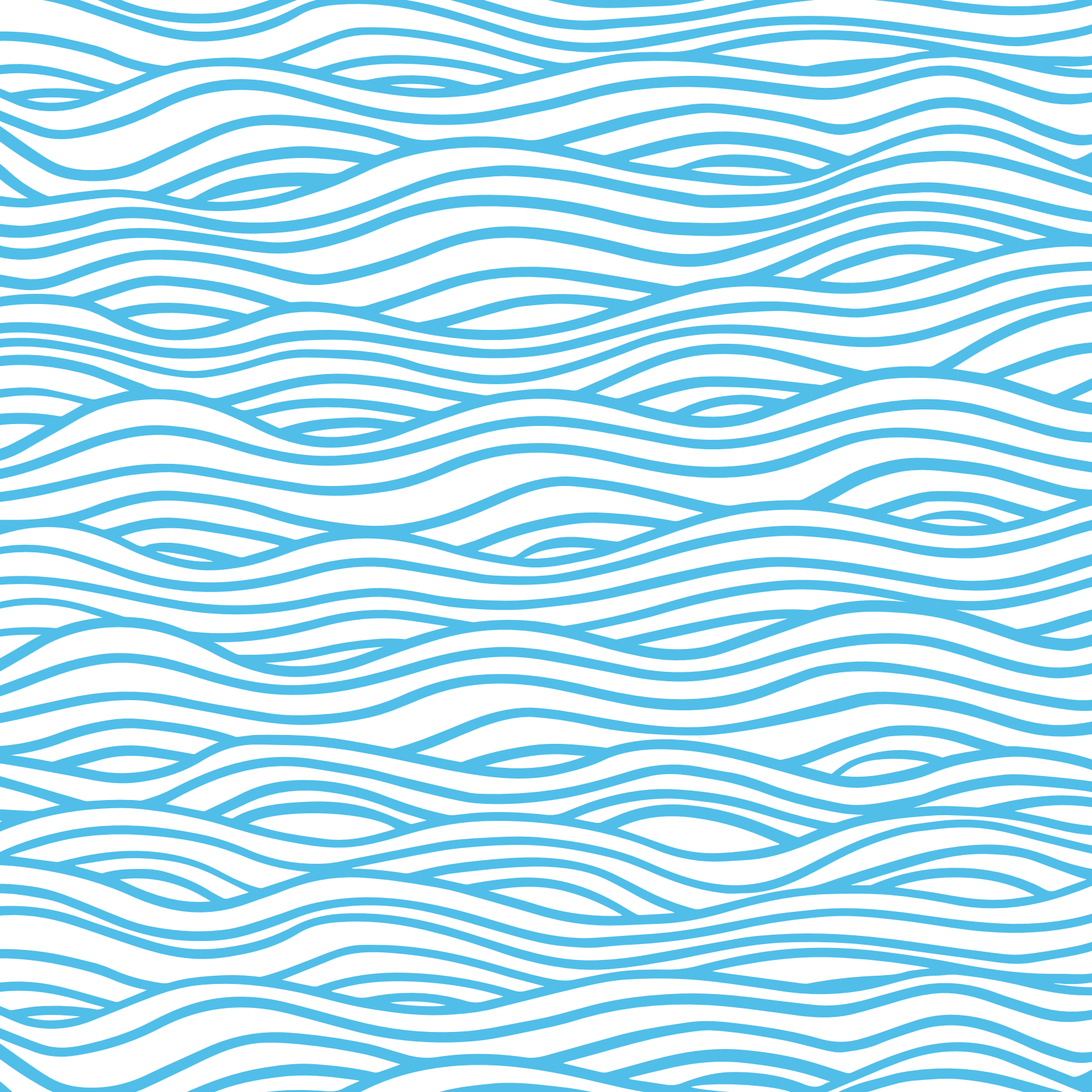




UPWELL



2021 Impact Report



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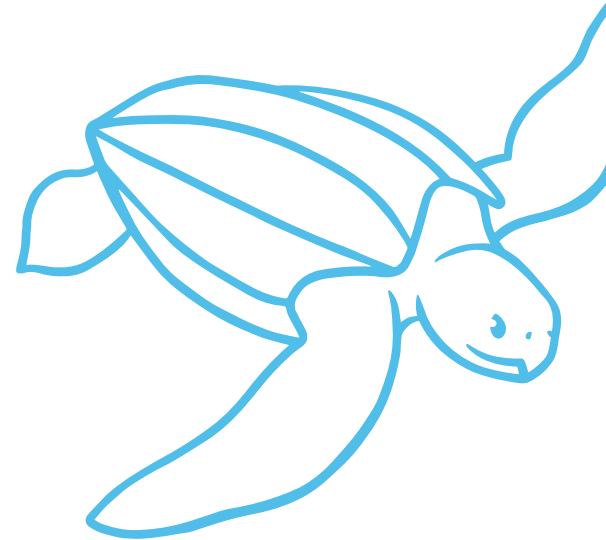
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A detailed photograph of a sea turtle swimming in clear, deep blue water. The turtle is seen from a high-angle perspective, moving towards the right. Its large, patterned carapace and flippers are clearly visible. The water's surface is slightly rippled, and light rays penetrate from above, creating a serene underwater atmosphere.

Upwell's mission is to protect endangered sea turtles by reducing threats at sea.

Conservation and wildlife management decisions set the future for our planet's most imperiled species. Policies that govern how we interact with the natural world are most effective when grounded in sound science.

Upwell deploys cutting-edge technologies, such as micro-satellite tracking, to uncover sea turtles' most enigmatic life history phases.

We impart learning from our research on how sea turtles use ocean environments around the world to guide marine policy and management frameworks ensuring these wondrous creatures receive the protections they need when and where they need them most.

Letter from Upwell's Director



Thank you for making 2021 a truly remarkable year for Upwell. I am pleased to share with you this report highlighting the profound impact made possible by your commitment to protecting turtles at sea. Despite ongoing travel disruptions and supply chain challenges, Upwell plunged back into fieldwork as soon as restrictions were lifted and continues to make great advancements in sea turtle conservation.

In 2021, we tagged one of the largest leatherbacks ever encountered off the California coast (weighing in at over 1,400 pounds!) and tracked his movements across the Pacific. Our efforts to unravel the mystery of sea turtles' lost years extended across the Atlantic. We released an additional 24 juvenile leatherbacks off the Florida coast, tracking their movements with custom micro-satellite tags. Working in partnership with engineers in Canada and oceanographers in France, we refined the tag design to yield longer transmission times. Our team traveled to the Azores to deploy the tags on loggerheads for the first time in the region, generating the longest transmission yet (107 days and counting!) for the prototype tags and charting previously unknown juvenile loggerhead movements within the Azores Current System.

In our mission to protect turtles at sea, we rely on an expanding network of partners and supporters. We extend our deepest gratitude to you for helping us advance the science needed to improve the odds for these iconic animals.

Best regards,

A handwritten signature in black ink that reads "George Shillinger". The signature is fluid and cursive, with a long horizontal stroke at the end.

George Shillinger, PhD

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Dr. George Shillinger

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EFFECTIVE CONSERVATION

Mobilizing data to protect leatherbacks in West Coast waters

“The partnership between Upwell and NOAA provides new opportunities to collect critical data on endangered leatherbacks throughout their foraging range off the US West Coast. These efforts directly support the development of science-based management actions to support recovery of this endangered species in the Pacific.”

— Dr. Karin Forney, Research Biologist, NOAA-NMFS-SWFSC, Marine Mammal and Turtle Division

Upwell completed another successful year of leatherback monitoring in partnership with NOAA on the US West Coast. Our trained aerial observers located five leatherbacks off the California coast and our boat-based team tagged one massive male leatherback in 2021. The turtle, named “Bumpy” by the crew, had been captured and tagged five years prior by NOAA researchers. With our newly installed deck scale on the R/V Sheila B., we recorded Bumpy’s weight at 1,419 pounds!

Bumpy’s tagging was unique for two reasons. First, it was only the second recapture off the California coast. Second, tracking data on male leatherbacks are rare and difficult to obtain. Male leatherbacks never return to land after leaving natal beaches and can only be encountered at sea. The arduous task of tagging leatherbacks in their foraging habitats offers a valuable opportunity to broaden our data beyond nesting females.

Our aerial observations and tracking data informed decisions on the opening of California’s 2021 Dungeness crab season, which helped fishers mitigate the risk of leatherback entanglement in fixed-line fishing gear. Our team provided regular updates to California’s Dungeness Crab Risk Assessment and Mitigation Program throughout the foraging period when leatherbacks are present in California waters feeding on abundant jellies.

Upwell and NOAA also worked together to expand leatherback monitoring into the Pacific Northwest in 2021, launching aerial surveys of critical foraging habitat. As in California, Upwell aims to provide regional fisheries managers and fishers in Oregon and Washington with timely presence and movement data to protect critically endangered leatherbacks in local waters.



6 months of satellite tracking capturing 1,175 viable GPS datapoints

Building trust with artisanal fishers in Mexico to reduce bycatch



Upwell Researcher Stephanie Rousso employed participatory science to begin collecting sea turtle bycatch data in the Gulf of California. The fabled seascape nestled between the Baja Peninsula and mainland Mexico is rich in biodiversity and hosts productive artisanal fisheries. Anecdotal reports collected via Upwell's Sea Turtle Spotter citizen science program and necropsies of stranded turtles suggest fisheries bycatch presents substantial risks to sea turtles in the Gulf of California, but quantifying incidental capture is challenging due to the absence of official statistics for the region.

A first-ever training workshop focused on collecting sea turtle bycatch data, supported by Upwell and co-hosted by 10 artisanal fishers in Sinaloa, forged a new path for conservation. Stephanie drew upon her community engagement skills—honed through years of outreach with sailboaters, ecotour guides, and SCUBA divemasters—to build relationships with a cadre of small-scale fishers participating in sea turtle monitoring. So far, the trained fishers have captured, measured, weighed, flipper-tagged and released 16 turtles in Sinaloa and La Paz Bay. Many of the fishers engaged in monitoring activities acknowledge their connection with the sea turtles and are eager to take a more active role to reduce sea turtle bycatch in their communities.

Partnering with respected fisher Adalberto Garcia, Stephanie drafted a methodology for quantifying and mapping sea turtle bycatch in artisanal fisheries. Adalberto and his crew have participated in sea turtle monitoring activities; they recognize the role sea turtles play as keystone species, maintaining balance in the marine ecosystems that sustain their livelihoods. Teaming up for turtles, Stephanie plans to map where, when and how often incidental captures occur, plotting the new monitoring and bycatch datasets against the backdrop of Adalberto's extensive knowledge of local marine habitats.



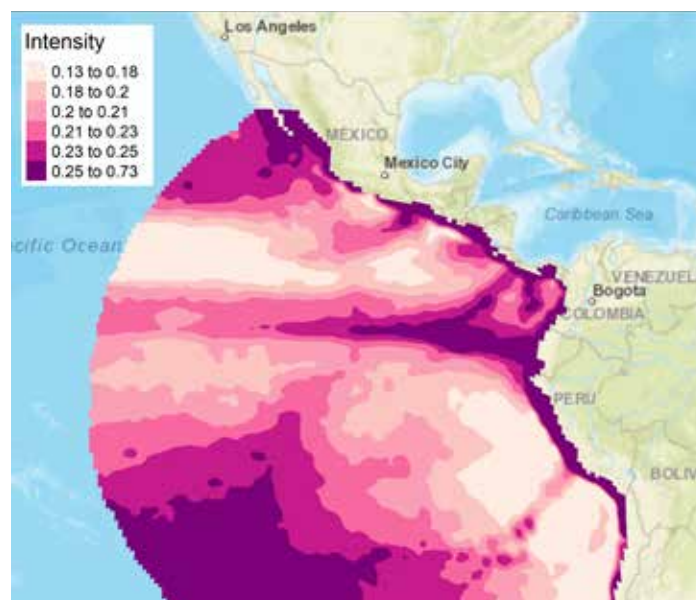
“There are more green sea turtles now and it is important to care for them because they eat a lot of jellies, which are predators of the shrimp and fish larvae that we need to sustain our lives.”

– Adalberto Garcia, Artisanal Fisher, Sinaloa

EFFECTIVE CONSERVATION

Broadening access to dynamic management tool in South America

Upwell Researcher Aimee Doyle posted a new web interface for the South Pacific Turtle Watch to our website, broadening access for resource managers and users from the region in addition to the scientific community and the general public. The model predicts leatherback presence to assist fishers and fisheries managers in bycatch reduction and conservation efforts for critically endangered East Pacific leatherbacks. Upwell plans to continue making improvements to the web interface with feedback from key user constituencies.



GROUNDBREAKING RESEARCH

Demystifying juvenile West Atlantic leatherback dispersal patterns



Upwell released another 24 juvenile leatherback sea turtles outfitted with tiny micro-satellite tags with Florida Atlantic University (building on our successful release of 18 in 2020). Once again, we worked with Mercator Ocean International to determine optimal release locations using the Sea Turtle Active Movement Model and to analyze their movements beyond the release location in the Gulf Stream. Our team also deployed satellite drifters with each release in 2021 to better understand the prevailing currents influencing dispersal.

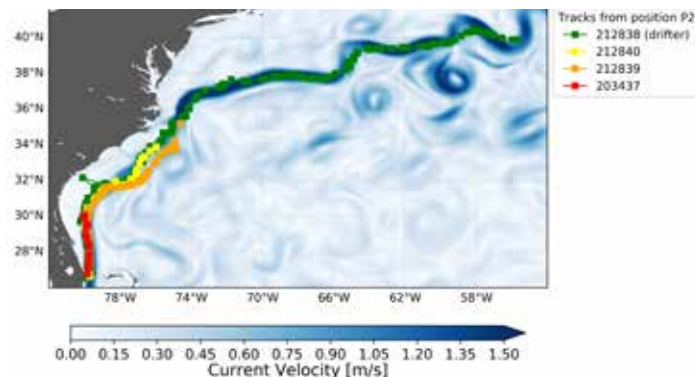
The more we know about how leatherbacks and other endangered turtles disperse from nesting beaches, the more effective conservation strategies we can implement to improve their odds of survival.

With technological improvements to the micro-satellite tags and 6 more turtles released with tags, we realized gains in tag performance, including significant increases in the number of position datapoints recorded per turtle, as compared to the previous year. Scientists monitoring the tagged juvenile leatherbacks after release noted diving behaviors, including one turtle's descent to "twilight zone" depths where pyrosomes and moon jellies (known prey species for mature leatherbacks) were observed.

Upwell's partnership with Florida Atlantic University's Gumbo Limbo Nature Center and the University of Tennessee significantly enhanced short-term captive rearing outcomes for neonate leatherbacks through risk reduction protocols and improved nutrition. Upwell Laboratory Veterinarian Dr. Samantha Kuschke is exploring the presence of beneficial bacteria in the microbiome of neonate leatherback sea turtles and the role they play in supporting overall health (e.g., fighting off pathogens, counteracting contaminants).

“Having an interdisciplinary team creates an environment where new ideas can be examined and developed from multiple perspectives. The work between Upwell, Florida Atlantic University and Mercator Ocean International has been incredibly successful at improving the health and husbandry of hatchlings and their release at sea. Within the last year we have successfully implemented multiple standard operating procedures to support hatchling health in the lab.”

— Dr. Samantha Kuschke, Upwell Laboratory Veterinarian







Charting the Lost Years for loggerheads around the Azores

Upwell deployed micro-satellite tags on juvenile loggerheads in the Azores for the first time in December 2021. This pioneering research was conducted in partnership with the COSTA Project, the Okeanos Center at the University of the Azores, the Aquário do Porto Pim, Mercator Ocean International and Florida Atlantic University.

The six young loggerheads we outfitted with tags were rehabilitated at the Aquário do Porto Pim in Horta, Azores after stranding on nearby beaches or incidental capture by fishers in the area. While it is understood that post-hatchling loggerheads are advected from Florida by the Gulf Stream toward the Azorean archipelago and young loggerheads inhabit the mid-Atlantic waters surrounding the islands, little is known about how long they remain or where they go when they depart.

The majority of the micro-satellite tagged loggerheads remained in relatively warm waters, heading in a northeasterly direction. All but one demonstrated active swimming, rather than passively moving with the current. Half the tags transmitted data for more than 107 days, yielding the longest transmissions yet from the prototype micro-satellite tags.

6 micro-satellite tags deployed with 1,386 satellite positions recorded



GROUNDBREAKING RESEARCH

Investigating cold-stunning in live stranded Pacific olive ridley, loggerhead and green turtles

Upwell's Wildlife Veterinarian Dr. Heather Harris launched a new study to improve outcomes for cold-stunned olive ridley, loggerhead and green turtles on the US West Coast. Hard-shelled sea turtles are sensitive to ocean temperatures and can become hypothermic and unresponsive, entering a "cold-stunned" state, when sea surface temperatures drop rapidly.

Cold-stunned Kemp's ridleys, commonly juveniles, are widely reported during the winter months in the Northeastern United States, but little is known about the health and condition of mature hypothermic olive ridley, loggerhead and green turtles north of California's Point Conception.

Dr. Harris and Upwell Research Assistant Emeline McMann-Chapman initiated an in-depth analysis of underlying health issues in these protected species. They identified a total of 53 historical cases from 2009 to 2021 with extensive case material, including medical records, animal husbandry notes, laboratory and diagnostic test results, necropsy reports, histology reports and ancillary diagnostics.

Upwell's aim is to develop a standardized intake protocol for the West Coast Stranding Network to aid in early diagnosis and treatment of key comorbidities commonly found in cold-stunned sea turtles and increase their chances of survival.

“Upwell is leading this highly collaborative effort to connect partners across the West Coast region who respond to live stranded sea turtles to learn as much as possible from each individual turtle to improve animal care and welfare.”

— Dr. Heather Harris, Upwell Wildlife Veterinarian



Laboratory samples from 53 cases collected for comorbidity analysis

Highlighting vulnerability of turtles to Caribbean vessel traffic

Vessel traffic presents a significant threat to sea turtles worldwide, and necropsies of dead turtles washed ashore often point to ship strikes. Upwell identified an opportunity to better understand and mitigate this issue by studying data on the movements of shipping vessels along the Caribbean coastline of Costa Rica (in proximity to the port of Limón) and satellite tracks from leatherbacks we tagged nearby at Pacuare Nature Reserve.

Upwell secured vessel traffic data for University of Maryland undergraduate student Melissa Vezard's analysis of vessel and leatherback movements during the vulnerable internesting phase when females remain concentrated in nearshore habitats. To determine if there was any impact on the turtle behavior, she analyzed vessel traffic exposure and speed and compared it to turtle movement characteristics; speed, turning angle, and absolute angle.



Findings indicated turtles were concentrated off the nesting beach and their turning angles were significantly associated with vessel exposure and speed. Regulations on vessel speed could reduce potential impacts of vessel traffic in or near interesting habitats, at least during known nesting periods.

“To date, little is known about the risks vessel traffic posed to the nesting females. This project synthesizes the telemetry tracks of six female leatherbacks with vessel traffic data to understand the risks of vessel traffic. This research can inform the conservation community about the impact vessel traffic may have on leatherbacks, and encourage potential mitigation measures, such as regulation on vessel speed near the nesting beaches.”

— Dr. Dong Liang, University of Maryland Center for Environmental Studies

TOP-NOTCH TECHNOLOGIES

Expanding acoustic tracking of leatherbacks in US Southeast

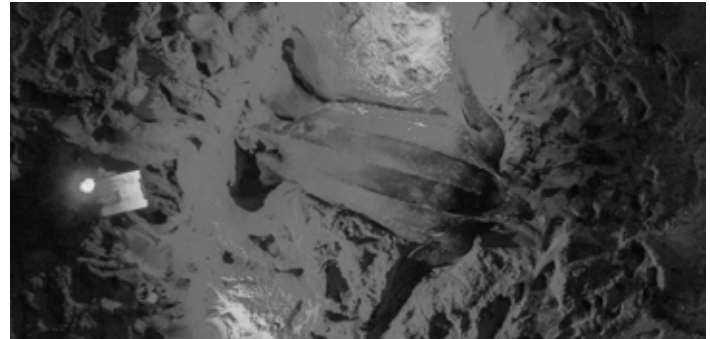
Upwell's Executive Director provided training on acoustic tag attachment techniques for researchers from Florida Atlantic University and the Loggerhead MarineLife Center and two acoustic tags for a new study on the subpopulation of Northwest Atlantic leatherbacks nesting in Florida. Leatherbacks tagged in 2019, as part of Upwell's initial deployment of acoustic tags on another subpopulation of Northwest Atlantic leatherbacks nesting at Pacuare Nature Reserve, continue to provide valuable data (including detections as far away as Nova Scotia, Canada) on their seasonal movements through waters off the US Southeast and up the Eastern Seaboard.

Acoustic tags cost less than satellite tags and can transmit much longer, and a robust acoustic receiver network already exists along the US Eastern Seaboard. The tags transmit location data to a receiver when the tag, and hence the animal being tracked, passes nearby. Of the two acoustic tags Upwell contributed to the 2021 research in Florida, one was detected 13 times by two acoustic arrays off the coast of Hilton Head, South Carolina. The second tag was detected 18 times by two acoustic arrays south of Myrtle Beach, South Carolina and 8 times off an array west of Cape Lookout National Seashore, North Carolina.

2 acoustic tags deployed by Upwell providing 39 detections

TOP-NOTCH TECHNOLOGIES

Piloting drones to assess health of Florida's nesting leatherbacks

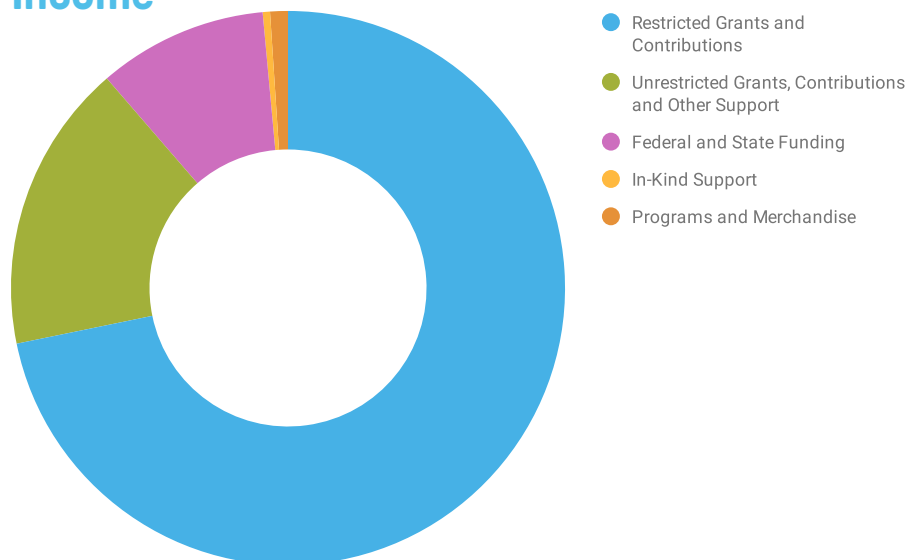


Upwell contributed to the development of a new, non-invasive method for assessing the body condition of nesting leatherbacks using imagery collected by drones. Sea turtle biologists and wildlife veterinarians use body condition, described using a scale that ranks individuals from 1 (emaciated) to 5 (obese), as a marker of a leatherback turtle's health. But weighing a fully grown leatherback is no easy task!

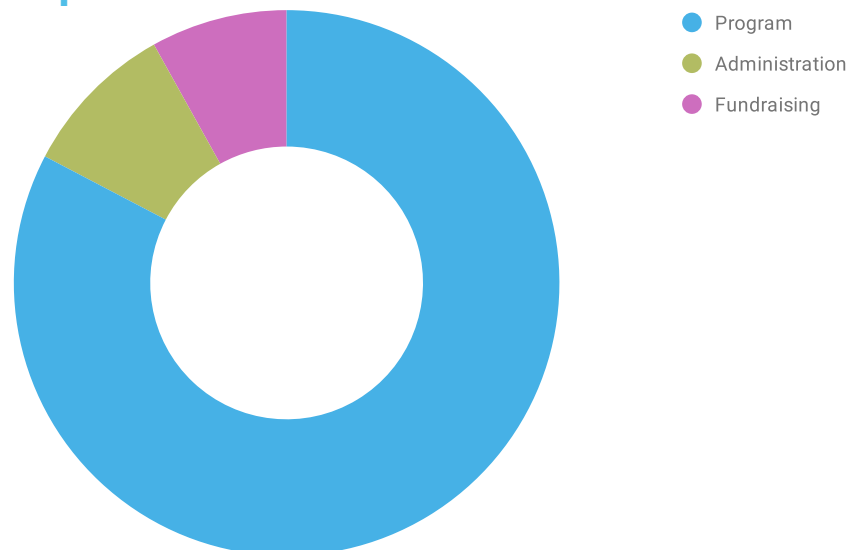
First, Upwell Researcher Derek Aoki, a graduate student at Florida Atlantic University, used one of our drones to capture aerial images of five nesting leatherbacks over the course of the 2021 nesting season on Juno Beach, Florida. Next, Dr. Duncan Irschick, our partner at the University of Massachusetts, Amherst, began development of a machine-learning tool to estimate body mass and body condition based upon the imagery. Validation of the tool relies on data from Upwell's Wildlife Veterinarian Dr. Heather Harris' study on leatherback body condition, including actual weights of leatherbacks measured on tripod scale by our intrepid team and collaborators from the Loggerhead MarineLife Center.

2021 Financials

Income



Expenses



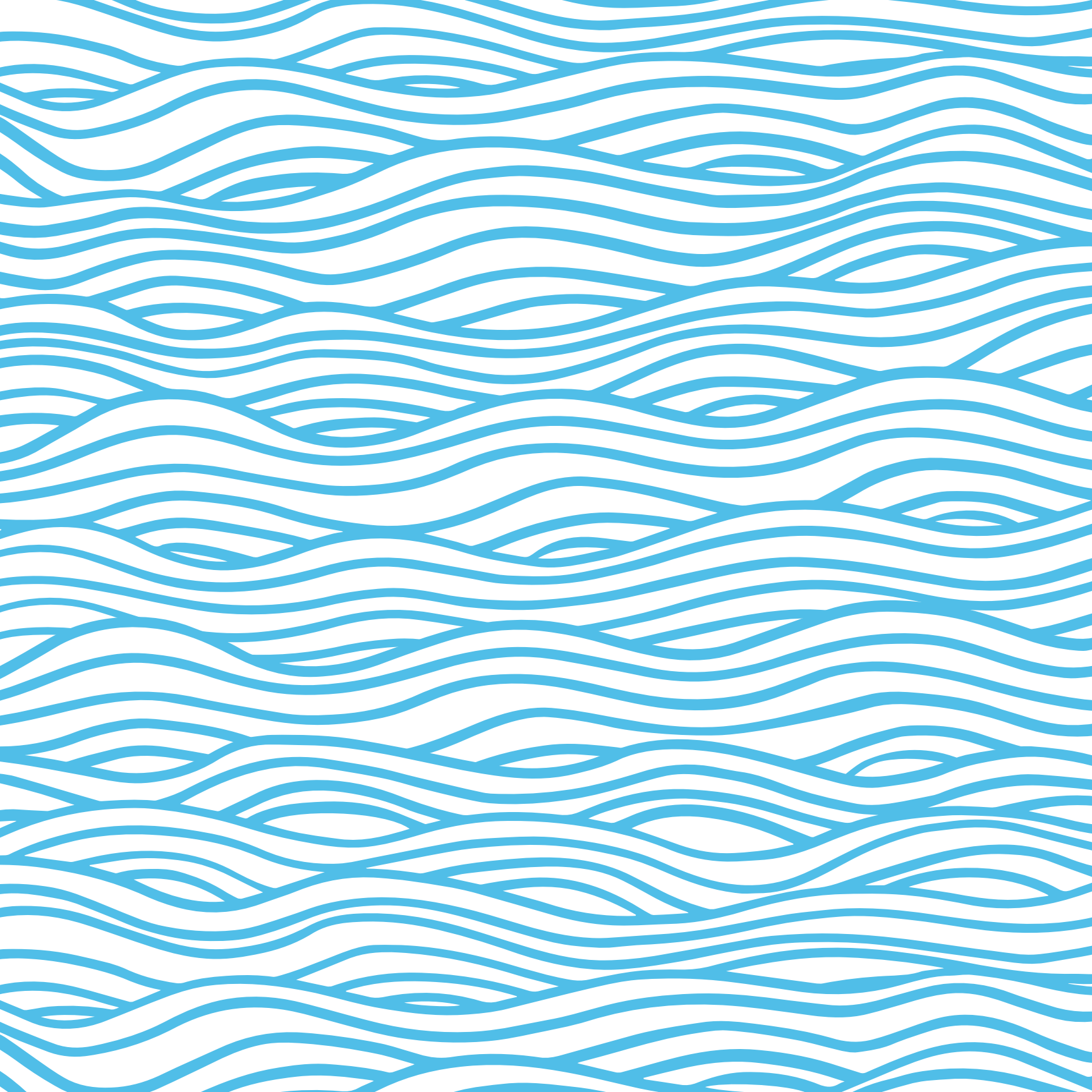
Recent Publications

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Degenford, J.H., Liang, D., Bailey, H., Hoover, A., Zarate, P., Azócar, J., Devia, D., Alfaro-Shigueto, J., Mangel, J., de la Paz, N., Davila, J., Barturen, D., Rguez-Baron, J., Willard, A., Fahy, C., Barbour, N., Shillinger, G. (2021). [Using Fisheries Observation Data to Develop a Predictive Species Distribution Model for Endangered Sea Turtles](#). Conservation Letters and Practice.

Queiroz, N., Humphries, N.E., Couto, A. et al. [Reply to: Shark mortality cannot be assessed by fishery overlap alone](#). Nature 595, E8–E16 (2021).

Image credits Jason Isley, Cover; Sergi Garcia, 2; Heather Harris, 4; George Shillinger, 5; Stephanie Rousso, 6 & 7; Dong Liang, 7; Jim Abernethy, 8; Tony Candela, 9; Nuno Vasco Rodrigues, 10 & 11; Nuno Vasco Rodrigues, 12; Heather Harris, 13; George Shillinger, 14; Derek Aoki, 15.





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