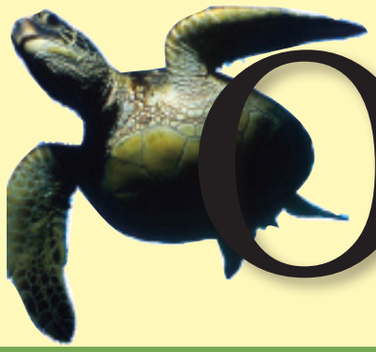

Florida Environmental Outreach

Volume 12, Issue 1

In This Issue

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Florida Environmental
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NATIONAL SAVE THE SEA TURTLE FOUNDATION

Volume 12 Issue 1

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Cover Photo: Captain Mike Osborne releases hatchlings rescued by Florida's FWC at the Marquesas Keys. Photo Credit: Sue Schaf.

Notes From The Field

2019 Nesting Season in Review

Larry Wood, Ph.D.

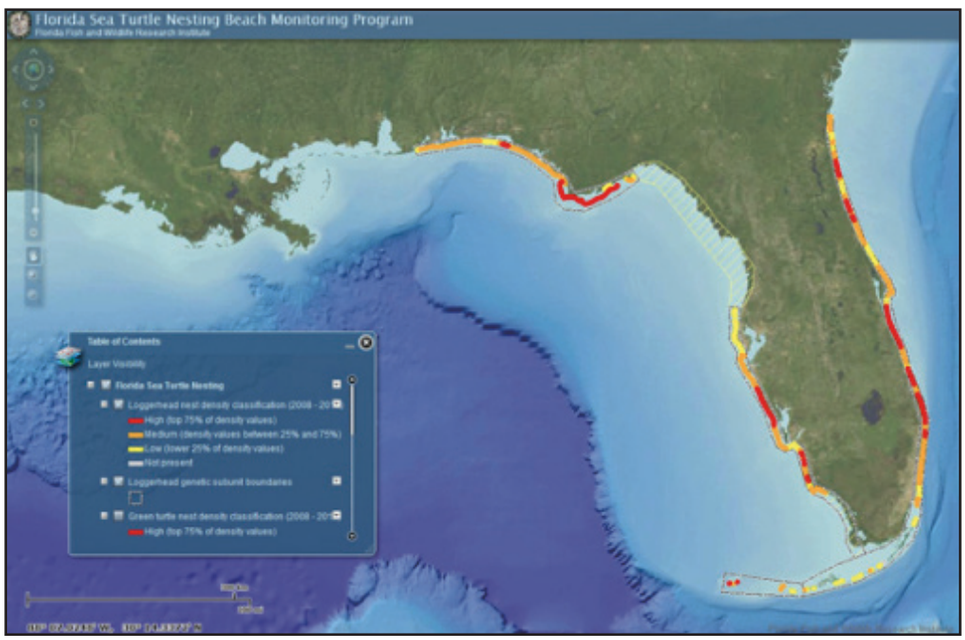
Each year, a virtual army of over 3000 volunteers, environmental professionals, students, and government employees combine their efforts to document the sea turtle nesting that occurs along Florida's beaches. With over 800 miles of coastline where turtles are known to nest, this is no small accomplishment! Nonetheless, these dedicated people do an amazing job of collecting the data that are critical to monitoring sea turtle populations. Knowing how many sea turtles there are at any given time in the ocean is virtually impossible, due simply to the vast ranges most are known to occupy, so scientists have turned to the next best thing available: nesting effort.

Since sea turtles have terrestrial ancestors, females still have to return to land to lay eggs. In the process, they leave conspicuous flipper marks, a.k.a. 'tracks' in the sand that reveal their species and nesting behavior. If careful observations are made consistently over long periods of time, the number of females in a population can be pretty accurately estimated, which then provides clues to not only an overall population size, but more importantly if that population is changing over time.

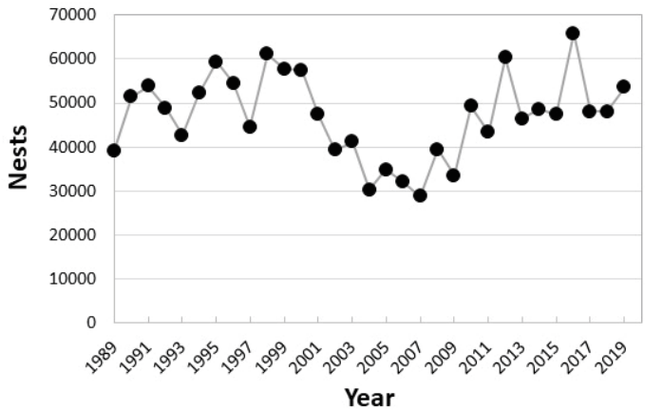
In Florida, people began collecting nesting data in the late 1970s under a cooperative agreement between the Florida Fish and Wildlife Conservation Commission (FWC) and the U.S. Fish and Wildlife Service. Now known as the Statewide Nesting Beach Survey (SNBS) program, people from all backgrounds provide nesting data from over 200 beaches representing about 800 miles of coastline. An astonishing 1.2 million+ turtle nests have been recorded since the program's inception.

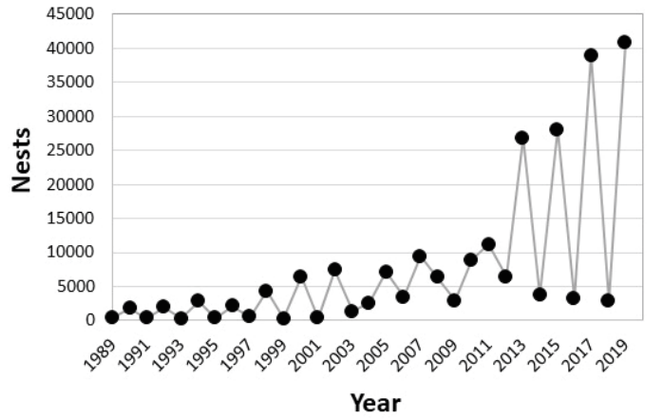
Though the totals are important and often impressive, they can't be used to study trends over time unless the data are collected exactly the same way, everywhere, all the time, which wasn't occurring in the early years. In response, in 1989, Florida's FWC initiated a program that eliminated a number of inconsistencies that inherently pop up among such a broad coalition of participants over such a large area. Now known as the the Index Nesting Beach Survey (INBS), the intent shifted to gather a smaller, but very consistent dataset that would be used for trend analyses only. As of 2016, 36 Florida beaches participate in the INBS program, representing 275 miles of coastline. Combined, the SNBS and INBS represent an almost unparalleled citizen science effort that continues to be one of the most comprehensive studies of sea turtles anywhere in the world.

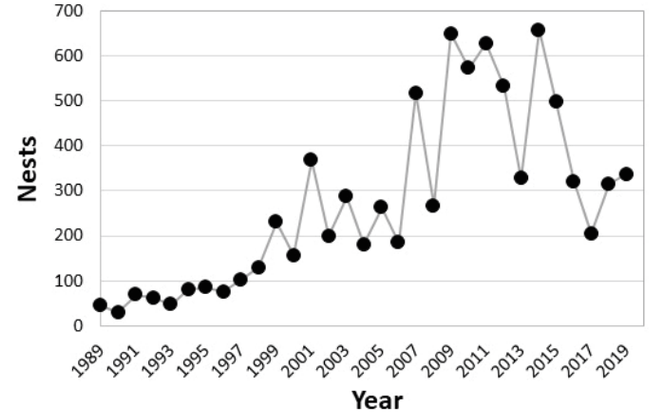
As a quick reminder, there are three species of sea turtles that consistently nest on Florida's beaches, and two others that rarely do. Loggerhead, green, and leatherback turtles are the staples of the effort, and the odd hawksbill and/or Kemp's Ridley do occasionally show up, but don't maintain stable reproductive populations in Florida. Of the three 'regulars', loggerheads make the most impressive showing by far, often producing 60,000+ nests annually. These numbers are of particular importance because around 90% of the entire Atlantic loggerhead nesting population relies on the beaches of the SE United States, especially Florida, to produce the bulk of their next generation.

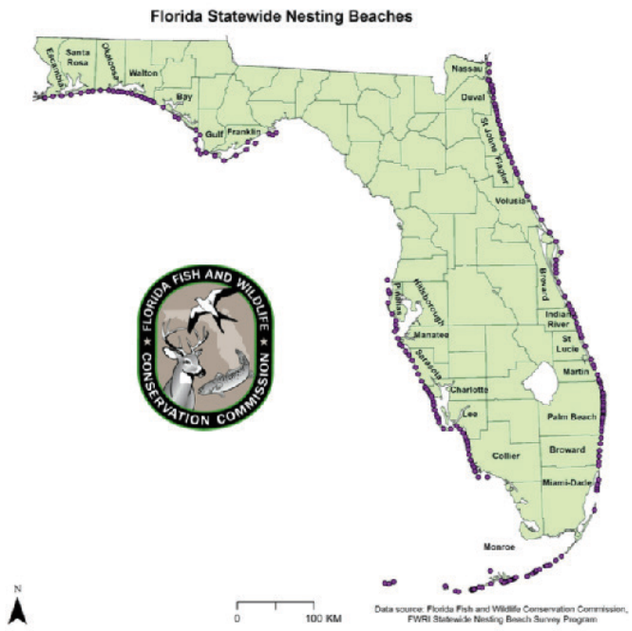


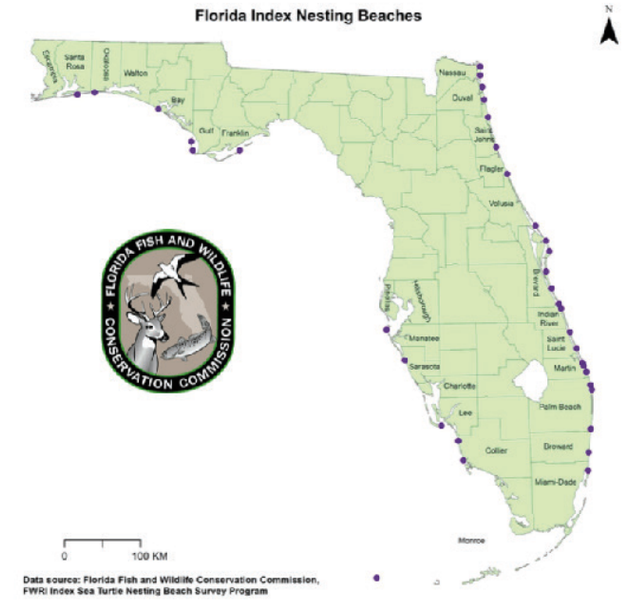
Next in terms of relative nest abundance are the green turtles, named for their internal coloration resulting from a primarily herbivorous diet of seagrass and algae. Green turtle nesting in Florida was pretty rare when the surveys began in the











Loggerhead (top), green (middle) and leatherback (bottom) nesting trends since 1989. These data represent a subset of the total number of nests from 36 representative beaches (see map bottom right) and are used solely for trend analyses. All together, over 800 miles of Florida's coastline is monitored for sea turtle nesting activity Source: Florida Fish and Wildlife Conservation Commission.

late 1980's, but gradually picked up throughout the following decades until some big changes started happening around 2012. Researchers were familiar with the alternating 'high vs. low' bi-annual nesting pattern that green turtles seemed to adhere to, but it's safe to say nobody expected the dramatic record turnout experienced in 2013, which was only to be eclipsed in 2015, 2017, and most recently, 2019. It seems clear that Florida'a green turtle populations have regained a solid foothold, and it will be exciting to see what the next decade brings for them.

2019 Statewide Nesting Totals:

Loggerheads: 106,652
Greens: 53,015
Leatherbacks: 1,105

Last in our list of nesters, but certainly not least, are the leatherbacks. When we say not 'least', we mean it: as sheer bulk goes, they win! Nesting females typically exceed 800 lbs., may reach 1500 lbs., and often end up around 6-8 feet long. The leatherback nesting numbers in Florida are on a smaller scale than those of the other two species, but nonetheless reveal an overall increasing trend in nesting activity, albeit highly variable, over the last 30 years, particularly since 2000. Though Florida's leatherback nesting population is important in this part of their range, it remains a relatively small contribution to Atlantic populations in comparison to nesting rookeries in lower latitudes throughout the Caribbean.

So, how did 2019 turn out? The numbers are in! There were a grand total of 106,652 loggerhead nests, 53,015 green turtle nests, and 1,105 leatherback nests counted in Florida last year. Per the overall trends, these numbers represent a fairly average year for loggerheads and leatherbacks, but as expected, another record year was achieved for the greens. Though these numbers may sound really impressive, it's important to remember that they don't tell the whole story; the net production of offspring is based on their overall success, not the number of nests originally produced. Rates of hatchling survivorship through to maturity are hard to estimate, but it's agreed that it's pretty low, so we do what we can to maximize their chances of making it through the incubation and dispersal processes while we have them under our care.

In an effort to help them along, the organizations that document the nests also have the opportunity to identify issues or challenges either the eggs or the hatchlings may encounter. Though little can be done in response to major natural events such as hurricanes, there are steps that can be taken to address areas that experience excessive destruction of nests by natural predators, or areas where excessive coastal lighting causes hatchlings to become disoriented and lose their ability to find the surf. A number of sea turtle rehabilitation facilities, aquariums, and other institutions are also available for people who may find hatchlings washed ashore, many of which recover quickly and get re-released into offshore habitats. Taken together, Florida's sea turtle programs have made measurable progress, but considerable work still needs to be done to ensure the future of these populations. Given what's been done so far, I think we're up to the task.

NSTSTF Sponsors Broward County Waterway Cleanup

Kelly Flanagan,
NSTSTF Social Media Coordinator

The ***National Save The Sea Turtle Foundation*** sponsored the 43rd annual Broward County Waterway Cleanup Kick-off Party at the Marine Industries Association office in Fort Lauderdale on Thursday evening, February 6 at 6:00pm. Guests enjoyed complimentary drinks and light hors d'oeuvres, and this year's artwork created by Steve Diossy was unveiled. The 43rd annual Broward County Waterway Cleanup, which was held on Saturday, March 7, is organized by the Marine Industries Association of South Florida and Marine Industry Cares Foundation. The event is the County's largest and longest-running environmental event. The Foundation has been a proud sponsor of the event since 1994.

The *National Save The Sea Turtle Foundation* is Proud to Support the Following Organizations

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Southeast Regional Sea Turtle Meeting
Trout Lake Nature Center
University of Central Florida
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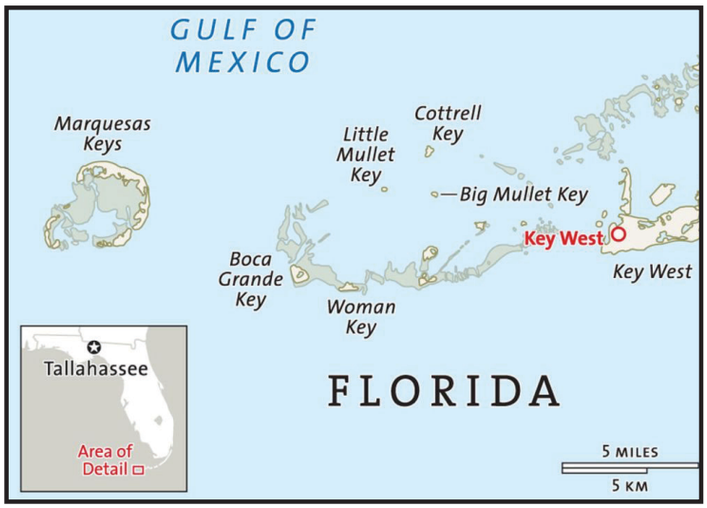
U.S. Geological Survey

National Save The Sea Turtle Foundation Provides FFWCC Transport to the Marquesas Keys

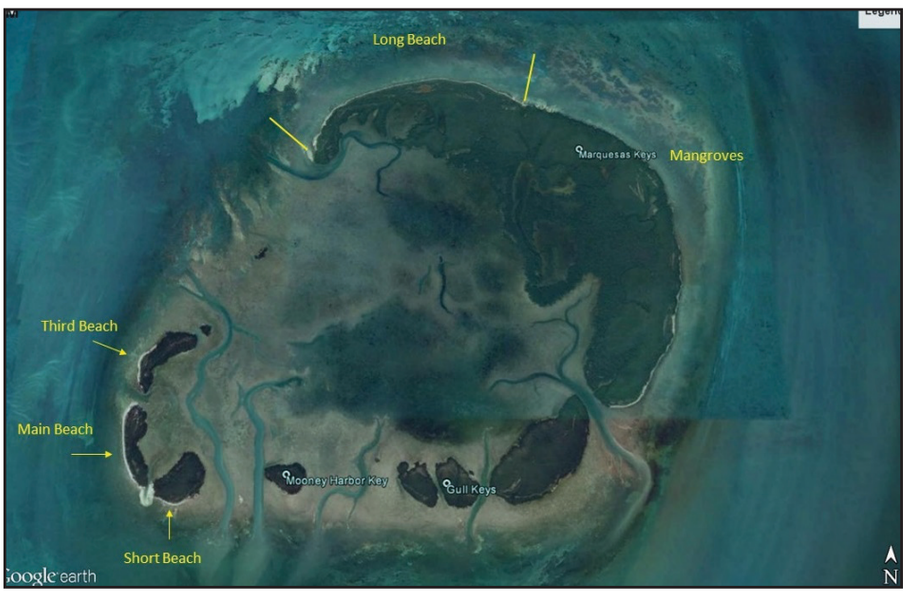
Sue Schaf, Biologist,
Marine Turtle Program
Florida Fish & Wildlife Conservation Commission



The 2019 nesting season proved to be one of the busiest seasons for the Marquesas Keys, especially for green turtles. With the continued help of the ***National Save The Sea Turtle Foundation*** and their Captains Mike Osborne and Troy Phillips, we were able to record this amazing nesting year.

The season was challenging, green turtles were crawling through older nests and even accidently digging up some earlier nests due to the concentration of crawls in certain areas of the beach. The first green nest was found on May 15 on Long beach. This is the earliest recorded green nest in the Marquesas! Loggerhead numbers were not as high this season as last season. The first loggerhead nests were found on May 7 on Main beach.

The Marquesas are a circular chain of islands approximately 30 km west of Key West. Tidal flats border the predominantly narrow beaches which also can be easily inundated with water during storm events. That being said, it is one of most beautiful and peaceful places to visit, and is an active nesting area for both loggerhead and green turtles. These beaches had been surveyed for nearly three decades by the Key West National Wildlife Refuge, but the Refuge is no longer able to conduct surveys. The loggerhead and green turtle populations nesting at the Marquesas are of particular interest due to their genetic differences from other populations in Florida; thus, the Florida Fish & Wildlife Conservation Commission (FWC) attempted to take up the survey for the 2018 nesting season and beyond. Because the Marquesas Keys are remote and difficult to reach, and FWC did not have adequate boat transportation to cover the 40-mile round trip from Key West, FWC reached out to the Foundation for assistance. The Foundation's Research Vessel, *Hawksbill II*, turned out to be the perfect mode of transport to get to the islands, so Captains Mike and Troy were at the ready. In 2019, three beaches were monitored in the Marquesas: Long beach, Main beach and Third beach (see map).



Nest Totals:

Third beach – **Loggerhead: 6**
Green: 0

Main beach - **Loggerhead: 13**
Green: 25

Long beach - **Loggerhead: 8**
Green: 50

Captain Mike Osborne (above) gets ready to release hatchling turtles from the ***National Save The Sea Turtle Foundation's*** Research vessel *Hawksbill II* (left) that were retrieved by FWC personnel at the Marquesas Keys (below left). The Marquesas host genetically distinct populations of green and loggerhead turtles that nest there each year.

The "Ghost of Halloween"

Leucistic Hatchling Captures the Hearts of Thousands

Heather D. Clarchick,
Conservation Program Manager, Sea Turtle Adventures, Inc.

Sea Turtle Adventures, Inc. has been monitoring a three-mile section of beach in Palm Beach County for sea turtle nests for over 20 years. We have assisted with many rescues, salvages, and have encountered our fair share of hatchlings with anomalies including an abnormal number of scutes, lack of color, and head and jaw abnormalities.

On November 1, 2019, Margie Talbott, a 10-year sea turtle nest monitor with Sea Turtle Adventures, Inc., was excavating one of the remaining green sea turtle nests on Gulfstream Public Beach in Palm Beach County. Three days after the nest hatched, Margie performed a nest productivity assessment. After removing 83 hatched eggs and 14 unhatched whole eggs, Margie saw something moving within the wall of the nest cavity. After carefully removing the surrounding sand, she gently pulled a green sea turtle hatchling from the nest. "He was big, easily the size of a leatherback hatchling. He had slits where his eyes should've been, but he didn't have any eyes" Margie told me. The hatchling was also white. Contrary to what she first thought, this wasn't an albino hatchling.

Albinism is a congenital (from birth) disorder characterized by the complete absence of pigmentation or coloration (produced by melanin) which results in white scales and skin and red eyes in reptiles. The skin's lack of pigment appears almost clear, most notably as seen through the limbs. Albinism is also an autosomal recessive trait, meaning that two copies of the abnormal gene (one from each parent) must be present for the trait to develop. When this occurs, typically several of the hatchlings in the nest exhibit the trait. In this case, only one hatchling was found in the nest. Upon closer examination, the hatchling did not appear to exhibit the true lack of pigmentation typical in albinos. The hatchling also exhibited additional facial structure abnormalities that helped rule out albinism and rather identify the anomalies as deformities that occur early on in development.

The white hatchling was taken within the hour to Gumbo Limbo Nature Center in Boca Raton, Florida. At Gumbo Limbo Nature Center, the hatchling was brought into their rehabilitation center where it was admitted to the Sea Turtle Rehabilitation Facility. The medical team noted the melanin disorder, jaw deformity, and an ocular deformity, later identified as Microphthalmia. Microphthalmia, an ocular developmental disorder, can occur in one, or both eyes causing them to be unusually small. The melanin disorder was identified as *leucism,* which is characterized by reduced pigment production. Leucism occurs due to a genetic mutation which creates the color anomaly. Environmental factors may also impact the occurrence of this disorder. Other than these abnormalities, the hatchling was like any other, and received the same supportive care as all admitted hatchling sea turtles. Sadly, the hatchling died within a week of being at Gumbo Limbo Nature Center, and was preserved. Prior to its passing though, the hatchling turtle stole the hearts of thousands on social media who often asked if they could visit the hatchling or receive daily updates. On Facebook alone, the story of this hatchling reached 41,000 viewers. What an excellent way to spread awareness of sea turtle conservation and biology!

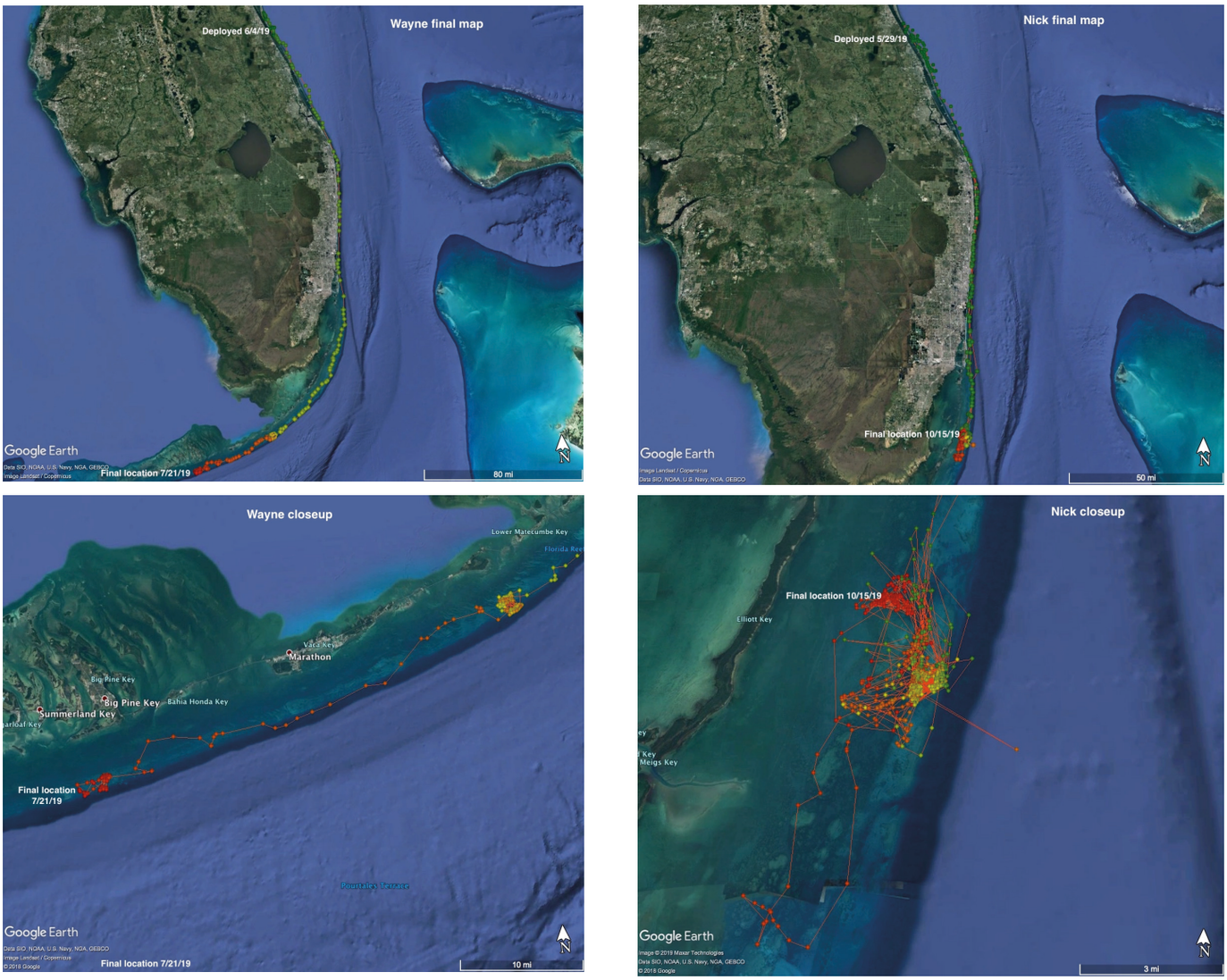
The preserved hatchling was given to Dr. Jeanette Wyneken, a professor at Florida Atlantic University, for additional research.

Research

Update: Tracking Male Green Sea Turtles in SE Florida

By Dean Bagley, Research Associate, University of Central Florida Marine Turtle Research Group and Vice President, Inwater

The ***National Save The Sea Turtle Foundation*** generously provided two satellite transmitters in 2019 for tracking male green turtles from the Brevard County portion of the Archie Carr National Wildlife Refuge where the University of Central Florida Marine Turtle Research Group has been working since 1982. Those transmitters were dedicated to and named for two Foundation team members, the late Captain Nick Reeves and key fundraising team member, Mr. Wayne Kurian. The purpose of this project is to learn about the behavioral aspects of male green turtles during the breeding and nesting seasons, to follow them through their migration to their foraging grounds and to identify those foraging areas. Once they are "home" we can also calculate their home range. Because they are so seldom seen, even by researchers, basic data like morphometrics are lacking. This study adds to the knowledge base each year they are encountered. The initial deployments and first few weeks of travel were described in an article in a recent issue (Vol. 11, Issue 2) of Outreach Magazine. This article recaps that information and continues their stories. In the maps below, each dot represents a GPS location received. These are accurate to within 20-70 meters, depending on how many satellites (4-10) were involved in determining that location. The colors represent the timeline, and change gradually from dark green to lighter green, to yellow-green, to yellow, yellow-orange, to orange, red-orange and finally the most recent locations are in red. The gradual changes to each color represent approximately 2-3 weeks.



Sea turtles often migrate between foraging and reproductive gounds, so the question was where the male green turtles may go after the breeding season was over. The above maps resulted from data collected from two male green sea turtles that were initially tagged in Brevard County during the breeding season. Both headed for the Florida Keys.

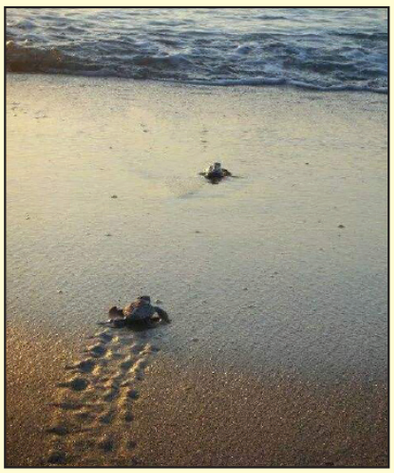
The first of our two turtles (Nick) was encountered as part of a mating pair, detained for satellite attachment and released about dawn on 5-29-19. Upon release, he immediately began swimming south, and continued beyond the 17th St. bridge in Vero Beach before turning around on 5-30-19 and returning to north of Sebastian Inlet, where he remained within 4.5 km of the inlet until 6-4-19. At that time he began swimming south again, hugging the coast until he reached Elliott Key, at the south end of Biscayne Bay on 6-9-19. About 24 hours later he started back north, and continued until he reached Jupiter Island (6 km north of Jupiter Inlet) on 6-13-19, turned around and began his migration south, back to Elliott Key, arriving on 6-17-19. (This part of his migration is all of the dark green dots). This is a behavior that we haven't seen previously, and one cannot imagine why this turtle, after reaching his foraging location, would spend the time and energy to make a 175 km one-way trip (more than halfway back to his deployment location), only to return immediately. It took an additional week of swimming for him to accomplish this round trip. Once he was back in his foraging area, he set up a beautiful night and day pattern (light green and yellow dots), sleeping on the reef at night and foraging in shallower Hawk Channel waters during the day, that lasted until 8-1-19. He made several small exploratory loops, to the west (8/15/19), north (9/3/19 to 9/4/19, 9/16/19 to 9/17/19) and to the south (9/5/19, 9/6/19 to 9/7/19, 9/8 to 9/15, 9/18/19 to 9/20/19), each time returning to the core area he'd been using. Then from 9/22/19 to 9/24/19 he made a large loop to the south, before returning to the core area and continuing on to the north and west, where he remained until his transmitter was lost on 10/15/19. It seems as though he was content until the beginning of August, then began searching for something. Once he moved north, it appears that he

found whatever that might have been. Our best guess is that is was a better foraging area, with more of his favorite foods. Nick was tracked for 147 days and traveled a straight-line distance of approximately 294 km, from his deployment location to the original core area at his foraging grounds. (And then he made that 350 km round trip to Jupiter and back).

"Wayne" was one of several adult male green turtles that were fitted with satellite tracking devices in Brevard County. He, like the others, headed for the Florida Keys after the nesting season.

The second of our two turtles (Wayne) was also encountered as part of a mating pair, detained for satellite attachment and released on 6/4/19 at about 5:30 a.m. Upon release he swam immediately north, about 18 km (his furthest point north) and then backtracked to about 13 km north of the deployment location. He spent his entire time while tracked at the nesting beach within a 4 km area between Satellite Beach and Indialantic. On 6/8/19 he began swimming south, passing Sebastian Inlet on 6/9/19 and continuing south along the coast until 6/20/19 when he stopped overnight south of Tavernier. Continuing on, he reached an area south of Craig Key, which is approximately 5 km north of Layton, FL on 6/22/19. Like, Nick, he immediately set up a very obvious pattern of sleeping on the reef at night and foraging in shallower Hawk Channel waters during the day. He kept this pattern until 7-8-19 when he began meandering southwest, stopping overnight about 5 km away, before continuing his journey. He traveled about 64 km to an area due south of Big Pine Key on 7/13/19, explored the area and began setting up his day-night pattern. A week later he began moving around again, then made his way about 2 km west. He traveled another km or so before his transmitter came off on 7/21/19 in an area of Hawk Channel, presumably while he was foraging. Wayne was tracked for one of the shortest durations in our study at 47 days. During that time, he traveled a straight-line distance of 339 km from his deployment location to his first foraging area south of Craig Key. From there, he moved another 68 km southwest to his subsequent foraging area south of Big Pine Key.

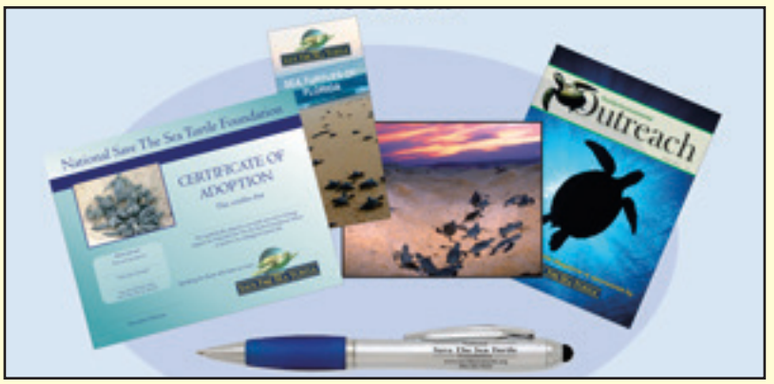
We plan to continue learning about male green turtles—the lesser-known segment of the green turtle species—and to try to fill some of the data gaps regarding males. To date, we have learned that our tracked males have all left Carr Refuge waters by the first week in July, and that most males have shown us new foraging areas; places that were not widely known as green turtle foraging spots prior to tracking. Samples taken for stable isotope analysis have provided isotopic signatures used in a recent Master's thesis and soon-to-be-released publication, and are being used in a larger statewide study. Plans are underway to track additional males in the upcoming season.



ADOPT A NEST

You can help the ***National Save The Sea Turtle Foundation's*** education, protection, and public awareness programs by symbolically adopting a sea turtle nest. You'll receive a Certificate of Adoption, a subscription to Florida Environmental Outreach Magazine, and other fun surprises!

*Proceeds from **The National Save The Sea Turtle Foundation's** **Adopt-A-Nest** Program directly support the Broward County Sea Turtle Conservation Program. Adopt a nest today! www.savetheseaturtle.org*



Study Examines Survival Rates of Green Sea Turtles with Fibropapillomatosis in Rehabilitation Facilities

Date: January 22, 2020
Source: Florida Atlantic University

Caused by a herpesvirus, fibropapillomatosis (FP) is the most significant infectious disease affecting sea turtle populations worldwide. It is widespread in warmer climates like Florida, where almost 70 percent of sea turtles in a population have FP in some places. It has been documented in the Caribbean, South America, Hawaii, Japan, Australia, and beyond. The disease leads to the formation of tumors on the turtles' eyes, flippers and internal organs, which often debilitate them by inhibiting feeding and movement, obscuring vision, and/or leading to organ failure.

FP is of major concern in sea turtle rehabilitation facilities and requires extensive quarantine measures to accommodate infected turtles. Even after surgical removal, there is still potential for tumor regrowth since the underlying associated herpesvirus infection remains dormant. These clinical factors, along with the infectious and potentially life-threatening nature of FP, complicate prognoses and extend rehabilitation times of sea turtles diagnosed with this disease.

Annie Page-Karjian, D.V.M., Ph.D., a researcher from Florida Atlantic University's Harbor Branch Oceanographic Institute and collaborators, conducted a large-scale, retrospective case series review evaluating tumor score, removal and regrowth in rehabilitating green sea turtles with FP in four rehabilitation facilities in the southeastern United States from 2009 to 2017.

The objective was to assess FP tumor score and regrowth and provide information on tumor regrowth and survival in turtles with different tumor scores. Applying a standardized method for quantifying and qualifying the extent of the disease is necessary to objectively understand the various clinical manifestations of the disease.

Results of the study, published in the journal Diseases of Aquatic Organisms, showed that the majority (75 percent) of the turtles with FP did not survive following admission into a rehabilitation facility, irrespective of whether or not tumor regrowth occurred following surgery. FP is of greatest concern in juvenile sea turtles in nearshore habitats. All of the green turtles with FP in this study were classified as juveniles.

Of the 756 cases, 312 (41 percent) underwent tumor removal surgery, 155 (50 percent) of those had tumor regrowth within an average of 46 days, and 85 (27 percent) had multiple (more than one) regrowth events. Of the 756 turtles with FP, 283 (37 percent) were euthanized and 280 (37 percent) died without euthanasia. Of the 756 turtles with FP, 193 survived, including 186 (25 percent) that were released and seven (1 percent) that were placed in permanent captive care.

"Evaluating cases of rehabilitating wildlife can be an extremely valuable approach for improving our understanding of pathogen activity in both captive and free-ranging wildlife, and for developing recommendations for treatment and management of important wildlife diseases," said Page-Karjian, senior author, an assistant research professor and clinical veterinarian at FAU's Harbor Branch. "Results from our study could help guide clinical decision-making and determine prognoses for rehabilitating sea turtles with fibropapillomatosis."

Tumor removal surgery increased the odds of tumor regrowth, but also enhanced survivorship, whereas tumor regrowth was not a significant predictor of case outcome. Three FP tumor-scoring systems were used to assign tumor scores to 449 cases, and differing results emphasize that tumor-scoring systems should be applied to the situations and/or location(s) for which they were intended. FP tumor score was not a significant predictor for the event or extent of FP tumor regrowth after surgical excision.

"Internal tumors or severe fibropapillomatosis irreversibly diminishes an animal's well-being and ability to survive," said Page-Karjian. "Application of the appropriate scoring system coupled with rigorous triage and admission criteria for stranded turtles with this disease can effectively help reduce facilities' burden in terms of rehabilitating fewer turtles with poor prognoses."

In situations of limited resources, and taking into account any co-morbid conditions, focusing rehabilitation efforts on turtles with lower tumor scores (i.e. one to two) will help further streamline admission and triage of turtles with FP in rehabilitation facilities, and lead to higher rehabilitation success rates.

Study collaborators represent Loggerhead Marinelife Center in Juno Beach; The Turtle Hospital, in Marathon; Clearwater Marine Aquarium in Clearwater; the Sea Turtle Healing Center at Brevard Zoo in Melbourne; and Georgia Sea Turtle Center/Jekyll Island Authority, in Jekyll Island, Georgia.

This project was funded in part by a grant awarded from the Sea Turtle Grants Program, which is funded from proceeds from the sale of the Florida Sea Turtle License Plate.

Story Source:
Materials provided by Florida Atlantic University. Original written by Gisele Galoustian. Note: Content may be edited for style and length. ScienceDaily. ScienceDaily, 22 January 2020. <www.sciencedaily.com/releases/2020/01/200122135304.htm>.

This green turtle has a heavy load of FP tumors around the base if its flippers. The tumors reflect unchecked cellular growth associated with a herpesvirus infection. Photo: D. Duffy, Whitney Lab, University of Florida.

Southeast Regional Sea Turtle Meeting Held in Corpus Christi, Texas

Larry Wood, Ph.D.

In response to a need for a formal venue in which researchers representing the southeastern region of the United States could share their findings, a group of scientists and volunteers came together in 2011 to create the Southeast Regional Sea Turtle Network (SERSTN). The Network aims to offer a biennial meeting for volunteers, students, and professional researchers that provides a friendly and informative atmosphere to share their ideas and discoveries. This meeting focuses on the presentation and exchange of scientific research from diverse disciplines conducted on the beaches and waters of the southeastern United States from Texas to Virginia, including the US Virgin Islands and Puerto Rico.

This year's meeting, held in Corpus Christi, Texas, was themed "Exploring New Frontiers". The meeting showcased new areas of research and conservation efforts for sea turtles in the southeast U.S., especially concerning the vast coastline of Texas. The program featured interesting Workshops, Keynote Speakers, and Invited Presentations, and a Special Session about past, present, and future research and conservation efforts in Texas.

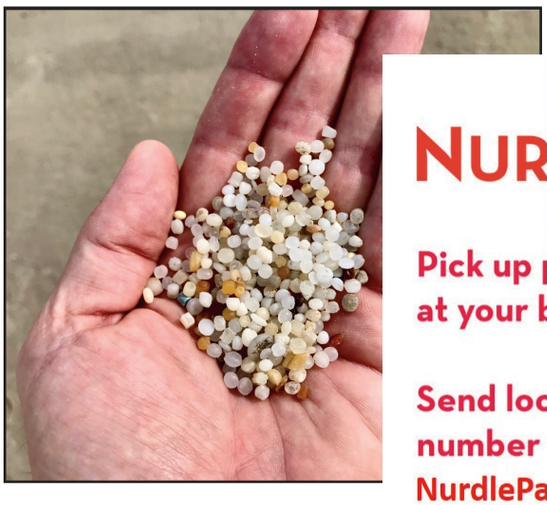
Workshop topics spanned a wide range of topics relevant to sea turtle conservation and research. Back by popular demand, there was an all-day workshop on Sea Turtle Health and Care, organized and led by Dr. Terry M. Norton, DVM, Dipl. ACZM and Director, Veterinarian, and Founder of the Georgia Sea Turtle Center. There were also half-day workshops focusing on Women in Science, Grant Writing, Social Science Survey Design, and Predator Management.

Three informative and inspirational Keynote Presentations were the highlights of the meeting. On Wednesday, February 5th, we heard from Dr. Thane Wibbels, Biology Professor at University of Alabama at Birmingham. Thane's distinguished career has included four decades of focus on sea turtle research and conservation. He has been a first-hand witness to, and integral part of, the evolution of Kemp's ridley conservation in the Gulf of Mexico. His talk was an entertaining and informative history of our understanding of the Kemp's Ridley sea turtle, which remained one of biology's most perplexing mysteries up until the 1960's when a series of discoveries shed light on it's unusual life history.

On Thursday, February 6th, there was a combined Keynote presentation focusing on efforts by Texas-based researchers working to quantify and educate the public about marine debris. The first presentation was by Christine Figgener, a Ph.D. student at Texas A&M University, who changed the world with a single video that she recorded of her research team removing a plastic straw from the nares of an olive ridley. This video and Christine's associated public education efforts led to a worldwide movement to eliminate the use of plastic straws and many accolades for Christine. Her presentation focused on the importance of our daily choices concerning plastic products.

Following her presentation, we heard from Jace Tunnell, Reserve Director at the Mission-Aransas National Estuarine Research Reserve at the University of Texas Marine Science Institute in Port Aransas, Texas. Jace has produced and directed more than 100 short videos about science, nature, and research. He has served on over 20 science and environmental committees across the United States, and has received several awards for his work. Jace's presentation focused on his Citizen Science 'Nurdle Patrol', the impacts of plastic pellets on sea turtles, and the future direction of the program. Yes, you read that correctly, nurdle. Turns out, 'nurdles' are the small plastic pellets that are used for the manufacture of plastic products. Essentially these make up the 'raw material' that eventually becomes everything from lighters to whiffle balls. To provide some sense of scale, it takes about 1000 nurdles to make a bottle of soda. Unfortunately, these pellets make their way by the hundreds of millions into the environment and add to the ongoing concerns of microplastics entering the food chain.

All-in-all the meeting was a great success; over 350 registrants were treated to a series of excellent talks, workshops, social events, and attractions surrounding the Corpus Christi area. We look forward to the announcement of the next meeting! The ***National Save The Sea Turtle Foundation*** is a proud sponsor of the Southeast Regional Sea Turtle Meeting.



"Nurdles" are tiny pellets of raw plastic that are transformed into innumerable products from plastic bags to water bottles. They escape into the environment and add to concerns of plastics entering the food chain.

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For more information about the Southeast Regional Sea Turtle Network, visit:

www.SERSTN.org

Essay

In Praise of Instincts

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In 1758, Carl Linnaeus invented the naming ("binomial", or two name) system we now use to identify, and to order the relationships between, the species of living creatures on this planet be they mouse, red wood tree or bacterium. He named us Homo sapiens, or wise human, but speaking objectively it seems strange to call a creature that is best characterized by its arrogance, aggressiveness, and utter disregard for the laws of nature governing the survival of life on this planet (including his own), "wise"! Yet here we are at an environmental cross-road, trying to muster the courage to actually plan ahead, avoid our much expressed tendency to favor short-term profits, and start behaving rationally not only for the sake of future generations but also for other living creatures.

For the student of animal behavior (I'm one of them!), a major example of human arrogance is our willingness under these circumstances to classifying ourselves as rational creatures whose behavior is dominated by "learning", and the rest of the animal kingdom as composed of critters whose lives are dominated by "instinct". More scholars than I have room to mention have made clear that such a simplistic, dichotomous behavioral classification is based upon philosophical and theological precepts, not scientific evidence, and furthermore is a false narrative. Strangely enough, this framework arose because humans are preoccupied with the "meaning of life" and the fear of death, which has led to a hope for an afterlife. That preoccupation, in turn, led to the concept of "soul", conceived by philosophers and theologians as the entity that actually lives on after we pass. This concept was further embellished by specific rules; if we had led a "rational" and "ethical" life, our soul would survive and if we didn't, it suffered an abominable existence. Animals were excluded because they were incapable of thinking rationally (that is, of learning to distinguish between good and evil). Eventually, that view was modified when it became apparent that animals can indeed learn some things! It was just that they didn't think rationally enough to qualify for an afterlife.

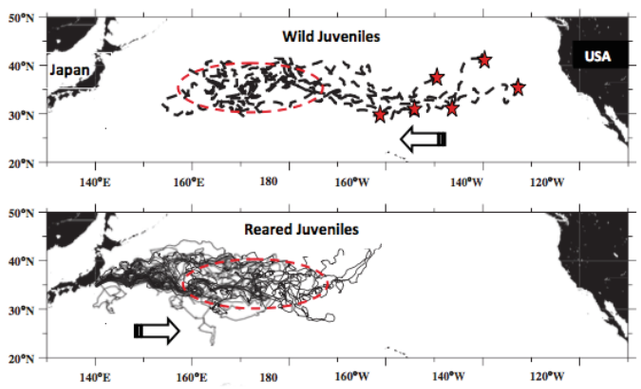

Figure 1. Track lines of (above) six Pacific juvenile loggerhead turtles caught by fishers on the east side of the basin, then released where indicated by the red stars. These turtles swam west to reach the KEBR (dashed circle). Below, paths of 37 juveniles loggerheads raised for 1-3 years at a Japanese aquarium, then released in the ocean. These turtles swam east to reach the KEBR. (After Polovina and colleagues)

At some future date, I'll write an essay that addresses these and related issues but for now, my purpose is to explain that instincts have been given a bum rap as somehow of less significance, complexity or importance than an ability to learn. I hope in this essay to convince the reader that instincts can be complex, magnificently adaptive in promoting the survival of the animals that possess them, fascinating to study, and of great complexity, so much so that while we may be able to describe them, we don't really understand how they work in the brain. That's also pretty much the state of our knowledge when it comes to how learning and how memories are stored, though far more progress has been made in that direction. In any event, I'll once again refer to our favorite animal, the marine turtles, to illustrate the magnificence, beauty and complexity of their instinctive behavior and how they use innate mechanisms to find their way to optimal locations within ocean basins that to humans, appear featureless. I hope that after reading about these achievements, you'll agree that instincts can be a source of wonder and amazement that functionally, rivals the utility of learning for solving problems of survival in a hostile world.

Finding the North Pacific Feeding Grounds

A substantial, though somewhat smaller, population of loggerhead sea turtles is present in North Pacific waters and in many ways, shows migration patterns that with age that resemble those we see locally in our North Atlantic population. For example, Pacific loggerheads nest primarily on the west side of the basin, specifically in Japan. Our turtles also nest on western shores and while they favor Florida, a minority nest elsewhere in the Caribbean. When the hatchlings depart from Japanese nesting beaches, they head east for offshore oceanic currents that lead them into the North Pacific gyre; our turtles also swim east toward the Gulf Stream and are soon entrained within the North

Atlantic gyre. The gyre serves as a nursery area for both populations. Of course the Pacific Ocean basin is much larger than the Atlantic but that distinction probably means little to a juvenile loggerhead that none-the-less manages to find its way no matter what. North Pacific loggerheads, like their Atlantic brethren, grow into larger juveniles by taking advantage of feeding "hot spots" located on the east side of the basin, that is, off shore from the coast of California and Mexico. Our loggers spend several years feeding in the rich areas of eastern productivity adjacent to the Canary Islands and Madeira.

But in the Pacific, there's another, seasonally productive feeding hotspot located just above the equator that oceanographers call the Kurishio Extension Bifurcation Region (KEBR for short). It's a favorite foraging area for large marine predators (tuna, sharks, and loggerhead turtles!) and all of them make annual pilgrimages to that site **(Figure 1)**. But it's a long way from Japan and hatchlings, initiating their offshore migration, don't go there. There are several reasons. For one, the surface oceanic currents flow in the opposite direction and as hatchlings, the turtles are too small and swim too slowly to make any forward progress. For another, hatchlings leaving Japanese beaches are carried to the northeast by the gyre current, which eventually takes them across the Pacific at higher latitudes. But perhaps most important, it would be suicide for a hatchling to show up where large oceanic predators are concentrated! As juveniles, however, loggerheads are stronger swimmers, better able to defend themselves, and capable of making progress forward even when ocean surface currents flow in the opposite direction. Juvenile loggers, feeding in the coastal waters located west of Mexico, commonly swim west to the KEBR. They also take advantage of the favorable ocean currents that flow in that direction.

As a curious naturalist, you might ask "How does a juvenile turtle, having reached the eastern side of the Pacific Ocean, know where the KEBR is located, or even that it exists? One possibility is that it makes that determination as a consequence of entering the sea from coastal Japan, then being carried across the Pacific to the opposite side of the basin. Put another way, previous experience migrating for months across the Pacific might be required. It turns out, however, that's not true! The Port of Nagoya Public Aquarium routinely raises loggerheads from eggs hatched in their laboratory. The hatchlings are reared for public display but after 1-3 years, they are released back into the wild. Jeffrey Polovina and colleagues put satellite transmitters on 37 of these turtles, then plotted their movements. All of them swam due east, against the prevailing current (which slowed their progress, but they persisted!) and all the turtles eventually arrived at the KEBR **(Figure 1)**. Yet none of these turtles had as hatchlings been carried across the North Pacific to California and Mexico.

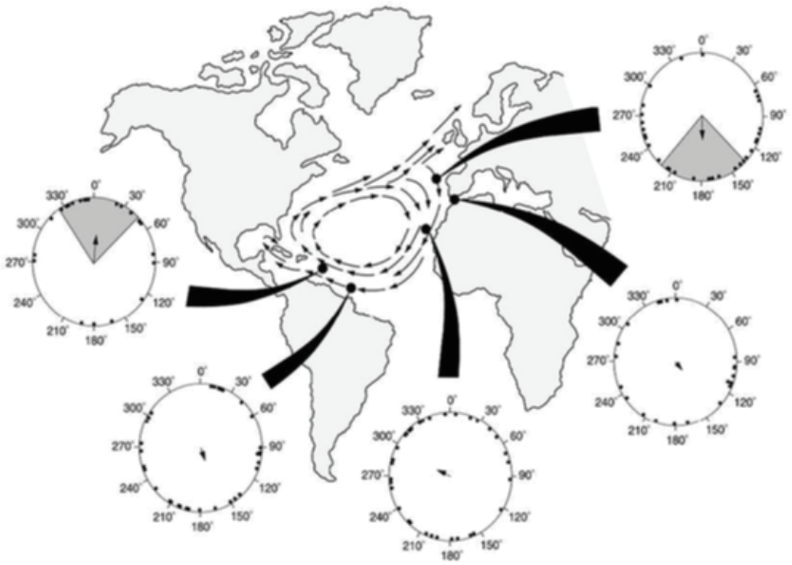

Figure 2. Diagrams showing how North Atlantic loggerhead hatchlings respond to the magnetic fields they would eventually encounter once they enter the North Atlantic Gyre, the circular current that serves as their "nursery grounds". In two of those locations (above right, just NW of Portugal; above left, just north of Columbia SA), the turtles orient strongly to the south or to the north, respectively (grey areas) to reduce the possibility of being displaced by bifurcating currents outside the gyre. When tested at the other locations, they show no orientation. Those responses suggest that the turtles discriminate between sites where they are "safe" and can drift passively, and those where they might be carried by currents into unfavorable locations and so swim in directions that minimize those possibilities. Yet these are hatchlings, tested before they have even entered the sea! (After Putman and colleagues)

Once at the KEBR, those turtles behaved exactly like 6 wild turtles that had been captured by fisherman on the east side of the Pacific, then released with satellite transmitters. They also swam (in the opposite direction!) to the KEBR (Figure 1). The inescapable conclusion: juvenile loggerheads raised in an aquarium possess a map of the Pacific Ocean that includes the location of the best foraging grounds - the "where". Their map apparently also contains instructions that tell them at what size/age to make the journey - the "when". None of these built-in instruc-

A loggerhead hatchling drifts along with a floating algae known as *Sargassum*. Even as hatchlings, sea turtles are able to recognize their position on the globe, and respond accordingly to remain in favorable locations. Photo: L. Wood

tions requires familiarity with or any previous experience migrating within the ocean itself, that is, any previous experience. The system is "built in" or innate, i.e. an instinct.

Site-specific Navigation, Even as a Hatchling

Additional results, consistent with these findings, have been recently described by Nathan Putman and colleagues who have carried out brilliant studies investigating the navigational abilities of North Atlantic loggerhead hatchlings. You may recall from a previous article in Environmental Outreach the experiments they did, showing that even hatchlings could navigate, that is, determine their exact location in the North Atlantic Gyre and orient in directions that promoted their continued retention in that current system. The gyre provides conditions that are favorable both for finding food and for growth.

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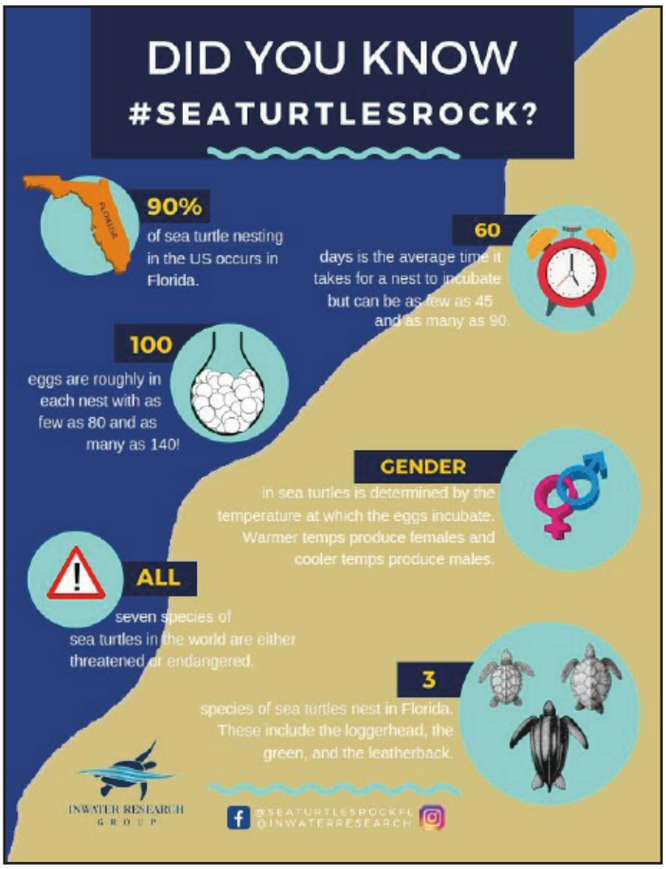
But more recent studies, at a finer spatial scale, show that the hatchlings can do much more; they actually anticipate and distinguish between locations within the gyre where the ocean surface currents are favorable or unfavorable for retention within the safety of the gyre **(Figure 2)**. In favorable locations, the turtles save energy by spending almost no time swimming in any one direction unless it's to find and to capture food; in the unfavorable locations, they show oriented swimming in directions that promote their transport away from dangerous locations, and toward locations where they can once again drift and save energy. Keep in mind that these responses are shown by hatchlings, immediately after they've emerged from their nest but before they've had a chance to crawl down the beach and enter the ocean. The conclusion: they have a complete, predictive and accurate picture of the world they are about to enter in exquisitely detail, even at that remarkably early stage of their development.

Conclusions

And so what do we make of these spectacular achievements? I think the answer is relatively straight-forward. Instincts represent one strategy for promoting survival in a hostile world, and are especially appropriate when for one reason or another, there isn't an opportunity to promote survival in other ways. A hatchling just doesn't have the luxury to risk its life trying to profit from experience, whereas an adult turtle that can defend itself certainly does, though whether such a capability is actually used or useful is another question. Other animals differ and, to varying degrees modify their behavior through experience but they are most definitely in the minority, both in number and in kind. Dependence upon learning is at this moment a radical and largely untested adaptation, characteristic of just a few species that have yet to pass the evolutionary test for longevity. So, is one solution "better" than or "superior" to the other? When it comes to promoting survival, probably not. And just in case you have doubts think about this: instincts have long been considered to be strongly influenced by genes - in fact, that's one of their defining characteristics. But recent studies show that what an animal learns, and when it most easily learns it, is also influenced by the animal's genetics. So, perhaps the two forms of adaptation, in terms of their underlying foundation, have more in common than we think. Under those circumstances, and until we know more, perhaps it's best to be humble!



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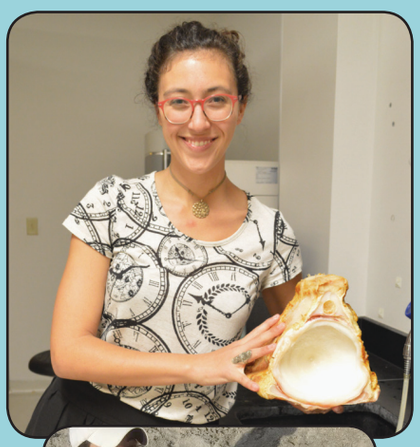

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