SWOT report

Volume XIII

The State of the World's Sea Turtles

特集：日本のウミガメ

SPECIAL FEATURE

Japan

INSIDE: PACIFIC LOGGERHEADS | FRENCH TERRITORIES | BYCATCH SOLUTIONS | AND MORE …

A hawksbill turtle feeds on soft coral in the Red Sea's Ras Mohammed Marine Park, Sinai, Egypt. © ALEXANDER MUSTARD/WWW.AMUSTARD.COM; FRONT COVER: A newly hatched green turtle in Okinawa Prefecture, Japan. © PETE LEONG I FOTOSHISA PHOTOGRAPHY

Editor's Note

Congratulations, but …

In contrast to the properly grim outlook of just a few decades ago, these are pretty good times for sea turtles. In a 2017 paper titled "Global Sea Turtle Conservation Successes," Antonio Mazaris and colleagues reported that published estimates of sea turtle populations tend to be increasing rather than decreasing globally. We have also seen the status of some species improving in recent Red List assessments led by the IUCN-SSC Marine Turtle Specialist Group, with both the leatherback and loggerhead improving to vulnerable globally (from critically endangered and endangered, respectively). Even the world's most threatened sea turtle species—the Kemp's ridley, which is still critically endangered—shows signs of a rebound (see pp. 32–33). Olive ridleys are smashing past abundance records at their arribada beach in Escobilla, Mexico, and *SWOT Reports* have shared many accounts of recovery, ranging from Michoacán black turtles (pp. 44–45), to the sea turtles of Japan (pp. 24–31) and Brazil, the Hawaiian honu, Cyprus greens, and loggerheads in Kyparissia Bay, Greece, to name a few.

Congratulations! Our sea turtle conservation movement can take pride in these gains as a direct result of our long and hard work on beaches, in labs, in board rooms and classrooms, at the desks of elected officials, and in innumerable conferences, multinational meetings, and community gatherings all across the globe.

But … the human hazards to sea turtles and healthy oceans are still out there, and some threats, such as climate change and pollution—for example plastics (pp. 42–43) and toxic runoff (pp. 8–9)—are clearly worsening, while others, such as bycatch (pp. 36–39), remain difficult to solve. And the juxtaposition of greater numbers of sea turtles and a growing human population in need of economic alternatives will bring back questions about what sustainable use is and how it will be measured, issues that our community must be prepared to address wisely.

The bottom line is that we cannot allow ourselves to become complacent about our successes or to believe for a moment that our job is done. The years ahead will require the same superhuman conservation effort that our movement has invested over the past half-century, and then some.

SWOT exists to strengthen our far-flung and diverse community, to better understand the globally ranging turtles we love, and to synergize our efforts around shared goals and priorities so that our collective conservation impact can be greater than the sum of our many disparate parts. In all aspects of our commitment to turtles, we will accomplish more together than apart.

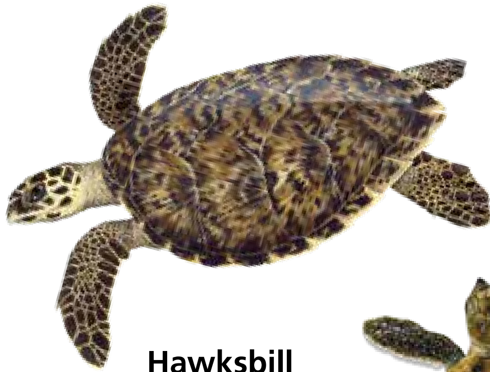
Thank you all,

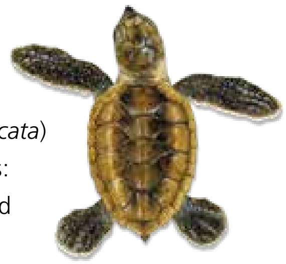
Roderic B. Mast
Chief Editor, *SWOT Report*

AT LEFT: An arribada at Ixtapilla, Michoacán, Mexico, a beach where mass nesting was unknown until 1997. Olive ridleys are nesting in record-breaking numbers throughout Pacific Mexico where they were once heavily exploited. © CARLOS SALAS

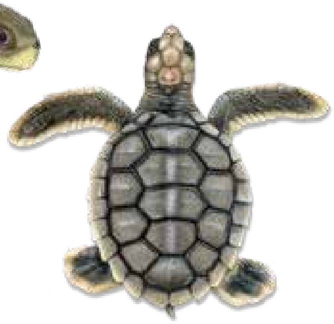
meet the turtles

The seven sea turtle species that grace our oceans belong to a unique evolutionary lineage that dates back at least 110 million years. Sea turtles fall into two main subgroups: (1) the unique family *Dermochelyidae*, which consists of a single species, the leatherback, and (2) the family *Cheloniidae*, which comprises the six species of hard-shelled sea turtles.



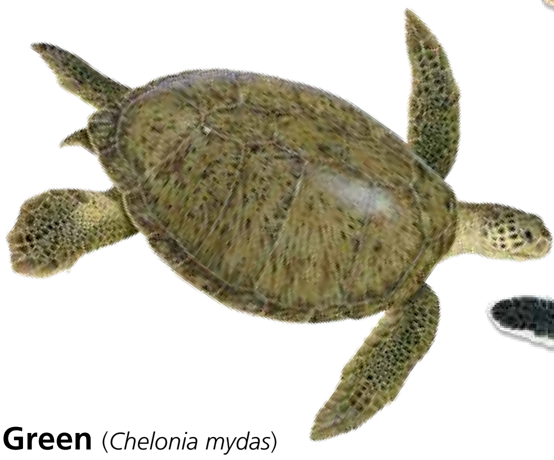


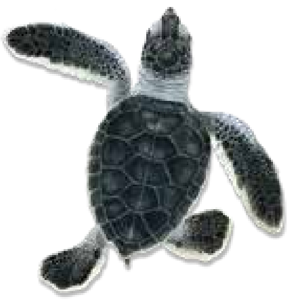
Hawksbill
(*Eretmochelys imbricata*)
IUCN Red List status:
Critically Endangered



Flatback (*Natator depressus*)
IUCN Red List status: Data Deficient

Kemp's ridley
(*Lepidochelys kempii*)
IUCN Red List status:
Critically Endangered





Green (*Chelonia mydas*)
IUCN Red List status: Endangered

Loggerhead (*Caretta caretta*)
IUCN Red List status: Vulnerable

Leatherback
(*Dermochelys coriacea*)
IUCN Red List status:
Vulnerable

Olive ridley
(*Lepidochelys olivacea*)
IUCN Red List status:
Vulnerable

Visit **www.SeaTurtleStatus.org** to learn more about all seven sea turtle species.

SWOT report
The State of the World's Sea Turtles

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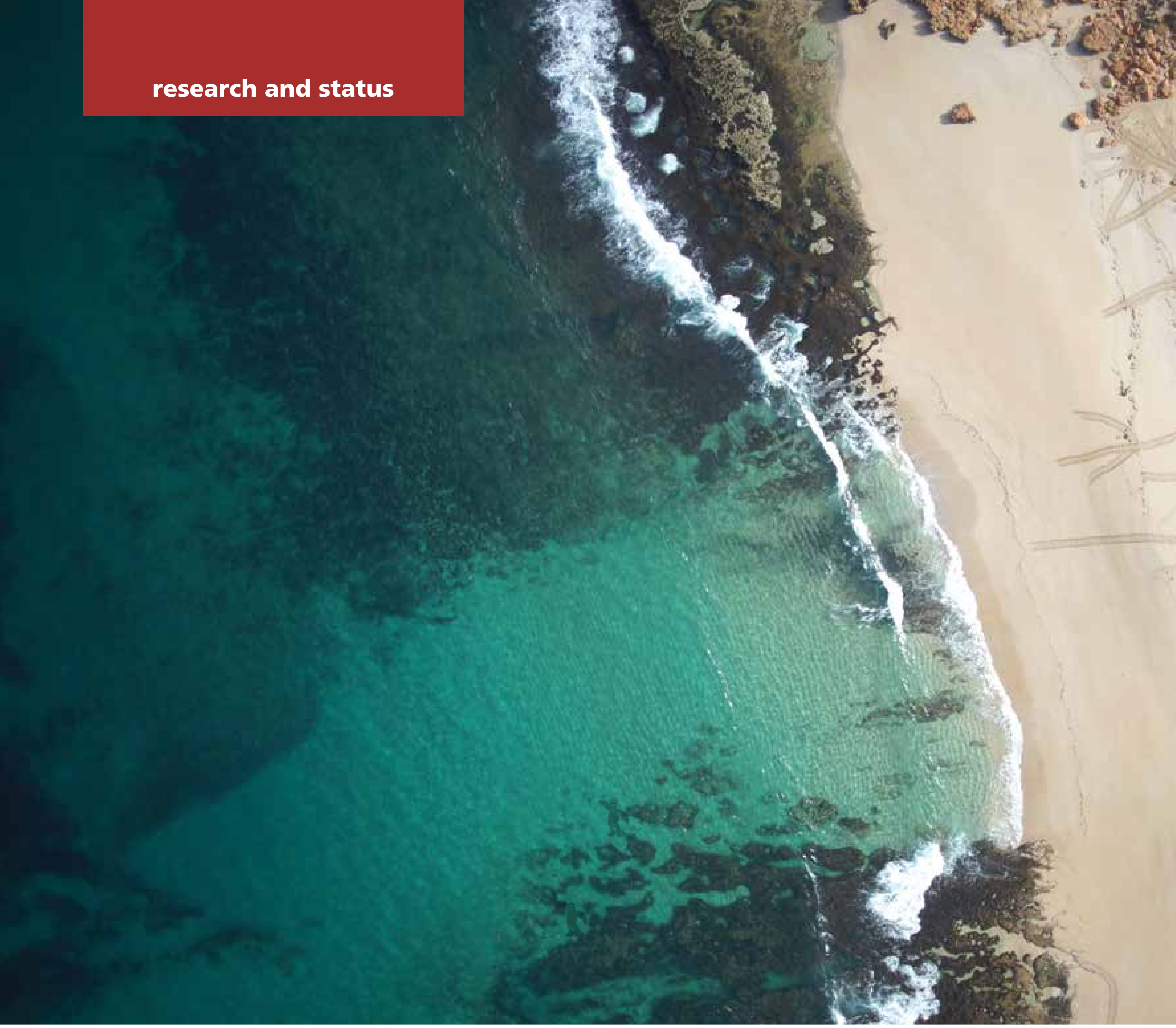
Find Mr. Leatherback!
Can you find all nine appearances of Mr. Leatherback's distinctive silhouette hidden throughout this issue of *SWOT Report*?



Rapid Assessment Tool

Helps Prioritize Nesting Beaches for Study and Protection

by NEIL COUSINS, ALAN REES, and BRENDAN GODLEY

Developers eyeing coastal locations for industrial ports, pipelines, hotels, or other major projects often need information quickly to make the best choices about where to site their projects for minimum environmental impact. Often there are little or no data available from long-term sea turtle monitoring to help inform these decisions, thereby forcing companies to take actions without fully knowing the potential hazards that projects may pose for sea turtles and their habitats. And sometimes, when data do exist, they can improperly bias decisions about where development should occur. Misinterpretations of such data may arise when turtle presence is assumed only for areas where data exist and "no data" beaches are incorrectly categorized as "no turtles" beaches.

Sea turtle tracks are visible on a remote beach in northwestern Australia. © ROB RYAN

Also, collecting field data can be slow and can require significant resources that may be lacking in project planning stages; there may also be a lack of local capacity to conduct studies, and sometimes a robust understanding requires seasonal data collection that does not align with developers' time lines. Often project decisions are postponed until robust levels of information are collected in line with a "certainty-oriented approach," thereby forcing developers ultimately to rely on strategies to minimize or restore and offset development impacts after the damage is done rather than to avoid impacts in the first place.

Data uncertainty requires more precautionary approaches that can be facilitated by rapid environmental assessments employing predictive analyses. Rapid assessment of priorities (RAP) initiatives have indeed become important in recent decades for a variety of conservation applications, from rainforest protection (for example, "hotspots" and other priority ecosystem approaches) to marine managed area definition.

Bluedot Associates, an international environmental consultancy in Bristol, U.K., has partnered with the Centre for Ecology and Conservation at the University of Exeter, U.K., to draw on best available current knowledge of sea turtles worldwide to develop the Sea Turtle Nesting Beach Indicator Tool. This software tool can rapidly assess and rank the value of beaches for their potential sea turtle nesting importance in areas where biological data are absent. The tool is designed for developers, consultants, and researchers to quickly determine the spatial extent of turtle nesting and the relative habitat value of different beaches where sea turtle nesting is possible but is poorly understood.

The Sea Turtle Nesting Beach Indicator Tool can rapidly assess and rank the value of beaches for their potential sea turtle nesting importance in areas where biological data are absent.

The simplicity of the tool was considered a core aim rather than a weakness, and it derives from a philosophy of forming raindrops to create waterfalls, which means creating small ideas that can cascade into something much more powerful in a way that is not always possible with complex approaches. The designers hope that this easy-to-use tool will promote better early-stage decisionmaking by developers whose projects may impact turtle nesting areas. In addition, the tool can be valuable for pointing to beaches that have high potential for conservation and academic research, and data from the tool can feed into strategic assessments for marine spatial planning at broader scales. The tool was developed to avoid overcomplicated approaches that may not add value to the aims of the user; as such, data can be collected by nonscientists and local networks with little training, thereby creating opportunities to engage communities and to develop their capacity to collect such data.

The tool is built around an Excel spreadsheet supported by an explanatory document in PDF form and therefore is easily shared and disseminated by email. It employs a scoring and rating system to assess (1) beach suitability, which is the potential for supporting a viable nesting population on the basis of habitat features, (2) human impacts, and (3) how these affect nesting beaches. The tool provides *indicative* rather than *conclusive* results on nesting potential; indications of poor suitability for certain beaches should not be used as evidence that there is no nesting. As such, the tool is useful in lieu of and supplementary to seasonal surveys that record the signs of nesting activity. In most cases, the indications generated by the tool should be followed up by more rigorous surveys performed by specialists because the tool does not collect biological or seasonal information, nor does it rely on long-term datasets.

We are seeking the best collaborative way to manage the information generated by the tool. By doing so, we can create new datasets, which could help developers make better decisions and could support sea turtle conservation locally, nationally, and internationally. We are also seeking collaboration and funding to develop field-based pilot studies. The Sea Turtle Nesting Beach Indicator Tool is available for free download at www.bluedotassociates.com; please use it and share your feedback with us. ■

Green Turtles

AS SILENT SENTINELS OF POLLUTION IN THE GREAT BARRIER REEF

by AMY L. HEFFERNAN, C. ALEXANDER VILLA, and CHRISTINE A. MADDEN HOF

Understanding the impact of chemical contaminants on turtles can inform turtle conservation and also can guide efforts to protect and conserve larger ecosystems. Northeastern Australian green turtles are excellent proxy indicators of the overall health of the Great Barrier Reef. Partners in WWF-Australia's Rivers to Reef to Turtles (RRT) project have spent the past four years studying the chemical profile and health impacts of pollutants found in green turtles in the hope of improving the way turtles and their habitats are monitored and conserved.

The Great Barrier Reef Marine Park, designated a UNESCO World Heritage site, covers 344,400 sq km (132,973 sq miles) along the coast of northeast Australia. It receives fresh water runoff from 35 river catchments from 424,000 sq km (163,707 sq miles) that transport sediments, nutrients, and chemical contaminants from agricultural, industrial, mining, and urban activities. Thousands of new chemicals are registered for use worldwide each year, often with minimal toxicological and environmental impact assessments. According to the Chemical Abstracts Service, a division of the American Chemical Society, 15,000 new chemicals are registered daily; that's one every 6 seconds, which makes maintaining up-to-date environmental contaminant databases incredibly challenging. The latest UNESCO report expresses "serious concern" for coral bleaching events on the Great Barrier Reef and highlights the role of water pollution as a key threat to the reef ecosystem. Whereas northeastern Australian waterways are monitored using water-quality and coral- and seagrass-cover assessments, currently, there is no mechanism to monitor the impacts of chemical contamination on wildlife. Green turtles are among the many iconic and vulnerable species found on the Great Barrier Reef, and they forage in coastal areas where they are exposed to complex mixtures of land-based pollutants.

Correlating environmental monitoring and biological samples from turtles is a major challenge. The relationships between external pollutant doses (for example, water, sediment, and seagrass), internal exposure (for example, blood concentrations), and subsequent toxicological and health effects in green turtles are poorly understood, yet establishing these links is critical to effectively inform Great Barrier Reef monitoring and management. The RRT project is a four-year collaboration among several university and research partners, led by WWF Australia with philanthropic support from Banrock Station Wines Environmental Trust. Now in its final year, RRT developed nontarget screening approaches combining environmental monitoring, turtle health, and toxicology to understand the effects of chemical contaminants on green turtles foraging in coastal Great Barrier Reef habitats adjacent to urban-industrial and agricultural-legacy mining activities. Turtles living in pristine offshore reefs served as a baseline for optimal turtle health.

During this study, coastal turtles were found to have elevated blood levels of multiple trace elements. Specifically, turtles from the agricultural site had cobalt levels up to 25 times higher than the healthy reference population and well within the range expected to cause acute toxicity. Additionally, a mixture of chemicals associated with human activities, including heart and gout medication, pesticides, and industrial sulfonic acids, were detected in coastal populations. Matched clinical results from the same animals showed signs of an active systemic disease in turtles from the urban-industrial site and a marked increase in inflammatory response in 44 percent of turtles from the agricultural site. Importantly, elevated cobalt, antimony, and manganese in the blood of these turtles were significantly correlated with clinical markers of acute inflammation and liver dysfunction. This finding was further supported by biomarkers of neuroinflammation and oxidative stress, including lipid peroxidation products. Ulcerative eye lesions were also observed in both coastal populations in years two and three.

Similarly, water-quality monitoring showed clear site-specific differences in metal and organic chemical profiles, but it only identified 13 pesticides, dominated by priority photosystem II inhibiting herbicides atrazine and diuron. Despite the suspected importance of incident sediment ingestion as a pollutant exposure source for foraging turtles, only trace levels of contaminants were detected in sediment.

Of importance was the wide range of exogenous compounds detected in turtle blood, thousands of which could not be identified. Of the compounds that could be identified, many were new chemicals and thus not included in routine Great Barrier Reef-monitoring programs. We currently know very little about the effects of these contaminants on the long-term health of green turtles. Moreover, the chemicals detected in water and sediment samples used for traditional (targeted) environmental monitoring were not reflected in the biological samples, and vice versa.

Green turtles have proven to be an accurate indicator of environmental health for their resident habitats in the Great Barrier Reef. Understanding the impact of chemical contaminants on marine turtles is paramount to effective species conservation, reef catchment restoration, and the continued health of the Great Barrier Reef, especially as coastal development including urban and industrial land use, ports, and expansion of agricultural practices is expected to increase the sources and diversity of contaminants released into the sea. We question whether existing environmental monitoring programs that analyze only targeted contaminants are adequate to address the combined toxicity of chemicals entering the Great Barrier Reef and its wildlife. Sea turtles can be used alongside other environmental measures as environmental sentinels to provide a more holistic overview of ecosystem health and an objective measure of anthropogenic impacts on the Great Barrier Reef. That is why, as the RRT project continues, we are developing a green turtle biomonitoring tool for use as a proxy indicator of wildlife and ecosystem health in the Great Barrier Reef and other coastal regions worldwide. ■

THIS PAGE: A researcher collects sediment samples for the "Rivers to Reef to Turtles" study. © GÖKSEL DOGRUER / WWF-AUSTRALIA; AT LEFT: A green turtle is released at Howick Island in Australia's Great Barrier Reef Marine Park after sampling for "Rivers to Reef to Turtles" biomonitoring studies. © GÖKSEL DOGRUER / WWF-AUSTRALIA

SOLVING THE MYSTERIES OF **MALE TURTLES** IN THE CARIBBEAN

by MARCO A. GARCÍA-CRUZ, CATHI CAMPBELL, KAREN BJORNDAL, LUIS CARDONA PASCUAL, KATHRYN M. RODRÍGUEZ-CLARK, MARGARITA LAMPO, HANNAH VANDER ZANDEN, MARIANA M. P.B. FUENTES, LUIS PIBERNAT, EDIS SOLORZANO, and ALAN BOLTEN

Most of the knowledge about the biology, ecology, and conservation needs of sea turtles has been obtained from studies of adult females on nesting beaches and, to a lesser extent, from observations of juveniles and subadults in their foraging and development habitats. Those studies have principally sought to understand natal homing and nest site fidelity, migratory movements, nesting trends, and survival rates. However, comparatively little effort has been invested in studying and understanding male sea turtle biology and ecology, and even less research has focused on the potentially important role of male turtles in management and conservation. Because male turtles do not come ashore as their female counterparts do, they are seldom seen by beach-bound researchers or included in tag-recapture studies, and the difficulties posed by capturing males at sea have made locating their feeding, courtship, and mating areas an ongoing challenge.

Despite the complications inherent in studying male sea turtles, understanding their differing biology and natural history traits is critically important for a variety of conservation reasons, especially now. For example, climate change is expected to increase the proportion of females in some populations because sex determination is temperature dependent, so understanding male sea turtles' roles in population viability will be crucial to formulating appropriate conservation strategies. The proportion of males to females that is necessary to maintain a healthy sea turtle population was determined by the IUCN Marine Turtle Specialist Group in 2006 to be one of the key unsolved mysteries (see *SWOT Report*, vol. II, pp. 6–13), and this mystery requires greater attention by scientists.

Aves Island Wildlife Refuge is unique among sea turtle reproductive sites because significant numbers of males and females of the same population congregate there for courtship and mating, and females do not face any anthropogenic threats on the nesting beach. Located approximately 670 kilometers (416 miles) north of continental Venezuela, in that country's maritime boundary, Aves Island is a mere 580 by 120 meters (1,902 by 393 feet). The refuge is one of the few areas on the planet where male green turtles are found in large mating aggregations in clear, shallow waters where they can be easily observed and studied.

Far to the west along the Miskito Coast of Nicaragua, the expansive Caribbean continental shelf of Mesoamerica provides some of the most extensive seagrass pastures in the Atlantic. Green turtles come from all over the region to feed. At the southern extent of this vast foraging area, green turtles exhibit a sex ratio of approximately three males to one female, making it yet another unique area for studying male green turtles. Researchers suggest that the high concentration of males is evidence of sexual segregation on the foraging ground and is likely a mating strategy to increase encounters with reproductive females migrating to near and distant nesting areas, particularly nearby Tortuguero, Costa Rica. Female green turtles nesting at Aves Island are known to use Nicaragua's Miskito Coast foraging grounds.

Studying male sea turtles in these and other important foraging and mating areas across the globe is vital to better understanding sea turtle mating strategies, contributions to genetic stocks, operational sex ratios, population dynamics, habitat needs, and other important aspects of their biology and ecology. To improve global knowledge of the biology and ecology of male sea turtles, we will use applied research to improve the conservation strategies for the species. Initially, we propose to work with existing data to create a global distribution map of courtship, mating, feeding, and basking sites for each species, and to identify links to nesting populations where known. We will also characterize male mating patterns and operational sex ratios on Aves Island and in Nicaragua using genetic analysis, and estimate effective population size. In addition, we will explore the pre- and post-reproductive behavior using satellite tracking of males at both sites.

Studying male sea turtles in these and other important foraging and mating areas across the globe is vital to better understanding sea turtle mating strategies, contributions to genetic stocks, operational sex ratios, population dynamics, habitat needs, and other important aspects of their biology and ecology.

Management strategies and actions to conserve sea turtle populations in the future will need to address the roles of male turtles more effectively and to consider how the impacts of regional climatic cycles, primary threats, and conditions in foraging areas apply to both females and males. To ensure that these concerns are addressed in sea turtle populations across their range, we have created a global initiative—the Global Male Sea Turtle Initiative—to promote the biological and ecological study of male sea turtles. We invite our colleagues from around the world to join this effort. ■

AT RIGHT: Mating green turtles accompanied by satellite males near Aves Island, Venezuela. © GABY CARIAS TUCKER

The **Paci**
So Excelle

fic Loggerhead,
nt a Connector

by JEFFREY A. SEMINOFF, F. ALBERTO ABREU-GROBOIS, JOANNA ALFARO-SHIGUETO, GEORGE H. BALAZS, HIDEO HATASE, T. TODD JONES, COLIN J. LIMPUS, JEFFREY C. MANGEL, WALLACE J. NICHOLS, S. HOYT PECKHAM, ALAN ALFREDO ZAVALA NORZAGARAY, and YOSHIMASA MATSUZAWA

It has been 20 years since the satellite track of Adelita hit the mainstream media and newly birthed internet, sharing the real-time migration of a loggerhead sea turtle from Baja California, Mexico to Japan with millions of people worldwide. Captured in Mexico's Gulf of California as a small juvenile and reared in captivity for more than a decade, Adelita couldn't wait to return home once released. Up to that point, nobody could have imagined that a turtle could swim more than 11,500 kilometers (7,145 miles) in only 368 days.

Satellite telemetry was still in its early years, and having a track of this magnitude highlighted the value of this technology for visualizing ocean connectivity and for revealing obscure aspects of sea turtle life histories. Moreover, Adelita became a *spokesturtle*, showing the world just how magnificent Pacific loggerheads could be. In fact, hers was the first track of *any* animal swimming across *any* ocean, and the simplicity of that remarkably straight path slicing across the vast Pacific was inspiring. Adelita not only demonstrated the value of satellite telemetry for understanding sea turtles; her odyssey also reminded conservationists of the power of using captivating animal stories to create enthusiasm among local and international audiences through media, children's books, and more. Her name was Adelita—not tag #07667—and she became one of the world's most famous living sea turtles.

Today, Pacific loggerheads are by far the most satellite-tracked creatures on Earth. Nearly 400 loggerheads have been followed in the North Pacific using satellites since Adelita's maiden track, and at least 200 more have been tracked in the South Pacific. We now have a stunning map resembling a network of crisscrossed circuits connecting the furthest stretches of the eastern and western North Pacific—a level of connectivity rarely observed in the natural world—as well as a huge swath of loggerhead tracks on both sides of the South Pacific (see pp. 16–17). This map is derived from the largest collection of Pacific loggerhead tracks ever assembled, and, when combined with overlays of oceanography and fisheries data, the priority areas for conservation action nearly leap off the screen.

The Pacific is the largest, most dynamic ocean basin in the world, and that makes the migrations of these turtles so amazing. From the time hatchling loggerheads depart nesting beaches in Japan, Australia, and New Caledonia to some 30 years later when they return as adults, each individual will have traveled tens of thousands of kilometers, interacting with countless habitats and dodging myriad human threats. From east to west, the Pacific stretches roughly 17,000 kilometers (10,563 miles) at its widest. It's an enigmatic sea: its submarine trenches are deeper (10,994 meters/36,069 feet) than the highest mountains. The Kuroshio Current off Japan can rage at nearly 11 kmph (7 mph). And in the abnormally cold eastern tropical equatorial waters, penguins swim with green turtles and iguanas. Taking this all in helps us understand the fascinating story of Pacific loggerheads.

There are two distinct loggerhead populations in the Pacific: (1) a northern group that nests almost exclusively in Japan, with many young traversing the North Pacific to U.S. and Mexican waters, and (2) a southern group that nests in Australia and New Caledonia and spans the South Pacific all the way to Peru and Chile. These two populations mirror each other across the equator. During the 1970s and 1980s, Pacific loggerheads in both hemispheres were declining fast because of threats on nesting beaches and in the sea. The conservation outlook was very bleak for both populations, and by the 1990s some scientists were forecasting that they would be functionally extinct within less than one human lifetime.

The alarming declines in annual loggerhead nesting throughout the western Pacific put conservation biologists on red alert, and both the eastern and western Pacific populations became the focus of important research and conservation efforts. Pioneers such as George Balazs, Jeffrey Polovina, and Don Kobayashi began studying loggerheads in the open ocean, while others such as Colin Limpus and Naoki Kamezaki were expanding protection on nesting beaches and in coastal foraging areas and conducting massive flipper-tagging and recapture programs. Later, Brian Bowen, Alberto Abreu-Grobois, Peter Dutton, and Michelle Boyle began to establish the east-west genetic links for loggerheads on both sides of the equator. The combined work of these early luminaries built a foundation of biological information that revealed the population structures of the North and South Pacific loggerhead subpopulations long before satellite telemetry studies provided indisputable proof of transoceanic migrations.

Significant progress has been made in understanding the ecology and movements of loggerheads in the northern and southern hemispheres since, but each question answered seems to yield a dozen more. What proportion of turtles in the North Pacific eventually makes it from Japan to Mexico's Baja California Peninsula? What is the age of maturity for loggerheads in the Pacific, and is it different in the north and south? Why has the return of subadult loggerhead turtles to coastal habitats of the southwest Pacific declined markedly over the past two decades? Why do adult loggerheads in the North Pacific feed in both oceanic and coastal habitats whereas those in the South Pacific are almost all coastal foragers? Is ingestion of plastic debris an important threat for juvenile loggerheads? What is the impact on loggerheads of illegal, unreported, and unregulated (IUU) fishing in the high seas? How will climate change affect nesting beaches and sex ratios of emerging hatchlings?

We don't have all the answers, but it's clear that the more we look, the more we learn. For example, new discoveries in the eastern North Pacific have revealed that loggerheads are present in a wider range of areas than previously known. They occur in the tens of thousands along the U.S. coast of southern California during El Niño periods, and they gather in the Gulf of California more than we knew just a few years ago. Long-term tracking of individual loggerheads in Australia has also revealed that they mature later and live longer than we realized. And, to the north in Japan, research has shown that the environment within which loggerheads forage can dramatically affect their size and reproductive outputs.

There is still much to learn about Pacific loggerhead biology, and many hurdles remain for their conservation. Clearly a huge challenge to their survival is bycatch mortality in fisheries. Given their delayed maturity, their transpacific movements, and the fact that fishing occurs almost everywhere, it is a near certainty that huge numbers of turtles will interact with fishing gear during their lives. But what then is their probability of survival? Intuition would suggest that it's low, but recent research has shed a sobering light on just how low survivorship can be. For example, the Gulf of Ulloa along the Pacific coast of

A loggerhead turtle that has been seen for three consecutive years on the same reef patch off the shores of Amami-Oshima, Japan. © KATSUKI OKI; PREVIOUS SPREAD: A barnacle-encrusted loggerhead exhales as it surfaces off the coast of Baja California Sur, Mexico. © WEDGE CREATIVE I WEDGECREATIVE.COM

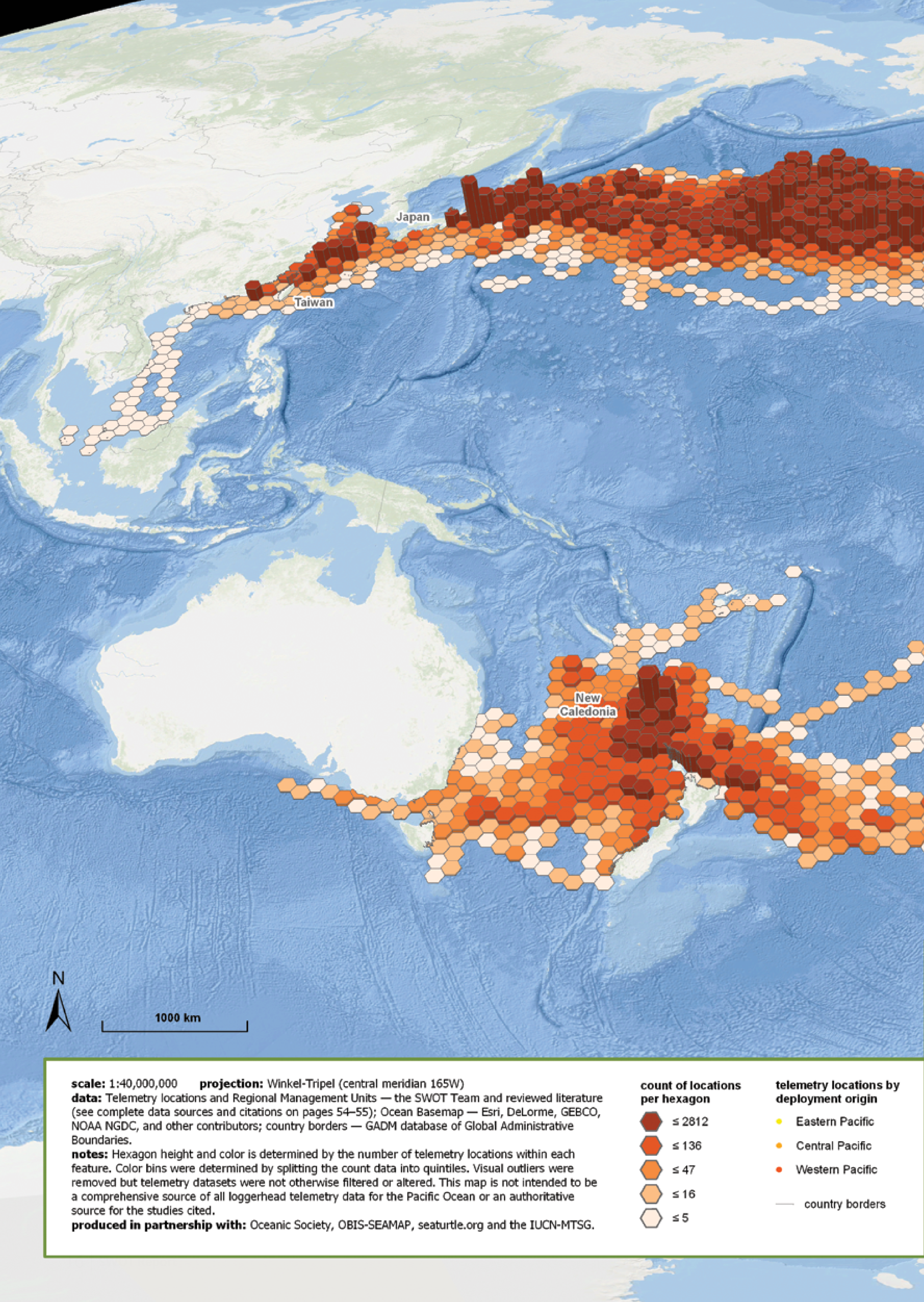
the Baja California Peninsula is the site of the highest bycatch mortality rates among artisanal fisheries worldwide (see *SWOT Report*, vol. III, p. 14). Today, the predicted survivorship of loggerheads spending more than 20 years in that area is less than 10 percent, emphasizing the urgent need for conservation measures.

Thankfully, several bright spots appear in this literal sea of bycatch. The use of circle hooks in place of J hooks is a perfect example; whereas circle hooks don't always stop turtles from interacting with hooks, they can lower mortality among turtles by reducing the incidence of deep hooking. Illuminating gillnets with LEDs has proven to reduce turtle bycatch by more than 60 percent in Peru. And in the South Pacific, the compulsory use of turtle excluder devices has coincided with an increase of nesting females at index beaches. In the North Pacific, TurtleWatch—a mapping tool that integrates fisheries effort and loggerhead habitat preferences to give real-time estimates of loggerhead hotspots (see *SWOT Report*, vol. IV, pp. 36–37)—has improved predictive abilities and allowed fishers to avoid bycatch in the Hawaii-based longline fisheries. Those are just a few of the many technological advances in bycatch reduction that most fishers are eager to adopt, because they too look to minimize interactions with turtles that can ruin their gear and slow their operations.

Assuring the success of these new technologies requires broad scale buy-in from stakeholders. North Pacific loggerheads may traverse the waters of three or more nations during their lives, and their South Pacific counterparts may pass through a dozen or more countries and territories. This fact has sparked several important cross-border management alliances. The North Pacific Loggerhead Trinational Recovery Team, for instance, brings together policymakers from Japan, Mexico, and the United States to manage a multinational conservation action plan. The Convention on Migratory Species plays a similar role among the South Pacific nations of Australia, Chile, Ecuador, Fiji, New Caledonia, Peru, and Tonga.

Of course, much conservation *planning* occurs at the state, national, and international levels, but a significant amount of conservation action occurs at the community level. Local support is built through field-based collaboration, trust building, artful leadership, and the often-slow shifting of narratives and paradigms. In eastern Australia, for example, more than 50,000 loggerhead hatchlings enter the sea, in addition to those from in situ nests, thanks to hundreds of trained volunteers who rescue doomed eggs and relocate them to safer sand following protocols from the Queensland Department of Environment and Heritage Protection. In Peru, the nonprofit ProDelphinus has used high-frequency (HF) radio to connect Peruvian fishers at sea with biologists on shore to promote the safe release of turtles and to gather and share information on turtle captures (see *SWOT Report,* vol. VII, p. 15). And an international fisher exchange program between Japan, Mexico, and Hawaii led to conservation breakthroughs in Baja California, Mexico, where one major fishing cooperative retired its bottom-set longline gear to adopt adopt bycatch-free fishing methods, thus sparing hundreds of turtles. In Japan, a similar exchange resulted in fishers teaming with scientists to develop turtle-friendly pound nets (see *SWOT Report*, vol. VII, pp. 16–17).

We are at an exciting time in the history of Pacific loggerhead research and conservation. The wealth of new knowledge and early signs of population increases at the nesting beaches after decades of decline are extremely encouraging. These gains can be attributed to a combination of (1) long-term indefatigable nesting beach protection by locals; (2) at-sea efforts led by policymakers and implemented by countless fishers who work the nets and longlines in more than a dozen Pacific countries; and (3) the goodwill and commitment of hundreds of nonprofits, communities, and individuals who care about the future of loggerheads and the health of their habitats. From individuals to organizations to nations, we've seen countless examples of people uniting to study and save this species. ¡Viva Adelita! ■



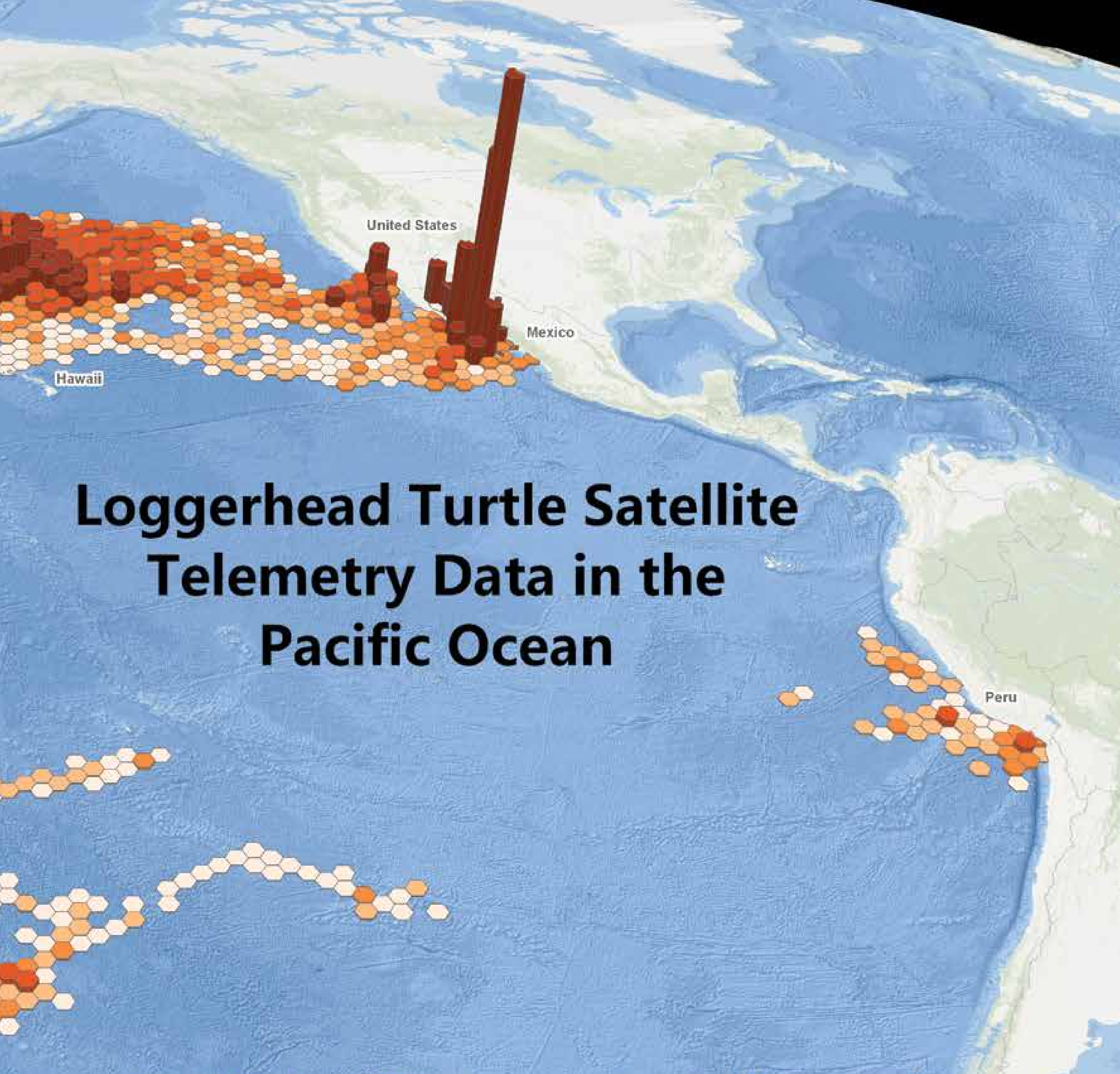
scale: 1:40,000,000 **projection:** Winkel-Tripel (central meridian 165W)

data: Telemetry locations and Regional Management Units — the SWOT Team and reviewed literature (see complete data sources and citations on pages 54–55); Ocean Basemap — Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors; country borders — GADM database of Global Administrative Boundaries.

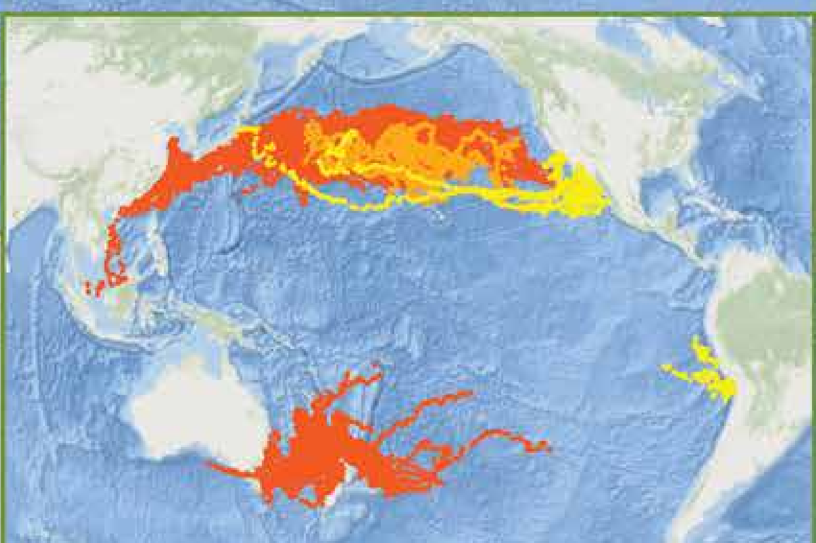
notes: Hexagon height and color is determined by the number of telemetry locations within each feature. Color bins were determined by splitting the count data into quintiles. Visual outliers were removed but telemetry datasets were not otherwise filtered or altered. This map is not intended to be a comprehensive source of all loggerhead telemetry data for the Pacific Ocean or an authoritative source for the studies cited.

produced in partnership with: Oceanic Society, OBIS-SEAMAP, seaturtle.org and the IUCN-MTSG.

Loggerhead Turtle Satellite Telemetry Data in the Pacific Ocean



Locations by Deployment Origin



Regional Management Units

sea turtles
OF THE FRENCH TERRITORIES

by KATIA BALLORAIN, MATHIEU BARRET, JÉRÔME BOURJEA, ALICE CARPENTIER, FRANÇOISE CLARO, CAROLINE CREMADES, MAYEUL DALLEAU, JEANNE DE MAZIÈRES, JOLT EVVA, ANAÏS GAINETTE, FRANÇOIS GALGANI, DELPHINE GAMBAIANI, CÉCILE GASPAR, ALEXANDRE GIRARD, MARC GIRONDOT, CLAIRE JEAN, LAURENT KELLE, JULIE-ANNE KÉRANDEL, RODERIC MAST, MICHEL ANTONY NALOVIC, JEAN-MARIE PÉRICARD, CAROLINE RINALDI, and JACQUES SACCHI

France's 12 overseas regions and territories range across all of the Earth's temperate, tropical, and polar seas, with a combined marine territory of nearly 10.2 million square kilometers (nearly 4 million square miles), an area larger than the mainland United States. Marine turtles are found throughout most French waters; indeed, it is easier to list the French territories where marine turtles are not found—only France's tiny sub-Antarctic and Antarctic island territories—than where they are. Thus, France bears a high level of global responsibility for the conservation of sea turtles and their habitats, and the country takes this responsibility seriously. No fewer than four sea turtle action plans have been put in place since 2007 (for Guadeloupe and St. Martin, Martinique, French Guiana, and the West Indian Ocean territories), as well as strict legislation protecting sea turtles in French Polynesia since 1990. To improve collaboration for sea turtle conservation and management among the far-flung French territories, France's Ministry of the Environment created a network—the Groupe Tortues Marines France (French Marine Turtle Group, or GTMF)—that represents more than 200 stakeholders from several government and non-profit institutions. Through regular communications, workshops, and meetings, GTMF helps facilitate exchanges among its members, prioritizes research and conservation efforts for France's sea turtle populations, and provides expertise on sea turtles to the French government and relevant international bodies, such as the Convention on Migratory Species, and the Indian Ocean South East Asian Marine Turtle Memorandum of Understanding.

SEA TURTLE DISTRIBUTION IN THE FRENCH TERRITORIES

France's sea turtle diversity can be described in measurable and immeasurable ways. French waters host six of the world's seven marine turtle species (all but the flatback), and all but the flatback and Kemp's ridley are known to nest on French beaches. The amount of France's Exclusive Economic Zone (EEZ) that serves as sea turtle foraging and migratory habitat is incalculably high, and it encompasses portions of 18 different regional management units, representing some of the world's most and least threatened sea turtle populations (see *SWOT Report*, vol. VII, pp. 20–31).

French sea turtles and their unique behaviors and biogeography are noteworthy in many respects. The leatherback nesting beaches of northern South America, which include those of French Guiana, are among the most important on the planet, as well as the most dynamic. Yalimapo beach in French Guiana, for instance, has shown dramatic swings in nesting intensity over the decades, with more than 60,000 nests recorded annually during the late 1980s and early 1990s, falling to just a few thousand nests per year more recently, due in part to habitat shifts and illegal bycatch. The dynamic nature of French Guiana's shoreline, where beaches undergo frequent dramatic changes in size and shape, provides a natural laboratory in which to study how sea turtles respond to environmental changes. French Guiana's leatherbacks also make long migrations to the North Atlantic Ocean to feed, where they have been found in the waters off Saint-Pierre-et-Miquelon, another French territory (see *SWOT Report*, vol. XI, pp. 24–25). Such migrations demonstrate the importance of working globally to protect turtles across their entire ranges.

Not far away, the presence of marine turtles in the French Caribbean territories (Guadeloupe, Martinique, St. Martin, and St. Barthélemy) has been known for centuries, but no significant studies were carried out until the early 2000s. Recent data from these islands has illuminated a very complex situation across a large number of nesting beaches, with no less than 156 beaches hosting three species of nesting marine turtles in an as yet unknown spatial distribution. More monitoring is needed to truly understand these unusual patterns, though recent research does point to a noteworthy multiyear recovery trend of green turtle stocks that had nearly disappeared at the time of European settlement.

In contrast, marine turtles have been well studied in the French islands of the Southwest Indian Ocean on the Îles Éparses (scattered islands) of Tromelin, Glorieuses, Juan de Nova, and Europa, where military and police forces remain year-round, and where biologists have gathered some of the longest sea turtle time series monitoring data in the world, dating back to the 1970s. On each of those islands, green turtles lay 5,000 to 10,000 clutches of eggs annually (except for Juan de Nova, which has much fewer). In nearby Mayotte, located in the Mozambique Channel, nest monitoring has been conducted since the 1990s, despite high levels of poaching and the difficulties of working on numerous secluded beaches.

School children observe a rare daylight-nesting leatherback in French Guiana. © THIERRY MONTFORD FOR WWF

The French territories in the South Pacific Ocean cover an enormous area, larger than Europe. French Polynesia consists of 118 islands, of which only 76 are inhabited, including Tahiti, the most populated. The region harbors marine turtles in all their life stages, yet little is known about them because monitoring is confounded by the region's size. Over the years, however, trained volunteers have begun to monitor turtles on several islands, and some data are beginning to be collected. Some monitoring also has been done in parts of New Caledonia, but long-term data on sea turtles are lacking. And the status of marine turtles in the remote Wallis and Futuna Islands is almost entirely unknown.

SEA TURTLE MOVEMENTS IN FRENCH WATERS

Research from throughout the French territories has revealed wide-ranging movements of sea turtles both within and beyond French waters, including a number of spectacularly long migrations.

The Atlantic waters of continental France are used by leatherbacks and loggerheads on their way to and from feeding or breeding grounds. These are often juveniles that drift into French coastal areas after being ejected by weather and currents from the North Atlantic gyre. One turtle was recently tracked returning from Atlantic France to the warmer waters of the western African coast. In French Mediterranean waters, several adult and subadult loggerheads have been tracked crossing the entire western Mediterranean up to Greece, while others swim through the Straits of Gibraltar into the Atlantic Ocean. On the other side of the Atlantic, leatherbacks that nest in French Guiana forage between 30 and 40 degrees north, adjacent to the French territory of Saint-Pierre-et-Miquelon near the Gulf of Saint Lawrence, making them the most northerly distributed of all sea turtles globally. Leatherbacks of French origin are not the only species known to make such long migrations; a juvenile green turtle originating from the French Caribbean traversed the entire Atlantic and was found off the West African coast. Green turtles that nest in French Guiana also show great behavioral plasticity, adapting their diving behavior to face the strong currents at the mouth of the mighty Amazon River while they travel to foraging grounds in Brazil.

In the southwest Indian Ocean, intensive satellite tracking efforts combined with genetic analyses have illuminated highly important migratory routes for green and loggerhead turtles that regularly travel between the French islands and surrounding countries of East Africa and Madagascar. In addition, loggerheads foraging near Reunion Island were found to have originated from nesting sites as far away as the Arabian Sea—some 4,000 kilometers (2,485 miles) away and in another hemisphere—requiring them to traverse nearly 50 degrees of latitude. Such migrations again demonstrate the importance of multinational cooperation in sea turtle conservation.

In French Polynesia, a male green turtle named Popora was tracked more than 4,500 kilometers (2,796 miles) in a crossing from Tahiti (Bora Bora) to New Caledonia. Other adult female green turtles from Tahiti (Tetiaroa atoll) seem to prefer foraging in Fijian waters, a few flipper strokes from the Wallis and Futuna Islands. A unique track of a subadult loggerhead turtle named Ariti showed a 14,000-kilometer (8,700 mile) migration from Tahiti (Moorea atoll) all the way to Fiji, then to Nauru, then to the Marshall Islands in the northern hemisphere, then back south of the equator to an area near American Samoa.

FRANCE'S EFFORTS TO ADDRESS TURTLE THREATS

Solving the bycatch threat. GTMF is addressing bycatch through collaborative fisheries research—among fishers, scientists, managers, and consumers—and developing and implementing conservation mitigation measures in the nations and territories where it has influence. Since its creation, GTMF has recognized the threat to sea turtles caused by widespread illegal, unreported, and unregulated fishing activities. The group is now taking action through its partners to gather available information on this most serious hazard. A report on a survey conducted among all GTMF partners, published in 2010, described the situation on France's mainland and territories, identified priority activities, and listed recommendations for specific actions to be carried out in locations where high mortality of marine turtles was reported. The current work also fills data gaps for other areas where impacts are suspected but remain unquantified. The report provides a comprehensive description of the research projects and actions dealing with sea turtle bycatch that have so far been implemented in the French continental waters of the Atlantic, Pacific, and Indian Oceans and the Mediterranean Sea.

GTMF has established a bycatch group whose purpose is to help local and national stakeholders better understand and address the problem, including how to develop more selective fishing gear, how to impose temporal and spatial fisheries closures, and much more. One example is GTMF's support for an initiative to ensure that the European Union (EU) requires the use of turtle excluder devices (TEDs) by trawl fishers in all nations from which it imports wild-caught shrimp. If adopted, such a regulation could save hundreds of thousands of marine turtles (see article on pp. 38–39, this issue).

Monitoring of habitat. France's coasts and overseas regions and territories are home to all types of sea turtle habitats, including seagrass meadows where green and hawksbill turtles feed. French turtle teams work closely with the French Coral Reef Initiative (IFRECOR) to assess seagrass health in the Caribbean and Indo-Pacific. In the Western Indian Ocean, the teams also help facilitate international cooperation to standardize seagrass monitoring protocols. Beyond habitat monitoring, the teams survey foraging populations and interspecies interactions within food resources. For

Cécile Gaspar releases a rehabilitated green turtle in French Polynesia. © TE MANA O TE MOANA

example, one current study in the Caribbean is assessing the effects of invasive seagrass expansion on green turtle foraging grounds. Other vulnerable and crucial habitats are monitored all around France, including coastal forests in the French West Indies where hawksbills nest and where beaches are threatened by illegal sand mining, light pollution, and other hazards. In collaboration with coastal cities in the Caribbean, French national action plans are addressing light pollution using the experience of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) to develop technical recommendations.

Monitoring of debris and other pollution. Ocean pollution is another threat to turtles in French waters as well as globally. GTMF published a survey in 2011 about interactions between marine debris and sea turtles in French territories. The survey found different levels of impact and interaction rates throughout French territories, as well as ingestion rates of up to 100 percent in stranded animals. In response to these shocking statistics, GTMF now works with other agencies in the eastern Atlantic, Mediterranean, and Indian Ocean waters to better understand and respond to the threats plastic pollution poses to turtles. GTMF's Marine Strategy Framework Directive considered Mediterranean loggerheads a good indicator of the impacts of marine debris in European states, and they are now used to determine trends in the monitoring programs of the United Nations Environment Programme's Regional Seas Conventions. French teams carried out a risk assessment and mapping exercise for sea turtle–debris interactions that supports this scheme. Other studies are also under way to evaluate the prevalence of turtle entanglement and define relevant metrics for measuring and under- standing the impacts of such pollution.

Turtle rescue and rehabilitation. Six rescue centers and several stranding networks rehabilitate sea turtles throughout the French territories. GTMF also has created a working group for pathology and rescue to support this important aspect of sea turtle conservation and to develop and share standardized protocols throughout the French territories. French stranding networks receive alerts when a sea turtle is dead or in difficulty. Since the early 2000s, more than 1,800 turtles have been rescued in France's territories, including about 200 in 2016 alone. To better understand the causes of strandings, the team records the species and causes of distress, which vary by region. For example, in French Polynesia, the Moorea sea turtle clinic treats mainly juvenile and subadult green and hawksbill turtles, most of them injured as a result of poaching for meat by spear guns. In the Mediterranean and Indian Ocean (Reunion), rescued turtles are mainly loggerheads that were accidentally captured by fishermen. And in Reunion, boat strikes are the second highest cause of rescue or stranding of greens and hawksbills. In Mayotte, the poaching of nesting green turtles for meat is the cause of 80 percent of stranded turtles reported by the local network. On France's western mainland, the La Rochelle rescue center admits mostly leatherbacks and loggerheads, as well as occasional Kemp's ridleys and green turtles; the center's necropsies show that 50 percent of stranded leatherbacks died from the ingestion of plastics, and others from boat strikes. The French Mediterranean rescue center (CESTMed) collaborates closely with local fishermen and has successfully rehabilitated more than 300 sea turtles since 2003. Disease is also monitored among sea turtles found in French territories. In Guadeloupe, for instance, 15 percent of the turtles monitored in Malendure Bay are affected by fibropapillomatosis. In Mayotte, this was reported only twice on adult green turtles. In some instances, remission was observed in both territories, which is encouraging.

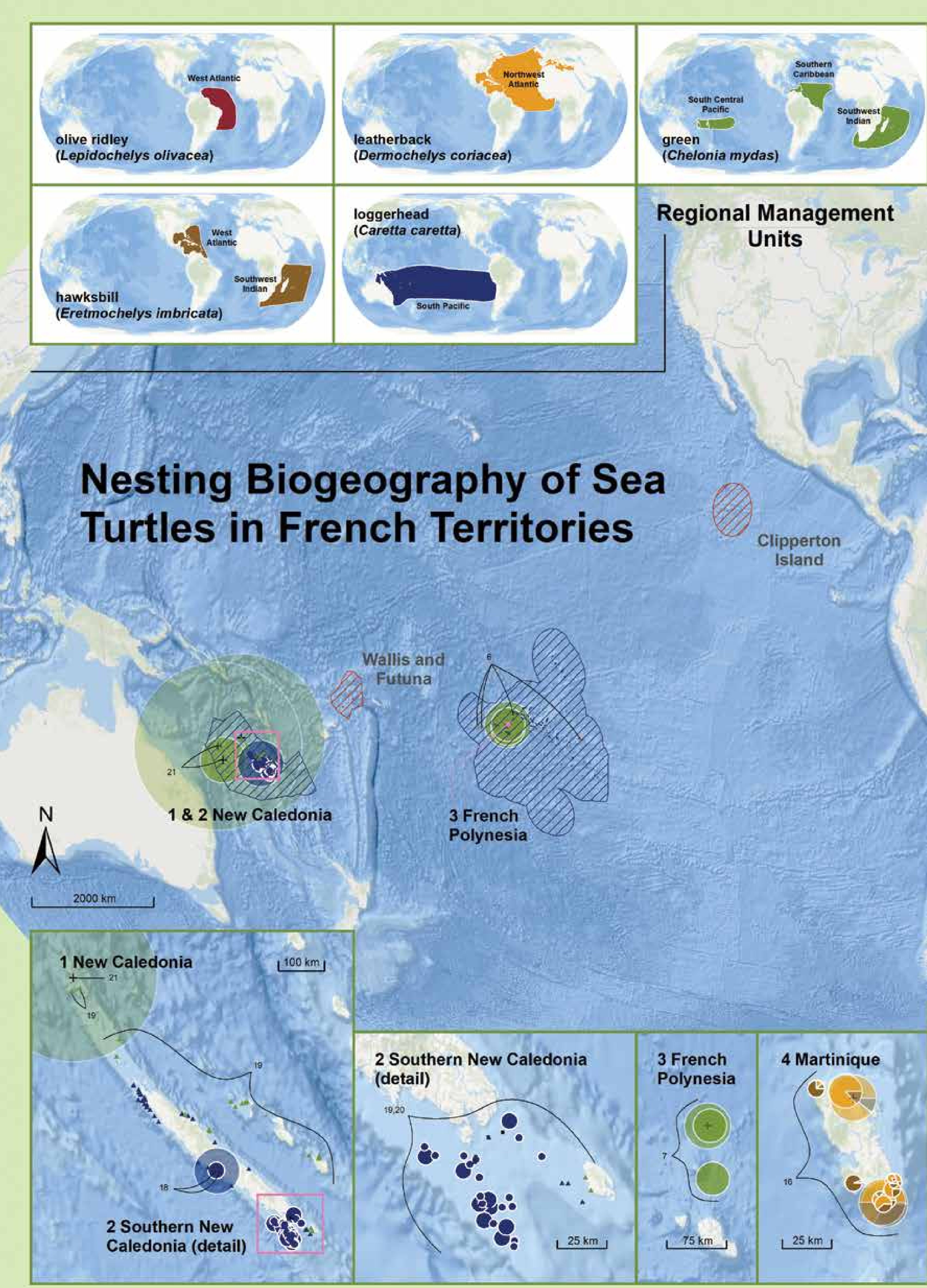
Education and outreach. Education and outreach programs are one of the main actions for sea turtle conservation in all of the French territories. For example, Kelonia, a public education and tourism facility located in Reunion, receives 140,000 visitors annually. In French Polynesia, Te Mana O Te Moana has reached more than 80,000 children with education programs since its creation in 2004. In several other locations (French Guiana, Mayotte, New Caledonia), ecotourism aims to educate and regulate tourists who visit beaches to observe turtle nesting and hatching. French media channels are also used to disseminate news and information about penalties and fines for disturbing or poaching turtles and to stimulate citizen participation in conservation. French divers, sailors, and beach users enjoy sharing observations that can be used for scientific purposes. To aid in such citizen reporting, almost all GTMF members have observation templates on their websites, and several mobile phone applications have been created to let citizen scientists share data. Both researchers and the general public can use the photo ID software to identify and monitor individual turtles and provide feedback. Programs to adopt or sponsor a turtle also raise awareness. Side-by-side with officials in charge of marine turtle action plans, local sea turtle volunteer networks are very active in many parts of France.

In the French West Indies and Reunion, where sea turtle consumption was part of local traditions, education and outreach efforts driven by the Marine Turtle Network of Guadeloupe and by Kelonia since 1998 have helped to reduce turtle harvests significantly. In New Caledonia, regulation of turtle meat consumption permits ancestral customs within specific cultural groups, and quotas are defined by authorities for each province with respect to traditional events. In French Guiana, Amerindian people are allowed to consume turtle eggs under certain conditions. In other regions, such as Polynesia, despite education efforts, local customs remain deeply embedded, and the fight against poaching is still a big challenge.

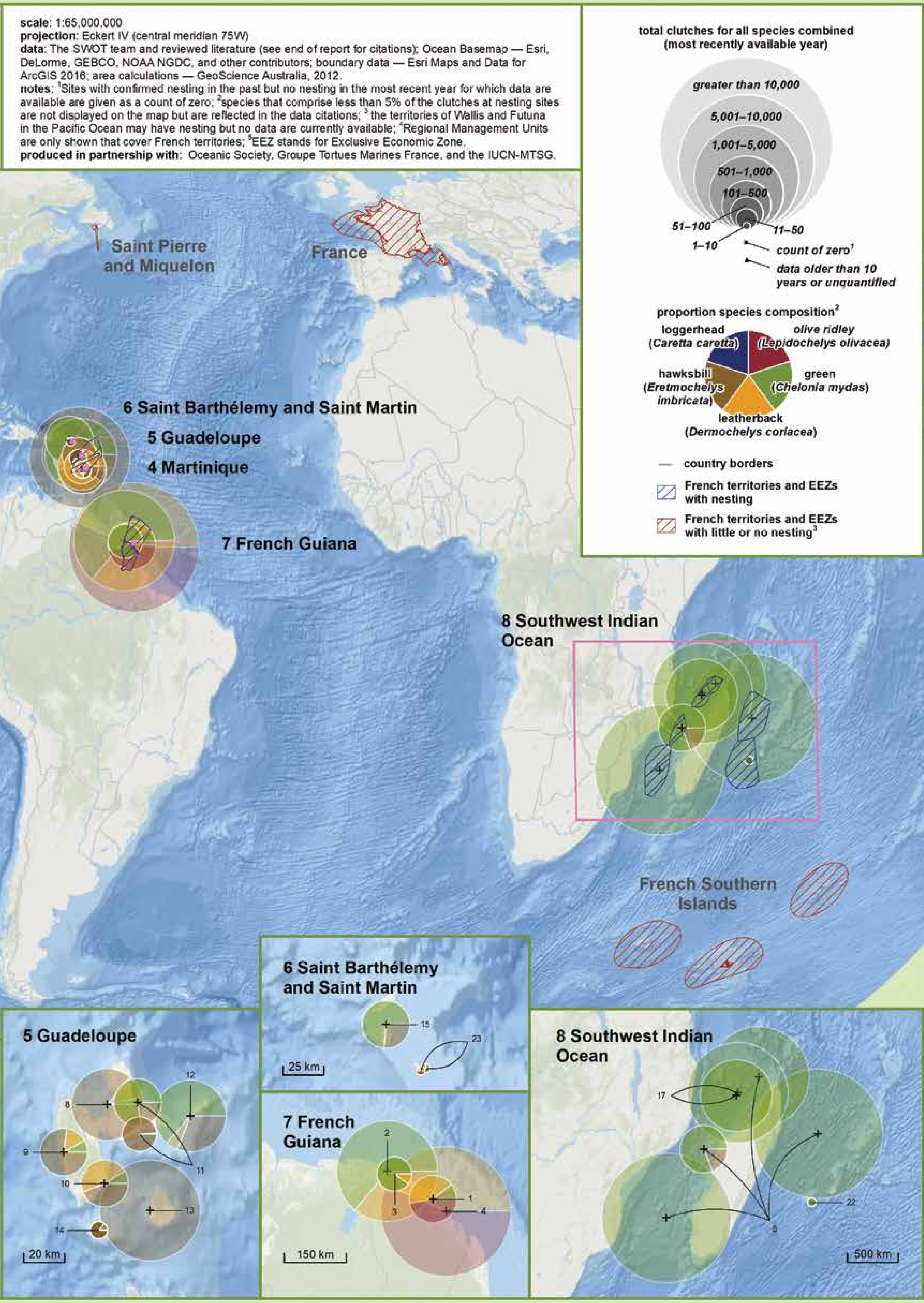
CONCLUSION

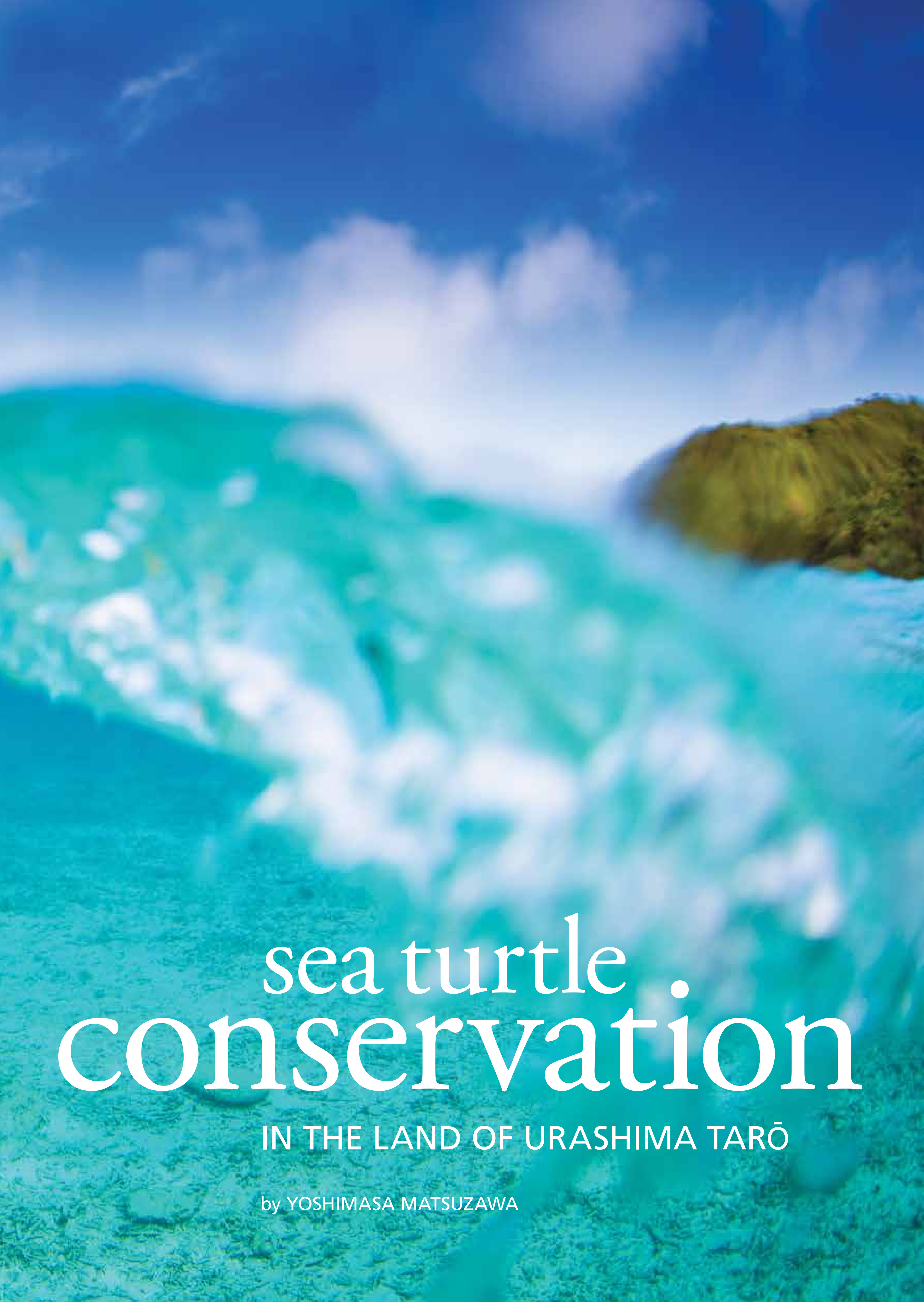
Geopolitics of the past have left France with many territories that are spread across the globe, and the coincidental overlap of so many sea turtle regional management units is a fortunate consequence that allows France to play a disproportionately important role in sea turtle conservation. France does not take this high level of global responsibility lightly and, indeed, GTMF's long-term goal is to rise to the challenge of protecting turtles wherever they may roam by addressing all the key threats. France must become a global leader in demonstrating that by protecting these sentient beings we further enhance the resilience of entire ecosystems. ■

The authors would also like to acknowledge the following individuals for their contributions to this article: Antoine Barnaud, Marine-France Bernard, Julien Chalifour, Stéphane Ciccione, Anne-Laure Clément, Gaëlle Darmon, Jacques Fretey, Philippe Gaspar, Dominique Lafage, Maxime Lalire, Sophie Lefèvre, Eleonore Meheust, Marc Orémus, François Poisson, Mireille Quillard, Tyffen Read, and Frank Urtizberea.


West Atlantic
olive ridley
(Lepidochelys olivacea)
Northwest Atlantic
leatherback
(Dermochelys coriacea)
Southern Caribbean
South Central Pacific
Southwest Indian
green
(Chelonia mydas)
West Atlantic
Southwest Indian
hawksbill
(Eretmochelys imbricata)
loggerhead
(Caretta caretta)
South Pacific
Regional Management Units
Nesting Biogeography of Sea Turtles in French Territories
Clipperton Island
Wallis and Futuna
1 & 2 New Caledonia
3 French Polynesia
N
2000 km
1 New Caledonia
100 km
2 Southern New Caledonia (detail)
2 Southern New Caledonia (detail)
25 km
3 French Polynesia
75 km
4 Martinique
25 km

scale: 1:65,000,000
projection: Eckert IV (central meridian 75W)
data: The SWOT team and reviewed literature (see end of report for citations); Ocean Basemap — Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors; boundary data — Esri Maps and Data for ArcGIS 2016; area calculations — GeoScience Australia, 2012.
notes: [1]Sites with confirmed nesting in the past but no nesting in the most recent year for which data are available are given as a count of zero; [2]species that comprise less than 5% of the clutches at nesting sites are not displayed on the map but are reflected in the data citations; [3] the territories of Wallis and Futuna in the Pacific Ocean may have nesting but no data are currently available; [4]Regional Management Units are only shown that cover French territories; [5]EEZ stands for Exclusive Economic Zone.
produced in partnership with: Oceanic Society, Groupe Tortues Marines France, and the IUCN-MTSG.





sea turtle conservation

IN THE LAND OF URASHIMA TARŌ

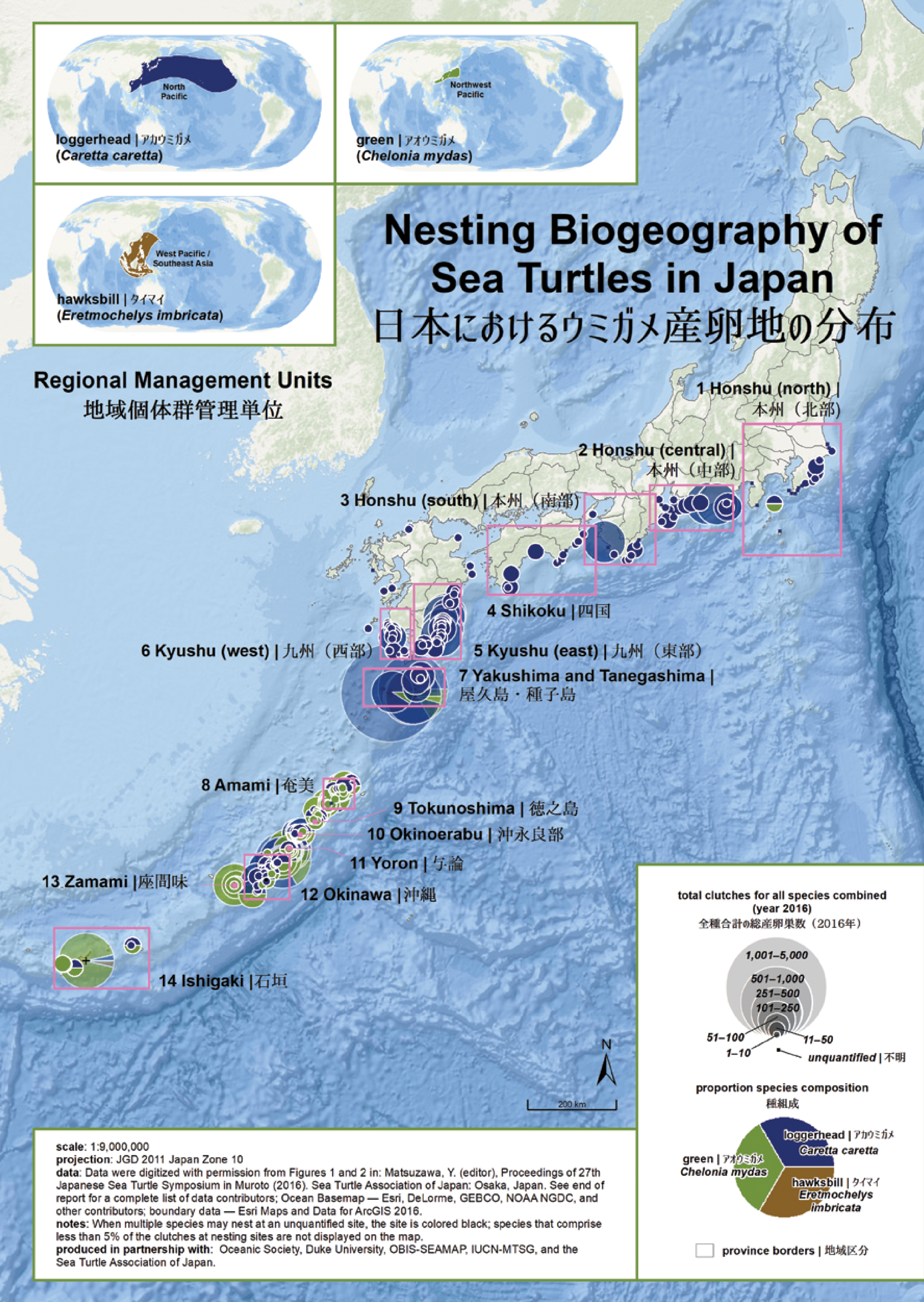
by YOSHIMASA MATSUZAWA

Japanese folklore tells of a fisherman, Urashima Tarō, who rescues a sea turtle from torment and sets him free. In gratitude, the turtle transports the fisherman to a mythical Dragon Palace beneath the sea, where he is welcomed by a beautiful princess. This eighth-century fable sets the cultural backdrop for modern sea turtle conservation in Japan, where community-led efforts have restored once-decimated sea turtle populations.

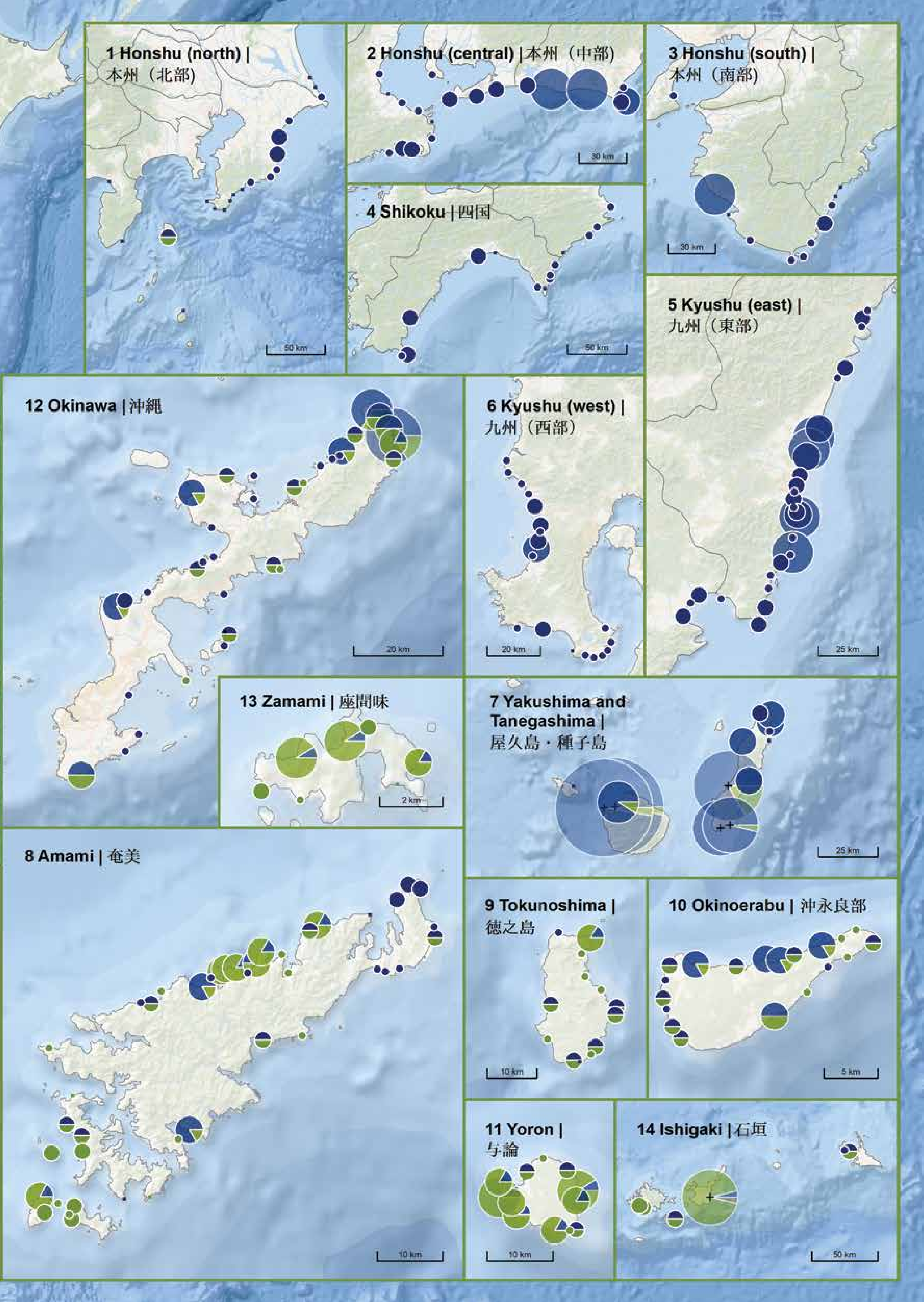
Japan boasts one of the world's first government-led initiatives specifically for sea turtle conservation in the Chichijima Ogasawara Islands, located 1,000 kilometers (621 miles) south of Tokyo. These islands are a major breeding ground for green turtles, and when the region was first settled in 1876, turtles were heavily harvested. To combat this overexploitation, Japan's Agriculture and Commerce Department established one of the world's first sea turtle head-start projects in 1910. Green turtle eggs were collected and hatched, and the juvenile turtles were released after one to seven months in captivity. The project was interrupted by World War II, then revived in 1976 by Yoji Kurata and Hiroyuki Suganuma of the Tokyo Metropolitan Fisheries Center. The project ultimately was passed on to the Ogasawara Marine Center, which has managed it since 1982. The project has released over 300,000 turtles to date, and the nesting population in the Chichijima Islands has seen a dramatic recovery.

Post–World War II economics led Japan to become one of the world's worst nations for sea turtle conservation. Until the early 1990s, the country was a major importer of tortoiseshell (bekko), a practice that threatened the hawksbill with extinction on a global scale (see *SWOT Report*, vol. III, pp. 24–25). Sea turtle bycatch was also a significant source of mortality, especially for north Pacific loggerheads. Decades of economic expansion, however, led Japan back to its long-held traditions of nature stewardship, characterized by voluntary, community-led initiatives that were often founded by a unique brand of local ocean heroes.

AT LEFT: An adult loggerhead near Amami-Oshima, Japan. © KATSUKI OKI; PREVIOUS SPREAD: A green turtle near Zamami Island, Okinawa Prefecture, Japan. © PETE LEONG I FOTOSHISA PHOTOGRAPHY



loggerhead | アカウミガメ
(Caretta caretta)
North Pacific
green | アオウミガメ
(Chelonia mydas)
Northwest Pacific
hawksbill | タイマイ
(Eretmochelys imbricata)
West Pacific / Southeast Asia
Nesting Biogeography of Sea Turtles in Japan
日本におけるウミガメ産卵地の分布
Regional Management Units
地域個体群管理単位
1 Honshu (north) | 本州（北部）
2 Honshu (central) | 本州（中部）
3 Honshu (south) | 本州（南部）
4 Shikoku | 四国
5 Kyushu (east) | 九州（東部）
6 Kyushu (west) | 九州（西部）
7 Yakushima and Tanegashima | 屋久島・種子島
8 Amami | 奄美
9 Tokunoshima | 徳之島
10 Okinoerabu | 沖永良部
11 Yoron | 与論
12 Okinawa | 沖縄
13 Zamami | 座間味
14 Ishigaki | 石垣
N
200 km
total clutches for all species combined (year 2016)
全種合計の総産卵巣数（2016年）
1,001–5,000
501–1,000
251–500
101–250
51–100
11–50
1–10
unquantified | 不明
proportion species composition
種組成
loggerhead | アカウミガメ
Caretta caretta
green | アオウミガメ
Chelonia mydas
hawksbill | タイマイ
Eretmochelys imbricata
province borders | 地域区分
scale: 1:9,000,000
projection: JGD 2011 Japan Zone 10
data: Data were digitized with permission from Figures 1 and 2 in: Matsuzawa, Y. (editor), Proceedings of 27th Japanese Sea Turtle Symposium in Muroto (2016). Sea Turtle Association of Japan: Osaka, Japan. See end of report for a complete list of data contributors; Ocean Basemap — Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors; boundary data — Esri Maps and Data for ArcGIS 2016.
notes: When multiple species may nest at an unquantified site, the site is colored black; species that comprise less than 5% of the clutches at nesting sites are not displayed on the map.
produced in partnership with: Oceanic Society, Duke University, OBIS-SEAMAP, IUCN-MTSG, and the Sea Turtle Association of Japan.



1 Honshu (north) | 本州（北部）
50 km
2 Honshu (central) | 本州（中部）
30 km
3 Honshu (south) | 本州（南部）
30 km
4 Shikoku | 四国
50 km
5 Kyushu (east) | 九州（東部）
25 km
12 Okinawa | 沖縄
20 km
6 Kyushu (west) | 九州（西部）
20 km
13 Zamami | 座間味
2 km
7 Yakushima and Tanegashima | 屋久島・種子島
25 km
8 Amami | 奄美
10 km
9 Tokunoshima | 徳之島
10 km
10 Okinoerabu | 沖永良部
5 km
11 Yoron | 与論
10 km
14 Ishigaki | 石垣
50 km

One such hero was Yasuo Kondo, a teacher in the Tokushima prefecture in the 1950s. He was playing baseball with his students at Ohama beach in Minami-cho (formerly Hiwasa-cho) when he discovered the remains of harvested loggerhead turtles. Yasuo was deeply saddened by the incident and proclaimed: “Sea turtles are emissaries of the Sea God! This should not happen again!” With his students, he launched a pioneering study of loggerhead nesting behavior; built and managed hatcheries; and studied embryogenesis, hatchling sea-finding behavior, allometry, and growth rates. Their work won multiple awards and resulted in the declaration of sea turtles and Hiwasa beach as national treasures in 1958. Their work also spurred the construction of an aquarium in 1960, which became the Caretta Sea Turtle Museum, now Japan’s flagship marine education facility. A male loggerhead named Hamatarō, that was hatched and raised at the museum, has become a local hero as the longest-living sea turtle for which a precise age is known (67 years). In 1968, Kondo went on to publish a book about his life with sea turtles that has become a great inspiration to many young researchers.

Another of the world’s longest continuous sea turtle nest-monitoring efforts is located on the Kamoda coast of Anan City in the Tokushima prefecture. In 1954, students at the Kamoda elementary school began to monitor turtles as a class activity, and when the school closed in 1992, local residents continued the program. It has now accumulated 64 years of data and has the distinction of being the longest uninterrupted sea turtle project in Japan. The postwar period was an era marked by economic growth, during which much of Japan placed little importance on the environment, thereby making the achievement of these school children all the more notable. Their work gained national attention and became a model; indeed, many of the sea turtle projects in Japan today were inspired by the efforts of Kamoda’s youth.

The largest loggerhead nesting beach in Honshu is found on Senri no Hama beach in Minabe-cho in the Wakayama prefecture, an area that was slated for residential development in the early 1960s. The leader of the town’s Board of Education, Hidematsu Toyama, and others convinced the prefecture to designate Senri no Hama as a natural monument to protect the turtles in 1964, and local youth groups began patrolling the beaches to stem the tide of illegal egg harvesting. In 1980, a local junior high school teacher, Osamu Uemura, and his school’s principal, Kiyoshi Goto, organized the Minabe-cho Sea Turtle Research Group to continue the monitoring, a noble effort that continues to this day.

One such hero was Yasuo Kondo, a teacher in the Tokushima prefecture in the 1950s. … he discovered the remains of harvested loggerhead turtles. Yasuo was deeply saddened by the incident and proclaimed: “Sea turtles are emissaries of the Sea God! This should not happen again!”

Yet another heroic turtle conservation effort began in the 1970s at the most important loggerhead habitat in Kyushu, where 90 percent of sea turtle eggs were being lost to poaching. The Miyazaki Wildlife Research Association, led by Hiroshi Takeshita and Yoshito Nakashima, responded to that crisis with an initiative that led to the virtual cessation of poaching by the end of the decade.

The largest loggerhead nesting site in the North Pacific is at Nagata, on Yakushima Island, where turtle egg harvesting rights were managed by an open bidding process that began shortly after World War II. In 1973 the town issued an ordinance to stop the practice, and by 1978 beach surveillance had effectively shut down the egg harvest. However, Yakushima’s turtles were also being affected by sand mining. A local photographer and farmer, Kazuyoshi Omuta, was deeply concerned, motivating him to create the Yakushima Umigame Kan (Sea Turtle Center) in 1985. That nonprofit organization patrolled Inakahama, Maehama, and Yotsuse beaches to study adult nesters, relocate doomed nests, and measure hatching success. Very few research groups in the world have conducted saturation tagging for fully three decades, and the organization’s persistent efforts resulted in a massive database that shows that the region hosts more than 30 percent of loggerhead nesting in the North Pacific. Those findings resulted in the designation of the area as a UNESCO World Natural Heritage Site in 1994, and in 2005 as a Ramsar Site. Omuta remains the guardian of this important loggerhead rookery, and he continues to innovate new projects, including the planting of weevil-resistant trees to screen the beach from traffic light, and the fencing off of high-density nesting areas from tourist foot traffic.

As these examples highlight, Japan’s 20th-century sea turtle conservation was often born of spontaneous, grassroots efforts led by brave and concerned citizens. Their isolated projects typically were conducted without coordination by government or international conservation groups; communication among projects was poor; and the projects seldom published standardized data or reports. As a result, Japanese sea turtle conservation was largely invisible to the outside world, and in turn, Japanese conservationists were unaware of threats to sea turtles beyond their shores.

AT LEFT: Yasuo Kondo and his students with captive-reared turtles in the 1950’s. IMAGE COURTESY OF YOSHIZO TERUMOTO (FRONT ROW, LEFT SIDE); AT RIGHT: A green turtle swims through coral spawn near Wase Beach, Amami-Oshima, Japan. © KATSUKI OKI

This all changed in 1988 when Itaru Uchida, one of Japan's leading sea turtle researchers, organized a symposium at Hiwasa. Many renowned sea turtle researchers attended, including Colin Limpus, George Balazs, Karen Bjorndal, Mike McCoy, and Rene Marquez. During the symposium, Hiroyuki Suganuma, of the Ogasawara Marine Center, and Naoki Kamezaki, of Kyoto University, met for the first time. Their friendship led to the launching of a new publication, the Umigame Newsletter of Japan, in 1989, and the creation of the Sea Turtle Association of Japan (STAJ) in 1990. The newsletter still promotes an exchange of information among Japanese sea turtle conservationists, and the STAJ hosts a Japanese Sea Turtle Symposium every year. Thanks to these advances in information sharing, 15 Japanese students now have doctoral degrees relating to sea turtles, and 5 of them have been recognized with awards at international sea turtle symposiums. Most important, the STAJ has become the national authority on sea turtles, providing guidance and expertise to the Japanese government and the global sea turtle conservation effort.

Japanese culture possesses strong cultural symbolism and a deep respect and compassion for nature. That is particularly the case for sea turtles, as reflected in a number of local practices that can still be observed today. For instance, dead sea turtles are often buried in marked graves, a practice normally reserved only for humans. Likewise, following the example of Urashima Tarō, traditional Japanese fishermen still respect the long-standing custom of rescuing sea turtles caught in fishing nets, often freeing them to the sea with an offering of sake. ■

THE CONSERVATION STATUS OF THE KEMP'S RIDLEY WORLDWIDE

by THANE WIBBELS and ELIZABETH BEVAN

The Kemp's ridley is a signature species for the Gulf of Mexico, and it has become an icon for conservation. Its story includes a long-term international conservation effort, undertaken by Mexico and the United States, which brought the species back from the brink of extinction. A recently completed IUCN Red List assessment not only evaluated the Kemp's ridley's current conservation status but also provided a rare glimpse into the history of a critically endangered species prior to its decline. The good news from that assessment is that the Kemp's ridley has been gradually recovering from near extinction in the mid-1980s to about 24,000 nests in the 2017 nesting season. The bad news is that historic nesting levels were estimated to be as high as 181,000 nests per season in 1947, and the species is no longer recovering at the exponential rate seen before 2010.

One of the most common challenges in evaluating the status of a threatened species is the absence of historical data about the species' abundance. Many species gain scientists' attention only after they are already threatened. The Kemp's ridley is a rare exception. In the late 1940s a Mexican businessman named Andrés Herrera became driven to find and document the nesting beach of the Kemp's ridley. Over a two-year period he flew his small airplane on 33 reconnaissance surveys, scanning the coast of Tamaulipas, Mexico, in search of nesting turtles. What he ultimately discovered was a phenomenon unknown to science at the time: a coordinated mass nesting event with tens of thousands of turtles coming onshore simultaneously, now known as an arribada. Fortunately, Herrera filmed the event. His 1947 film not only provided the first documentation of this amazing biological phenomenon, but it also provided a historic benchmark of the Kemp's ridley's abundance, when its population was still stable and robust.

The team working on the new IUCN Red List assessment of the Kemp's ridley capitalized on this benchmark by conducting a thorough evaluation of the film. They uncovered previously unreported information about the arribada when the Herrera family graciously provided the personal files of the late Andrés Herrera. The IUCN team also evaluated the historic office files of Henry Hildebrand, who initially reported the Herrera film to the scientific community in 1963. The analysis of the film and related files allowed the team to accurately estimate the number of nests in that single arribada—26,000 to 40,000 nests—but this was only part of the story. An important question remained: How did the size of that single 1947 arribada relate to the size of the entire population?

The idea of how to solve this mystery came to the assessment team during a long research trip to the Kemp's ridley nesting beach at Rancho Nuevo, Mexico. The Rosetta Stone was the recovering Kemp's ridley population itself. In recent years, the large arribadas at Rancho Nuevo beach had resumed after decades. The resurgence of this phenomenon allowed us, for the first time, to determine that the number of nests laid during a single large arribada was 22.15 percent, on average, of total nests for the season (from 2006 to 2014). This was the key to estimate the total nesting population size at the time of the 1947 arribada. We were

AT LEFT: A large Kemp's ridley *arribada* in 2011 at Rancho Nuevo, Tamaulipas, Mexico is an encouraging sign of slow but steady population growth for this species that was once at the verge of extinction. © TONI TORRES

ANNUAL KEMP'S RIDLEY NESTS (1947, 1978–2017)

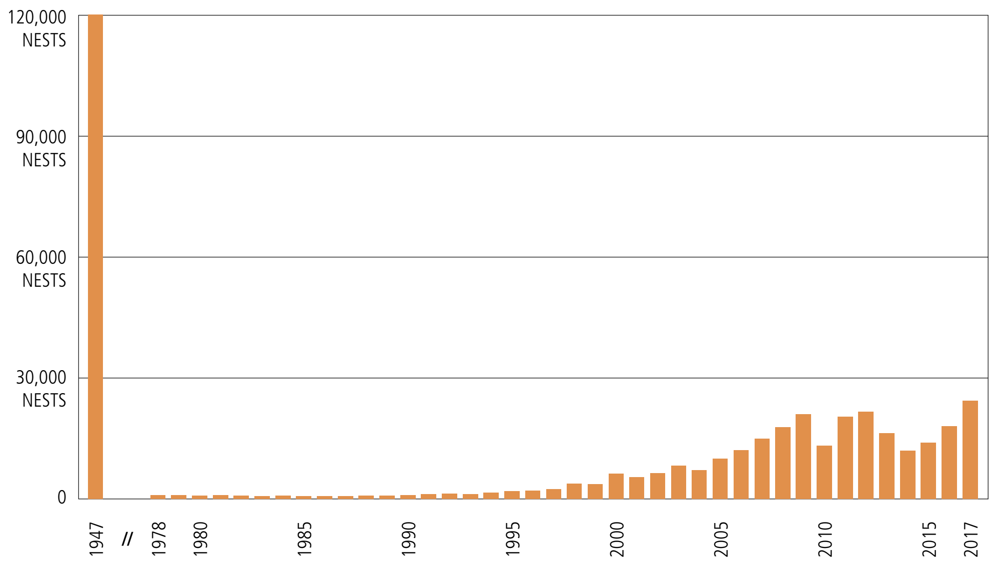


FIGURE: Annual Kemp's ridley nests from 1947, estimated (1947) and observed (1978–2014). Source: Bevan, E., T. Wibbels, B. M. Z. Najera, L. Sarti, F. I. Martinez, J. M. Cuevas, B. J. Gallaway, L. J. Pena, and P. M. Burchfield. 2016. Estimating the historic size and current status of the Kemp's ridley sea turtle (*Lepidochelys kempii*) population. *Ecosphere* 7 (3):e01244.

thus able to estimate that a total of 121,000 to 181,000 nests were laid during the 1947 nesting season, providing a truly rare and important benchmark from the Kemp's ridley's past, before its decline and brush with extinction.

Although the Kemp's ridley has shown significant recovery since the mid-1980s, the approximately 24,000 nests recorded throughout Mexico and Texas in the 2017 nesting season still represents only a small percentage of its historic population size in 1947. The population has also deviated from the exponential recovery it was undergoing from the 1990s through 2009. Nesting numbers actually dropped precipitously during 2010 but have since increased in recent years, hovering at over 20,000 nests per season (see figure).

It is not clear whether the Kemp's ridley will regain its exponential recovery trend or whether the current nesting levels represent the new normal for the Kemp's ridley. One hypothesis is that the species may be reaching its carrying capacity for the Gulf of Mexico in its current condition, which is dramatically different from its condition in 1947. Time will tell. What we do know is that because of an intensive international conservation effort by Mexico and the United States, this species has shown significant recovery since its near extinction in the 1980s. What we don't know is whether the Kemp's ridley will ever recover to its historic levels. ■

GLOBAL STATUS
Critically Endangered

The Kemp's ridley turtle is categorized as critically endangered globally for two reasons: (1) the global population is estimated to have declined by 88–92 percent over the past 67 years (more than three generations), based on the new evaluation of the 1947 arribada size and its context in the annual nesting population; and (2) the causes of the decline have not ceased. Unique among sea turtle species, the Kemp's ridley is represented by a single subpopulation, or regional management unit; therefore, a single global Red List assessment was completed.

The Wayuu

SHEPHERDS OF THE SEA

by HECTOR BARRIOS-GARRIDO

The convergence of human settlements and marine turtles in coastal areas around the globe is well documented, resulting in a long list of traditional groups that count sea turtles among the key elements of their ancient history. Marine turtles are commonly found in the petroglyphs, rupestrian art, and mythical stories among Pacific Islanders, for instance, and sea turtle bones have been found alongside human bones in pre-Hispanic archaeological sites in the Caribbean and elsewhere.

Many indigenous groups around the world revere turtles to this day for their spiritual and cultural values and as a source of food, medicine, and other products that are crucial to their daily lives. In recent decades, as national laws such as fisheries bans and endangered species protections have contradicted traditional uses of sea turtles, some native groups have quietly continued their practices but have

become more cautious about sharing information about their customs with nonfamily members. It can sometimes take years for outside researchers and anthropologists to earn the trust of indigenous people and to develop the intercultural skills needed to gain insights about indigenous cultures and perspectives; as such, modern scientists have barely scratched the surface of understanding the incredible relationships between marine turtles and indigenous people that have remained intact for millennia.

The most populous indigenous nation in both Colombia and Venezuela are the Wayuu, direct descendants of the Arawak people who once inhabited an enormous portion of the southern Caribbean before the arrival of Europeans. The Wayuu's traditional territories today lie mostly in the Guajira Peninsula (for that reason, Wayuus are also colloquially called *Guajiros* in Spanish), with some hamlets also found on the slopes of the Sierra de Perijá mountains on both sides of the Colombia–Venezuela border. This ancestral territory is in the northernmost portion of South America, between Colombia and Venezuela, facing the Caribbean Sea. Hence, the Wayuu's magical and cosmogonic world is full of stories that relate to the sea and its inhabitants.

The Wayuu consider themselves to be the protectors and custodians of an ancient culture based on maintaining a harmonious alliance with nature. They consider natural elements such as mountains, trees, and animals as their kin. Within their matriarchal society, wisdom, beliefs, customs, and ancestral rituals are passed from one generation to the next orally in Wayuunaiki (Wayuu language) through stories and myths and are rarely spoken of in the presence of "Alijünas" (non-Wayuu).

The Wayuu were classified by Europeans during the colonization period in two groups: shepherds and fishers. Wayuu people refer to the latter as Apaalanchi, and for the Apaalanchis marine turtles are an extremely important component of their culture. One Apaalanchi who we interviewed claimed "… they (marine turtles) represent to us what petroleum represents to Venezuela; they are vital for us." In the Wayuu magical realism and belief system, marine turtles are referred to as the "cattle of the sea"; the sea is the Wayuu's backyard, and the coral reefs are the flowers in their gardens. Apaalanchis have their own perspective of the sea, where snappers are considered their goats and Atlantic goliath groupers are their donkeys; in similar fashion, barracudas are dogs, lobsters are hens, green morays are snakes, sharks are jaguars, and so on with all marine fauna. In a nutshell, the Apaalanchis define themselves as shepherds of the sea.

Everything Apaalanchis have is provided by the sea, including their medicine. They use multiple marine species to treat illnesses, and marine turtles play an especially important role in their traditional pharmacopoeia. Up to 11 parts of the marine turtle are used as medicine, and they may be administrated in at least seven different ways. Asthma, rheumatism, high blood pressure, kidney stones, and diabetes are some of the diseases that, according to Wayuu traditions and beliefs, are cured by using marine turtles. Marine turtles are even used as preventive medicine, protecting the Wayuu people from the "bad spirits" that may produce illnesses and death in their community.

AT LEFT: Wayuu community leader Teresa Fernandez from the Urariyu clan poses with a green turtle that she and her family rescued on the Guajira Peninsula.

Marine turtles have many other positive connotations in the daily life of Wayuu people. Dreams of marine turtles are considered messages from Maleiwa (God) and the ancestors. During funerals, sharing turtle meat among the mourners minimizes their pain and suffering, and the Wayuu believe that marine turtles will accompany the deceased to the mythical place of *Jepirá*, where the Yolujas (spirits) wait before returning to Earth as *Juyá* (rain) bringing life to the arid Guajira Peninsula.

Similar traditions are found in West African aboriginal people, who also have strong cultural links with marine turtles. It remains unclear whether these similarities (1) are coincidental, (2) represent cultural co-evolution, or (3) are linked to the proven interactions between African ex-slaves and Wayuu people during and after the colonization period. Research to understand this potential connection is still in its early stages.

Marine turtles also play a vital role in reaching adulthood for Wayuu young people. Young male Apaalanchis must harvest a turtle in front of their family (sometimes in front of all the community) to commemorate adulthood, and young female Wayuu members must shower with "moon water" (water that has been bathed by the light of the moon for a night) dripped from a marine turtle carapace. In this way, both males and females receive all the benefits and properties of marine turtles, including longevity and fertility.

We are still in the process of understanding all the traditional ways the Wayuu indigenous people use marine turtles, and we strive to remain unbiased observers while not promoting the illegal use of marine turtles in the Guajira Peninsula. Instead, we are seeking compromises through in-depth discussion among all stakeholders about the regulations that are needed to include Wayuu traditions and beliefs in the modern legal frameworks for sea turtle protection in Colombia and Venezuela. ■

Building Bycatch Solutions from the Ground Up for the East Pacific Leatherback

by JUAN MANUEL RODRIGUEZ BARON, AMANDA WILLIARD, MARINO EUGENIO ABREGO, ALEXANDER TOBON, DANIA BERMUDEZ, and YEHUDI ARRIATTI

The East Pacific population of the leatherback is one of the world's most threatened marine turtle regional management units (see *SWOT Report*, vol. VII, pp. 20–31) and has already seen dramatic declines (90 percent since 1980) in the number of nesting females at its major nesting beaches in Mexico and Costa Rica. Now there may be fewer than 1,000 adult females in this population owing to a combination of fisheries bycatch, egg harvesting, and other threats. Bycatch of adult and subadult turtles on foraging grounds is of particular concern, given the strong influence that these life stages have on population dynamics. As such, an expert working group was assembled by the IUCN Marine Turtle Specialist Group with support from the National Fish and Wildlife Foundation in 2012 to develop a 10-year regional action plan to halt and reverse the decline of the East Pacific leatherback turtle.

The regional action plan identified numerous actions to address fisheries bycatch, including the characterization and mitigation of impacts on immature and adult leatherbacks in Colombia and Panama, regions for which very little information was available. Subsequently, the Eastern Pacific Leatherback Network (LaudOPO) was formed in 2016 by a number of organizations that had been working at nesting beaches in Mexico, Costa Rica, and Nicaragua, as well as groups coordinating bycatch reduction programs in Ecuador, Peru, and Chile. Within this group, a scientific collaboration was initiated between the Latin American nonprofit JUSTSEA Foundation and the University of North Carolina at Wilmington specifically to address the lack of knowledge about bycatch in Colombia and Panama. JUSTSEA team members were trained by Mexican experts in rapid bycatch assessment methods to ensure that a standard approach would be implemented across the region and that this training was passed on to local fishers in the target study areas in Colombia and Panama.

To date, these fishers have obtained results from 800 surveys in seven Colombian port cities (Tumaco, Buenaventura, Bahía Solano, Juradó, Nuquí, Pizarro, and El Valle) and eight more ports in Panama (Muelle Fiscal, Juan Díaz, Puerto Coquira, Vacamonte, Caimito, Puerto Mutis, Puerto Mensabe, and Remedios). These surveys, coupled with extensive interviews, quantified impacts to a variety of bycatch species, including sea turtles, elasmobranchs, and seabirds. The preliminary results are already helping to identify sites of importance for East Pacific leatherback conservation.

In Colombia, reports of leatherback turtle interactions have been documented through fishers operating out of Juradó, Nuquí, Bahía Solano, and Buenaventura. In Juradó, Nuquí, and Bahía Solano, 12 leatherback bycatch incidents were related to the use of artisanal J hook longlines. In Buenaventura, one fisher reported capturing two leatherbacks while fishing for sharks with gillnets (20-centimeter mesh) near Malpelo Island National Marine Park. Another fisher from this same port reported capturing two leatherbacks just a few months later in the same area. According to fishers and government fisheries observers interviewed in Buenaventura, it is common to see leatherback turtles near Malpelo Island.

In Panama, we received seven reports of entanglements of leatherbacks from the towns of Puerto Mutis and Remedios, all of which reported using longline gear near Coiba National Park, an island approximately 50 kilometers off the Panamanian coast. In addition to providing information about leatherback interactions, our surveys also revealed very high levels of bycatch for other species of sea turtles, seabirds, and migratory sharks in both countries.

Through JUSTSEA surveys under way since 2016, good relationships have been established with local fishers, several of whom now assist by documenting geographic coordinates of leatherback interactions using handheld GPS units. Similarly, partnerships between the Colombian and Panamanian environmental ministries and government agencies in Colombia (Autoridad Nacional de Acuicultura y Pesca, AUNAP) and Panama (Autoridad del los Recursos Acuáticos de Panamá, ARAP) have been successful. Those partnerships will be very important for implementing remediation that will likely arise in the future.

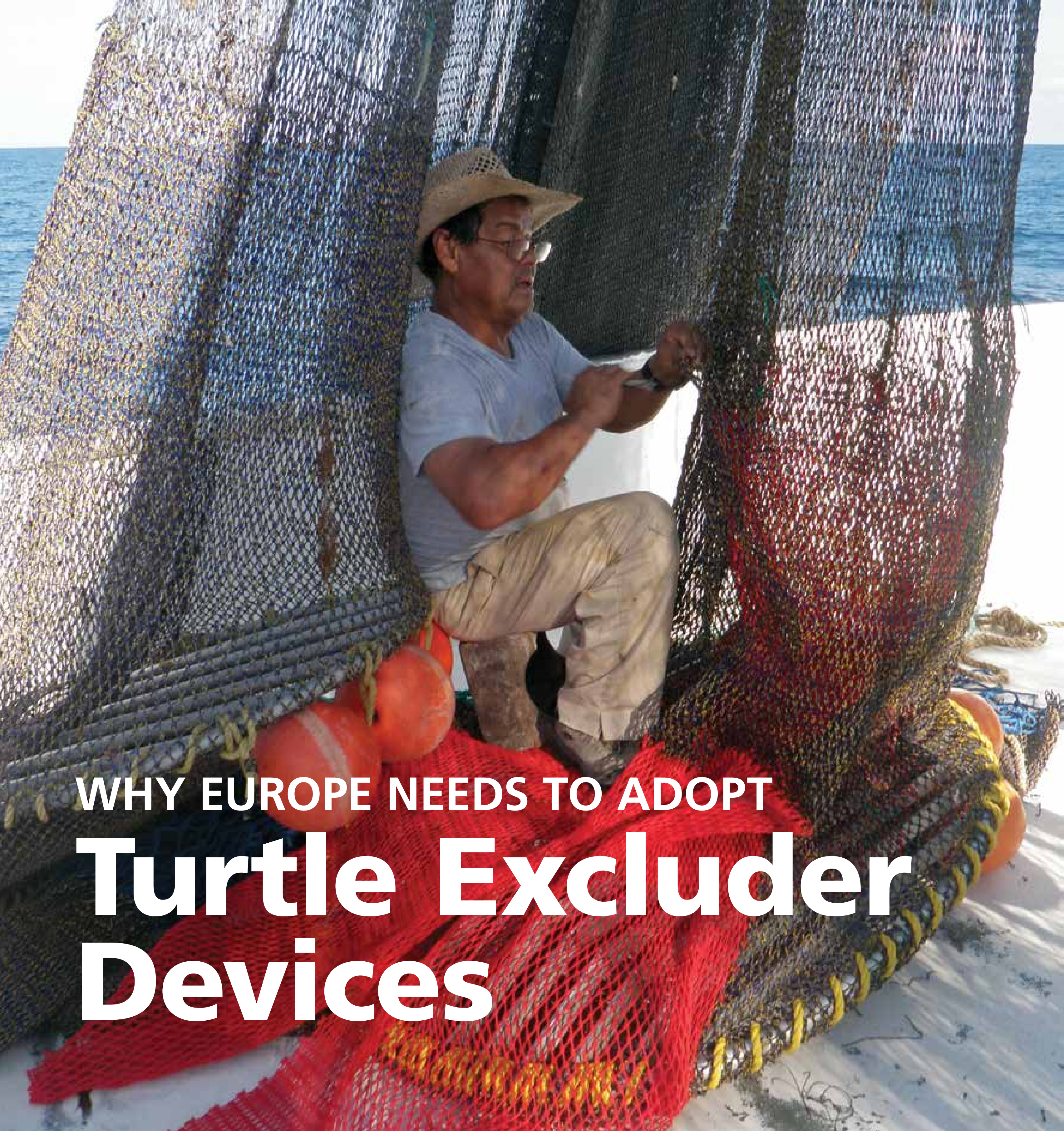
AT LEFT: A severely entangled leatherback shows the dangerous and often lethal impacts of turtle interactions with fishing gear.

Project staff members and participants are confident that the goal of mitigating all bycatch threats to leatherbacks in Colombian and Panamanian waters may one day be achieved through continued collaborative work with fishers and other key stakeholders.

In July 2017, JUSTSEA offered five workshops for more than 150 fishers to (1) share preliminary results of the rapid bycatch assessments, (2) train them in techniques for handling and releasing entangled turtles and seabirds, and (3) train them to use GPS units and digital cameras to record megafauna bycatches, with a special focus on leatherback turtles. In addition, 100 short-handled pigtail de-hookers were donated to fishers who primarily use longline fishing gear. The success of these workshops in Colombia (Buenaventura, El Valle, and Tumaco) was greatly enhanced by the participation of Peruvian fishers who have worked for many years in the bycatch mitigation program led by ProDelphinus (see *SWOT Report*, vol. VII, p. 15). Similar workshops were offered in Panama City and Santiago de Veraguas, with logistical support from the Smithsonian Tropical Research Institute and the University of Panama. Training on best fishing practices and bycatch release techniques at these events was led by representatives of the onboard observers program of National Oceanic and Atmospheric Administration (NOAA) Fisheries in Hawaii. The support of the ministries of the environment and national fisheries agencies mentioned previously was also fundamental to the success of all these meetings.

JUSTSEA and its partners continue to collect survey data at fishing ports to have better resolution of the leatherback bycatch in the American Pacific, and GPS reports of marine megafauna interactions continue to trickle in from project-trained fishers to this day. Moreover, onboard observer programs in gillnet and longline fisheries in both countries are being launched so we can better understand the fisheries and gear types most strongly associated with leatherback interactions and be able to identify best strategies for bycatch reduction.

Data resulting from this project have been shared in several international forums as well, including the International Sea Turtle Symposium, LaudOPO regional meetings, and the meeting of the Scientific Committee of the Inter-American Convention for the Protection and Conservation of Sea Turtles. Furthermore, JUSTSEA will contribute to efforts by the Marine Turtle Specialist Group of the International Union for Conservation of Nature to update knowledge about the conservation status of sea turtles in the East Pacific. Project staff members and participants are confident that the goal of mitigating all bycatch threats to leatherbacks in Colombian and Panamanian waters may one day be achieved through continued collaborative work with fishers and other key stakeholders. ■



WHY EUROPE NEEDS TO ADOPT

Turtle Excluder Devices

by AIMEE LESLIE, THEA JACOB, EMA FATIMA, VINOD MALAYILETHU, MICHEL NALOVIC, and LAURENT KELLE

Trawl fisheries have long been recognized to have major negative impacts on species and habitats, and tropical shrimp trawlers are especially damaging to sea turtles, resulting in turtle deaths estimated in the millions worldwide each year. Turtle excluder devices (TEDs) are grids designed to allow turtles and other marine megafauna to escape from trawls while retaining shrimp. When installed correctly, TEDs exclude at least 97 percent of the turtles with minimal loss of target catch (less than 2 percent). Any losses that do occur are largely compensated for by the other many advantages of using TEDs, such as quicker and safer processing of the catch, less net damage, reduced fuel costs, and higher market prices for better-quality shrimp because crushing by large objects or animals is reduced.

TEDs are a simple but elegant solution for minimizing sea turtle bycatch in trawl fisheries. As such, they are now mandated by many governments around the world and their use is enforced. Regulatory measures have been the key to creating incentives for TED use. American fleets are required by U.S. federal law to use TEDs, and foreign fleets wishing to export wild-caught shrimp to the United States must demonstrate that they are not incidentally capturing marine turtles. More than 40 shrimp-exporting countries now meet the requirements of U.S. Public Law 101-162, Section 609. However, Europe, which is the largest market for fisheries products in the world, has no such regulation and provides an alternative market for countries that do not use TEDs.

French Guiana, in South America, has become one of the most recent tropical shrimp trawl fisheries to implement TEDs. Even though French Guiana does not export shrimp to the United States, being certified under the U.S. Section 609 program allows the industry to receive technical support from U.S. shrimp fishing gear experts. Marine turtles are ubiquitous in French Guiana's Exclusive Economic Zone, and historically they were frequently captured by the shrimp fisher. TEDs were introduced through a collaboration with the World Wildlife Fund to reduce turtle mortality. TEDs have since been adopted voluntarily by local fishers, who subsequently brought the TED issue to the attention of the French national fisheries administration, requesting that TEDs become mandatory in French Guiana.

TEDs are a simple but elegant solution for minimizing sea turtle bycatch in trawl fisheries. As such, they are now mandated by many governments around the world and their use is enforced.

Since then, the French Guiana Regional Fisheries Committee (CRPMEM Guyane) has officially requested that France and the European Union (EU) develop a TED implementation strategy based on the successful collaborative fisheries research model, which promotes and fosters the development of working relationships between fishers, scientists, and managers. A report titled "Wild-Caught Tropical Shrimp Imports into the EU and Associated Impacts on Marine Turtle Populations: The Need for EU Import Restrictions" identifies six countries that export wild-caught shrimp to the EU but are not certified to export wild-caught shrimp to the United States: Bangladesh, India, Indonesia, Madagascar, Thailand, and Vietnam. All of these countries, except for Vietnam, have national regulations requiring TEDs, yet they do not enforce their laws. The report makes the case that by restricting the countries' access to European markets, Europe can potentially save tens of thousands of marine turtles a year.

For example, India is one of the largest exporters of shrimp globally, generating approximately US$6 billion in revenue in 2017 alone. The largest export markets for Indian shrimp, including wild-caught and farmed, are the United States, Europe, Southeast Asia, and Japan. Currently, European markets account for about 30 percent of the farmed and wild-caught shrimp exported from India. Shrimp trawl fisheries pose an enormous threat to sea turtles and their habitats along India's east coast, which includes the olive ridley arribada (mass nesting) sites in the state of Orissa. Trawlers in this region unintentionally entangle turtles in their nets, resulting in more than 10,000 turtles reported as bycatch every year. In response, the local government in Orissa has enacted several protective measures, such as closing areas near arribada sites to trawl fishing during the nesting season and mandating the use of TEDs in trawl nets. Nevertheless, very few trawl operators actually use TEDs, and the threat to turtles persists. The failure can be attributed to varied and complex factors, primarily the poor implementation of regulations, lack of coordination between departments, misconceptions related to TEDs, lack of incentives, and political interests. In response to this dire situation, WWF-India is engaging with multiple stakeholders to address these factors. For example, they are changing the misconception that the use of TEDs causes a 30 percent loss of total catch by carrying out experimental trials with operators on board that clearly demonstrate losses under 2 percent with 100 percent exclusion of turtles. Nonetheless, so far there has been a lackadaisical response from stakeholders in India, perhaps because they perceive their largest markets to be ensured (the United States for farmed shrimp and the EU, which does not require TEDs, for wild-caught shrimp).

The main European countries that receive shrimp exports from the six tropical export countries that are not certified to export wild-caught shrimp to the United States are Belgium, Denmark, France, Germany, Italy, the Netherlands, and the United Kingdom. Although the EU has made important progress toward creating a more sustainable fishing industry in its waters and abroad, it needs to address the lack of TED use in wild caught shrimp imports as an important step toward sustainability and as part of its ongoing conservation efforts and international environmental obligations. Accordingly, European businesses, consumers, and governments should implement measures to ensure that wild-caught tropical shrimp imports are sourced from fisheries that follow voluntary restrictive measures and therefore are not implicated in marine turtle bycatch.

Following the publication of its report in February 2017, CRPMEM Guyane, together with WWF-France, have brought this issue to the attention of the French government. France's ministry of the environment recognized the importance of the topic and the need to regulate tropical shrimp imports at the EU level. France, including the French National Fisheries Committee, has been very supportive of the initiative. France's environment minister at the time, Ségolène Royal, committed strongly to this effort and in March 2017 asked the European Commission to regulate and control tropical shrimp imports and create incentives for all stakeholders to modernize their shrimping fleets and practices.

As the only country fishing for tropical shrimp in EU waters and as a significant importer of wild tropical shrimp, France could play a leading role in addressing the problem of turtle bycatch in shrimp trawl fisheries. Its government could rally other importing EU countries and reach out to the European Commission to create and implement coherent regulations that would include providing technical support to exporting countries to develop TED capacity-building programs and implementation. The time for action is now. ■

AT LEFT: A trawl captain installs and adjusts a TTED as part of testing trials in Texas. © MICHEL NALOVIC

ITAPUÃ, BRAZIL
A Case Study for Urban Engagement in Turtle Conservation

by EDUARDO C. SALIÉS, NATHALIA BERCHIERI, LILIANA P. COLMAN, MANUELA R. B. BOSQUIROLLI, ALEXSANDRO SANTOS, FREDERICO TOGNIN, MARIA A. MARCOVALDI, VALÉRIA ROCHA, and PAULO H. LARA

For 37 years, Projeto TAMAR (the Brazilian Sea Turtle Conservation Program) has been monitoring and protecting the five sea turtle species that occur along the Brazilian coast: loggerhead, hawksbill, green, olive ridley, and leatherback. During this time, the number of protected nests has risen from 62 (in 1982–83) to approximately 30,000 (in 2016–17) thanks to an array of successful conservation programs, from hatchery management and beach protection, to training and environmental education with local communities. Brazilians living near TAMAR project sites have become increasingly aware of and involved with marine conservation and are now TAMAR's closest allies in turtle protection. Currently, 97 percent of turtle nests each year are left in situ in Brazil; only those found in areas of extremely high urbanization or intense beach use are relocated to open-air hatcheries.

The city of Salvador in the northeastern state of Bahia was established in 1549 as Brazil's first capital, but it was not until the 1950s that it began to expand vastly to house a growing human population. Unregulated expansion of tourism was most significant near the beaches, and that development degraded habitats because of coastal armoring, intense beach use, and artificial lights. An excellent illustration of the degradation can be found in the turtle nesting area at Itapuã, a coastal neighborhood of Salvador with high-density housing, hotels, and businesses along a five-kilometer stretch of beach that remains important for turtle nesting.

During the 1990s, the strategy adopted by TAMAR in Itapuã was to relocate all nests to a safer beach farther north. However, more recently TAMAR has been mapping the entire coastal zone, identifying areas where nests could safely remain on the beach (in situ) and areas where natural nests would face threats, including intense beach use during the day, poaching and artificial lights by night, vehicle traffic, and more. At the same time, researchers identified community stakeholders from public, private, and civil society institutions, focusing on those who could be potential partners in protecting sea turtles. Members of the municipal government—the military and environmental police, public sanitation, lifeguards, and zoonotic control—were identified as possible partners. Hotels and resorts, schools, and local businesses were among private sector partners, and among civil society organizations, TAMAR identified local neighborhood and surfing associations.

Meetings were held with all stakeholders, and monitoring strategies were developed to ensure that nests could be safely left in situ. The long-term, early-morning daily patrols conducted during the nesting season by TAMAR would continue to identify and mark natural nests, and their daily protection would fall to other stakeholders. Responsible parties were subsequently trained by TAMAR staff in the proper protocols and procedures for managing the nests and hatchlings, recording nest predation by domestic animals, and helping females and hatchlings who are disoriented by artificial lights as well as females coming ashore to nest during the day at moments of intense beach use.

During the daily monitoring of the beach, the local TAMAR employee (or tartarugueiro) erased all signs of turtle presence on the sand to ensure that turtle activities remain unnoticed by beach users who might potentially disturb the nests. Clutches that were deemed to be at risk of tidal flooding or damage by beach erosion, or that were in areas with intense beach use, were relocated by TAMAR to safer beaches nearby. Turtle disorientation and anthropogenic disturbances such as poaching were meticulously recorded by TAMAR and the partner network for use as a metric for evaluating the effectiveness of the strategy. The use of instant chat apps as a tool to involve citizens in exchanging information with the local stakeholders kept citizens involved throughout the nesting season and beyond.

Simultaneously with fieldwork, TAMAR launched environmental awareness campaigns in the study area, called TAMAR na Escola (TAMAR in the school) and Nossa Praia é a Vida (our beach is life). The first of these campaigns promotes activities for schoolchildren related to sea turtle biology and threats, and the latter led actions on the beaches during the nesting season, including exhibitions, beach cleanups, and hatchling releases. The programs did a great deal to raise the awareness of local residents,

Hatchlings return to sea as part of environmental awareness activities with local communities. © PROJETO TAMAR / FUNDAÇÃO PRO TAMAR BRASIL

tourists, and beach users. These types of activities and other communications and outreach work have brought the local community together in mitigating the potential impacts and conflicts related to sea turtle nest management.

Through a social media network coordinated by TAMAR, all stakeholders receive regular updates on nesting numbers, environmental awareness activities, and hatchling releases, along with information on disoriented hatchlings and other topics. Local news media have also been critically important for sharing the conservation message with a broader national and international audience. To avoid potential damage to nests from curious beachgoers, at no time was information about a nest's exact location shared publicly.

The attention drawn to this project by the media, along with the school and public outreach activities, strengthened the team. It was clear for those in TAMAR that this new panorama of activities brought feelings of happiness and responsibility toward marine conservation among the partners and the local community members. The live coverage of the hatchling releases and beach exhibitions reached local and state media as well, being broadcast to thousands of people across Bahia state. The high visibility contributed to an even greater empathy toward sea turtles and a public understanding of the broader marine conservation message.

When TAMAR started monitoring Itapuã beach in 1990, because of the intense human pressures at that time, staff had to relocate nearly all nests to ensure that hatchlings would survive. In the ensuing years, enhanced local participation in the protection efforts made it possible to increase in situ protection of nests from only 3 nests in 1990 to more than 140 nests in 2016–17, and in the past year only three anthropogenic disturbances of turtles were reported.

TAMAR has learned through its nearly 40 years of experience that local community involvement is the only way that long-term conservation of species can be effectively achieved. During the next phase of work at Itapuã—to achieve sustainable coexistence between sea turtles and urban nesting beaches—TAMAR will no longer conduct daily monitoring patrols, thereby reducing costs and allowing the program to focus its efforts on monitoring priority areas only. The strong relationship with the local stakeholders will help to ensure that turtles will be cared for and their nests protected. When TAMAR encourages the involvement of local communities in conservation, as it has done at Itapuã, it is ultimately promoting awareness for the future generations. ■

Addressing the Plastic Pollution Challenge in Uruguay

by DANIEL GONZÁLEZ-PAREDES and ANDRÉS ESTRADES

A broadly quoted MacArthur Foundation study claims that "by 2050, there will be more plastic than fish in the world's oceans." This nightmare scenario could become reality if humans continue to produce plastics at predicted rates, and if we continue to fail to dispose of those plastics properly. The current output of plastics exceeds 300 million tons annually, of which an estimated 8 million tons or more end up in the oceans, an amount roughly equivalent to 500 billion plastic drink bottles every year. This uncontrolled buildup of plastic waste in the ocean threatens marine ecosystems and species in many ways, from lethal ingestion, to bioaccumulation of plastic-based toxins in the tissues of sea life, to entanglement, and much more. These persistent and highly buoyant pollutants fragment into increasingly smaller pieces when subjected to the action of ocean currents and winds, and the minute particles ultimately accumulate into a sickening slurry of plastic waste and biomass in enormous garbage patches that can now be found in nearly every ocean gyre.

Uruguayan waters are considered an important foraging and developmental habitat for marine turtles in the southwestern Atlantic Ocean. In particular, these waters host a mixed stock of early juvenile green sea turtles that feed mainly on macroalgae and gelatinous macrozooplankton, among which small plastic fragments are found more and more frequently and are easily mistaken by turtles as food. The ingestion of plastics can manifest as sublethal effects on turtles' health, such as a decrease in nutritional gain, but it can also lead directly to their death by starvation by blocking the digestive tract. Not surprisingly, each year dozens of weakened and dead turtles are found stranded along Uruguay's 710 kilometers (441 miles) of estuary bank, beaches, and rocky shores with clear evidence of plastic ingestion. Based on studies of stranded sea turtles in Uruguay, estimated mortality from plastic ingestion has surpassed bycatch deaths to become the primary cause of strandings.

Since 1999, the Uruguayan nongovernmental organization Karumbé has worked on all aspects of sea turtle research and conservation, and in recent years Karumbé has focused a good deal of its attention on the issue of plastic pollution around three complementary pillars: preservation, research, and education.

PRESERVATION

Karumbé has built a stranding and rescue network that is served by two rehabilitation centers that help weak and injured animals recover to healthy status before being released to the sea. The successful implementation of this network began with the education and training of specialized technical staff to deal with sea turtles suffering from health effects of plastic ingestion. The network launched information campaigns using social media that were aimed at increasing the number of rescued turtles along the Uruguayan coast, and they have drawn the attention of a significant number of volunteers and concerned citizens. This increase in public engagement has exponentially increased the stranding and rescue alerts received by the organization, and Karumbé now rescues and recovers more than a hundred turtles per year.

RESEARCH

To improve our understanding of the dynamics and impacts of plastic pollution in Uruguayan waters, Karumbé has undertaken a multidisciplinary program that uses hydrodynamic and oceanographic dispersal models to determine the drift trajectories and transport patterns of plastic debris. In addition, necropsies and veterinary observations provide detailed evaluations of the effects of plastic pollution on the health of stranded sea turtles. The results are helping to develop risk assessment protocols for plastic ingestion in sea turtles; such protocols will ultimately help to design effective mitigation strategies and conservation plans.

EDUCATION

Karumbé strongly believes that to have long-term success and public support, all its preservation and research efforts in Uruguay must be closely linked to increased environmental awareness. Karumbé's education programs and actions address many different sectors of society:

- **Coastal communities.** The Karumbé team provides workshops on topics such as responsible consumption, litter management, and recycling to raise awareness and empower locals to solve the problem of plastic pollution in their own neighborhoods. They also offer specific training (for example, How to Rescue a Stranded Turtle, and First Aid for Injured Turtles) to those sectors with a relevant official presence on the Uruguayan coast, including Coast Guard officials, lifeguards, and fishermen.
- **Schoolchildren.** Educational programs for schools are also offered, in which students learn about sea turtle biology, habitats, and threats. In recent years, some schools have sponsored injured

turtles, with students regularly monitoring the health and recovery of these turtles until they are released to the sea.

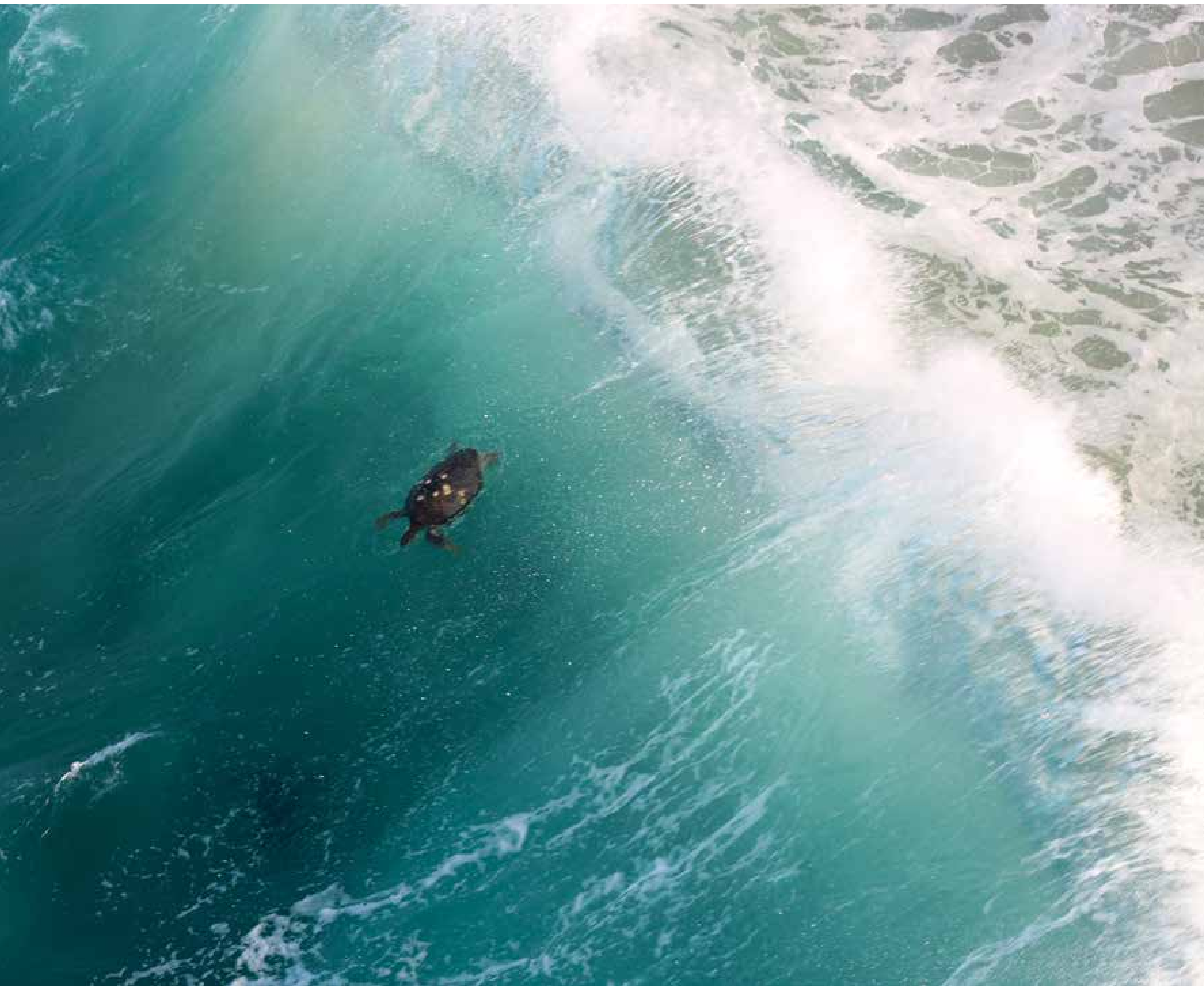
- **General public.** Karumbé operates two visitor centers in strategic locations along the Uruguayan coast (at La Paloma and La Coronilla). Through guided tours, visitors receive information about sea turtles while passing through different sections. One section is exclusively dedicated to the theme of Plastic vs. Sea Turtles; in this section, people see explicit examples of the impacts of plastic pollution on turtle health, such as samples of gut contents. Visitors can also observe live turtles in the rehabilitation pools and witness the daily tasks of the veterinary staff. These modest centers receive around 15,000 visitors every year.
- **Special events.** Occasionally Karumbé hosts turtle release events at which recovered animals from the rehabilitation facilities are returned to the sea. All those wishing to participate in these emotionally rewarding events are invited. The ceremonies begin with a general presentation about marine turtles and conservation. Staff explain the story of the individual turtle being released, how it wound up with so much plastic in it, and how the recovery process took place. Participants engage in games, songs, and dances until the culmination of the event, when everyone comes together on the shore to return the turtle to the sea. These ceremonies are the highlight of Karumbé's work and are without a doubt the best way to assure that the message of conservation becomes deeply rooted within the Uruguayan people.

Although the threat of plastic pollution in the worlds' oceans looms large, the battle is not yet lost. The solutions lie within the power of humans. More and more people are already demanding changes in policies and changes in plastic production and consumption patterns worldwide. Our responsibility as conservation organizations is to spread the message as widely as possible and to raise awareness about marine turtles among as many people as possible. Perhaps this will be a long and arduous path, but as one of Uruguay's most renowned writers, Eduardo Galeano, once said, "Many small people, in small places, doing small things, can change the world." ■

TOP: Plastic ingestion is now the leading cause of sea turtle strandings in Uruguay. © KARUMBÉ NGO; BOTTOM: A rehabilitated green turtle is released to the sea after recovering at one of Karumbé's rehabilitation facilities. © RUTA TORTUGUERA

MICHOACÁN'S BLACK TURTLE
Back from the Brink

by CARLOS DELGADO TREJO



The rugged, vast expanse of Mexico's Pacific coastline is the setting for one of the most inspirational sea turtle conservation success stories of all time. Located halfway between the resort cities of Acapulco and Puerto Vallarta, the coastline of Michoacán is comparatively quiet and secluded. Broad, sandy beaches here provide ideal nesting habitat for the black sea turtle. Once believed to be a separate subspecies of green turtle found only in the Eastern Pacific, it was formerly considered among the most threatened sea turtle populations in the world.

The black turtle, known locally as tortuga negra or tortuga prieta, is actually a somewhat genetically distinct variety of the globally ranging green turtle (*Chelonia mydas*), which is known to occur in many colors, shapes, and sizes (see *SWOT Report*, vol. VI, p. 34). The black turtle thrived in Mexican waters until the late 1960s, when intense harvesting of eggs and adult turtles led to drastic declines. Harvest data from the period indicate that the black turtle population was particularly abundant in the early 1960s. According to information from Colola Beach, 70,000 eggs per night were harvested during the peak of the 1965 nesting season. It is estimated that 25,000 black turtle females nested there at that time. However, according to René Márquez, a researcher at the Mexican National Fisheries Institute, harvests exceeded 4,500 metric tons (4,960 U.S. tons) from 1966 to 1970. That intense, unsustainable pressure resulted in a near collapse of the black turtle population, and by 1988 as few as 170 nesting females remained on the Michoacán beaches of Colola and Maruata.

Much of the data on the decline can be attributed to American biologist Kim Cliffton, a researcher at the Arizona-Sonora Desert Museum, who began aerial surveys of the region in 1978 to better understand black turtle distribution and abundance in Pacific Mexico. At that time, Cliffton reported significant nesting on at least 12 beaches along the Michoacán coast; the highest nesting concentrations were at Colola and Maruata, which combined accounted for approximately 48 percent of total nests in the state.

Researchers began to respond to the population crisis in 1982. That year, Javier Alvarado-Díaz, a professor in the biology department at Michoacán University of San Nicolás de Hidalgo, led a trip to Colola and Maruata to begin systematic research and conservation of the black turtle. Despite the best efforts of Díaz and his team, the population continued to decline from 1982 to 1999, with the most drastic declines recorded in 1988 and 1998.

Part of the challenge the researchers faced was that the pressures from elsewhere in Mexico and the American Pacific also contributed to the decline. Working on the Baja Peninsula, Wallace J. Nichols, a scientist at the California Academy of Sciences, estimated in 2002 that in Baja California alone between 7,000 and 15,000 black turtles were captured for human consumption, despite the Mexican ban on sea turtles and products that had been in place since 1990.

But in 2001, the outlook was beginning to improve for the black turtle. The number of protected nests on the beaches of Colola and Maruata increased significantly. The number of reproductive adults reported in Michoacán also increased for the first time, thanks to improved conservation efforts in Baja California led by Grupo Tortuguero de las Californias. The increase in the number of nesting females has remained steady, and we estimate that approximately 10,000 black turtle females now nest on Colola beach alone. Considering that black turtle nesting is also occurring on adjacent beaches such as Motín del Oro, Paso de Noria, Arenas Blancas, and La Llorona, we estimate that the black turtle nesting population in Michoacán is at approximately 15,000 females. That figure represents a 60 percent increase from the estimated population in the early 1960s. One particular highlight was a nesting event on September 14–15, 2014, during which 1,086 nesting females came ashore at Colola—something unheard of since the mid-1960s—demonstrating the success of local conservation efforts.

THIS PAGE: Black (green) turtles aggregate for mating off of Colola, Michoacán, Mexico. © CARLOS DELGADO-TREJO; AT LEFT: A black (green) turtle in the surf near Colola, Michoacán, Mexico. © CARLOS DELGADO-TREJO

Thirty-five years after the start of conservation activities in the eastern Pacific, researchers are seeing encouraging signs of recovery for the black turtle population, and it is now considered one of the 12 healthiest sea turtle populations in the world (see *SWOT Report*, vol. VII, pp. 20–31). The research that has accompanied those conservation efforts—including tagging of almost 12,000 females in Michoacán—has resulted in important information about the natural history of the black turtle, such as life history traits (age of sexual maturity, clutch size, reproductive and nesting intervals, and much more) and has also shed light on reproductive and foraging behaviors, adult migratory routes, reproductive ecology, conservation status, and hatchling and operational sex ratios.

The recovery of the black turtle is the result of an unprecedented regional effort involving both indigenous communities in Michoacán and fishing communities in the states of Baja California, Sinaloa, and Sonora in northwestern Mexico, as well as conservation activities in Guatemala and Costa Rica. Institutions that have steadfastly supported black turtle conservation in Michoacán over the past 35 years include the U.S. Fish and Wildlife Service, World Wildlife Fund (WWF-US), the Gladys Porter Zoo, Sea Turtle Inc., and Billion Baby Turtles.

The recovery of black turtles in Michoacán is an example of how community-based conservation is a key element in the recovery of sea turtle populations around the world. In particular, it would not have been possible without the valuable intervention of the Nahuas indigenous communities of Colola and Maruata. This is especially true of the younger generations, who adopted conservation as a way of life and have been committed to bringing the black turtle back to their communities as an important icon for their culture. ■

Scientific Tourism, Fibropapillomatosis,

AND LEARNING TO STAY OUT OF NATURE'S WAY

by MARCELO RENAN SANTOS and YHURI NÓBREGA

Who would you take to a desert island?

It is seven o'clock in the morning, and we are on an old wooden pier in a mangrove swamp on the south coast of Bahia, Brazil. After a night spent on a bus, our group boards two traditional fishing boats heading to Coroa Vermelha Island, a coral reef 13 kilometers offshore. Students of veterinary medicine and biology, journalists, an economist, an architect, a sales representative, and a retiree—we make up quite a diverse team. For some, it is the first time at sea. For us, as sea turtle researchers, it is a perfect opportunity to transmit the message of sea turtle conservation to a special audience in what we hope is a transformative way. Our shared goal is to capture juvenile green turtles for health assessment and blood sampling.

We spend three days together camping on Coroa Vermelha, a tiny atoll with no fresh water and no human structure to provide comfort and shelter. Despite these seeming discomforts, the group is keen to participate in our research effort and to assist in capturing turtles and getting to know them close-up. The participants go through a transformative experience in the marine environment that simultaneously advances our research to understand a little more about green turtle fibropapillomatosis (FP). The entire expedition was funded by the participants in a form of scientific tourism that links research goals with environmental education. And it worked! Not only were our scientific objectives achieved, but our diverse participants now have a greater and more personal connection with the sea and are aware of how and why we need to keep it healthy.

In three scientific tourism expeditions to the island of Coroa Vermelha, we were able to verify the presence of turtles with FP and to evaluate their overall health. Incidence of FP is low on the island in comparison with the Brazilian coast, but it is present in the turtles of Coroa Vermelha and also those in the Abrolhos Archipelago, a marine national park that lies 55 kilometers (34 miles) east of the island. It is there that we made the first report of the disease in 2015 and demonstrated that sea turtles are affected by this insidious disease even far from continental shores. In mainland Brazil, there are reports of FP in green turtles up and down the coast, and the incidence is highest near areas with significant agricultural activity. In contrast, oceanic islands like the Rocas Atoll (240 kilometers, 150 miles, offshore) and Trindade (1,200 kilometers, 745 miles, offshore) have no reports of FP. Similar disparities have been reported elsewhere in the world.

FP is a type of cancer that affects the skin of turtles, who develop tumors that can reach the size of a melon. In some places, the incidence of tumors in internal organs is common; but in Brazil, this is unusual. Some turtles may have a few small tumors and still be very affected, whereas others with larger tumors appear to be in good condition. Affected turtles suffer debilitating symptoms as tumors rob them of energy and disrupt swimming, feeding, and vision. The large cauliflower-like external tumors are ugly masses and are subject to injury by predators or by contact with stones and corals. They can become gateways for opportunistic infections.

The disease is related to a herpes virus (ChHV5) specific to sea turtles. Although this virus has lived with turtles for hundreds or thousands of years, it has only caused the disease since the 1930s. Perhaps environmental factors that have not yet been well defined, such as pollutants and algal toxins, play a role in the development of the disease. However, its transmissible feature has already been proven and manifests itself through high rates of occurrence in polluted, low-flowing waters where turtle densities are high. During their pelagic phase, hatchlings are far from the apparent sources of the disease, becoming infected later as they grow and return to the coast where they are exposed to environments with FP. The incidence

Members of the Marcos Daniel Institute's scientific tourism expedition in action. © LEONARDO MERÇON

can vary widely between relatively close locations, and this variation is related to the mobility and habitat-use characteristics of juvenile green turtles.

Initially, the worst was feared: the disease would drive green turtles to extinction. But fortunately, green turtle populations have been recovering in various parts of the world despite the threat of FP. Indeed, some turtles do recover from the disease: they become adults without tumors, and they can reproduce and transmit resistance genes to their offspring.

There is still much to discover about FP. Our SWOT-supported group (see *SWOT Report*, vol. XI, p. 44) has collected incidence data in some parts of the Brazilian coast, thereby confirming the epidemiological characteristics of fibropapillomatosis and also verifying that this disease is not alone. Other diseases affect sea turtles. We have observed a high rate of turtles without tumors with low weight and poor body condition on Coroa Vermelha Island. This draws attention to the need for a broader view on the health of green turtles, taking into account that disease manifestations in free-living wildlife reflect a complex network of ecological interactions between various pathogens, their hosts, and the environment. Fibropapillomatosis is not a monologue character in which green turtles are the stage, but a part of a much more complex drama involving human beings and their interference in the functioning of the planet.

Perhaps the biggest lesson we have learned from FP is that we have to be more aware of the resilience of turtles. Even an evil such as FP has not been able to limit the populations of green turtles from reproducing and continuing their struggle for survival. Humans have not aided the green turtle's recovery from widespread FP infections; if the turtles are recovering, the merit is theirs. Our role in this effort is to understand the phenomena and to apply that knowledge to develop practices that minimize our negative interference in the marine ecosystem. That is the lesson we must take home and ultimately act on. Our daily lives greatly affect the health of the marine ecosystem, but we are not very effective in helping the ecosystem recover. Yet the strength of nature and its ability to reorganize and go its way is tremendous. We should do our human best to stay out of nature's way. ■

WHY SHARING DATA WITH SWOT IS GOOD FOR YOU

...and good for your turtles

by BRYAN WALLACE, RODERIC MAST, BRIAN HUTCHINSON, and CONNIE KOT

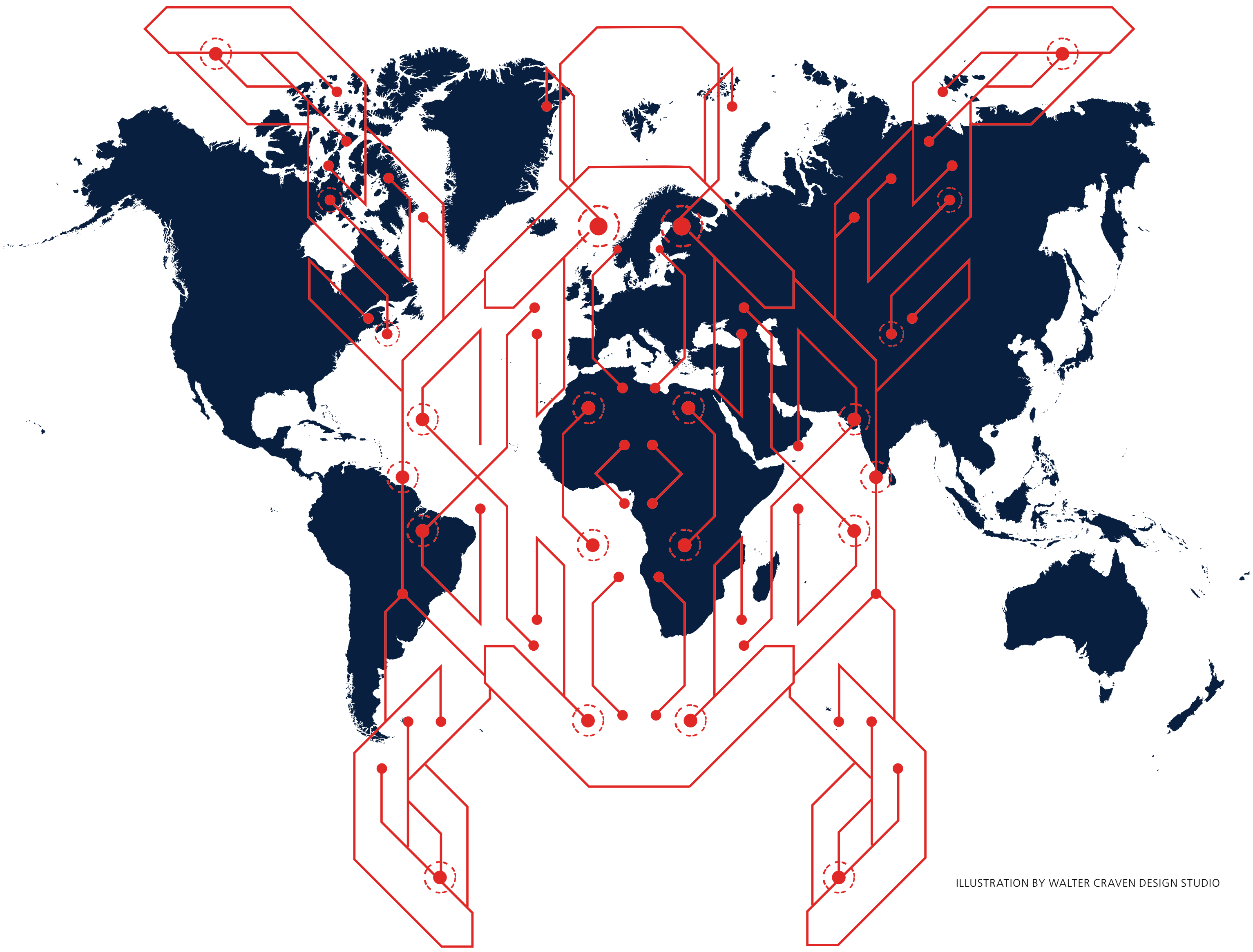


ILLUSTRATION BY WALTER CRAVEN DESIGN STUDIO

What is the SWOT program, really? What role does it play in the sea turtle world? At its core, SWOT is a platform for *sharing* information, data, and resources to enhance sea turtle conservation worldwide. SWOT's products include the annual *SWOT Report*, the regularly updated SWOT database of sea turtle biogeography, maps that are published online and in print, a website (**http://seaturtlestatus.org**), annual small grants, and more. Among all those products, the best example of what SWOT is and does is the SWOT database of sea turtle biogeography, which is a central feature of the SWOT effort.

Since SWOT began compiling information with a single year's of nesting abundance data for a single species (the leatherback) back in 2004, the goal has always been to facilitate and encourage the sharing of knowledge within a global network to get the greatest conservation value possible for all the world's sea turtles. Through its database, SWOT brings sea turtle researchers together virtually and physically through shared information, then synthesizes the data to create products and tools that make our collective conservation work more effective.

From modest beginnings, the SWOT database has grown incredibly. It now contains data from more than 500 people and organizations, representing in excess of 3,000 nesting beaches in over 100 countries. It also contains telemetry data from more than a thousand satellite tracked sea turtles, as well as freely downloadable shapefiles featuring global distributions, regional management units, and genetic stocks for all species. And all of this is easily accessed by the public at **http://seamap.env.duke.edu/swot**. It is important to recognize that the data SWOT compiles does not belong to SWOT, but rather to all of the people who have gathered them and openly chosen to share them through the platform SWOT provides.

Although this range of data might seem impressive, the data housed in SWOT for most nesting sites are several years old, and very few sites have more than a year or two of data. Therefore, the SWOT database is not yet able to achieve its long-term goals to be a truly global resource for (1) tracking changes in turtle population abundance through time, (2) identifying key areas for focused conservation and research, and (3) contributing to marine policy and management in areas within and beyond national jurisdictions. These are not just SWOT's goals; they are big gaps in sea turtle conservation globally.

The State of the World's Sea Turtles Program (SWOT)

OUR VISION

A permanent global network of specialists working to accelerate the conservation of sea turtles and their habitats—pooling and synthesizing data and regularly sharing the information with audiences who can make a difference.

WHY SHARE DATA?

Sharing is the key to making SWOT work. That should be easy, right? We've all been taught to share with others from the time we were in diapers, begrudgingly taking turns with our toys in the sandbox. But sharing isn't always simple. Sharing is especially hard when it comes to things we care about greatly, have invested a lot in, or deeply identify with personally or professionally. So why share data? Here are some reasons to consider.

1) **Have strength in numbers.** Ask yourself: how broadly can you apply your results about abundance, trends, behavior, habitat use, and other things if data come from a single site or only a few sites? Would your sample size or geographic scope be sufficient by itself? Or might the data have even more impact and interpretative power if they were combined with similar data from adjacent areas, or even in regional or global contexts? Sharing can help make the most of your data.
2) **Make new friends.** Do you have all the skills in-house to do the types of analyses you want to do? Do others outside your project or your field site have similar data that might be relevant for your work? Sharing can foster new collaborations and insights that can benefit you, your project, and sea turtle conservation globally.
3) **Make an even bigger impact.** How many and what kinds of products have your data been used for? Have your data informed regional or international policy or management? By sharing, you can make sure that big picture analyses, policies, and conservation plans include your data and your perspective.

WHY SHARE DATA WITH SWOT?

Over our years of requesting data contributions to SWOT, we've learned a lot about sharing—mostly about why it doesn't always happen. There are a handful of common reasons why people don't share data with SWOT, and our responses can be summarized like this:

Reason #1: I want to publish my data before sharing with SWOT.
SWOT's response: Contributing data to the *SWOT Report* and the SWOT database absolutely does not preclude you from publishing your data elsewhere. The *SWOT Report* is a magazine, not a scientific publication, and data contributed to SWOT are simply displayed, not analyzed. You can publish your data whenever and wherever you want! There are countless examples of people contributing data to some collective database or broader-scale analysis project in addition to publishing their own data in their own way (for example BirdLife International's Important Bird Areas).

Reason #2: We need to protect our project's or students' data.
SWOT's response: No problem! SWOT has very robust data protections in place, including a thorough "Terms of Reference" for data providers, which outlines explicitly that SWOT will not share your raw data with others without your permission, following a formal request process. Additional steps may be taken to protect your data upon request, such as reporting binned values only rather than raw count data. The bottom line is, data provided to SWOT are not SWOT's data; SWOT is merely a repository for those data. The data providers are the data owners.

Reason #3: That's all great, but still, no.
SWOT's response: Okay, maybe some time in the future! We understand that there could be a variety of reasons for not sharing data, and we are open to discussing them further with you. Please feel free to contact us with any questions and concerns so that we can be aware of them and find ways to address them. All are welcome, and there is strength in numbers and power in community (think of the ways you already participate in synergistic global communities from Airbnb to Facebook), so we hope you'll consider contributing again in the future!

SWOT takes the responsibility of data stewardship very seriously, and we continue to strive to be a free reference tool and a global monitoring system to support sea turtle conservation around the world. Despite the challenges, we have already achieved a lot. Nesting data contributed to SWOT became the anchors for delineation and assessment of regional management units (RMUs) for all sea turtle species worldwide. SWOT data have provided a catalyst for dozens of innovative conservation research projects and for many school and university GIS course requirements. SWOT data have also given life to first-ever global and regional maps that include both nesting and telemetry data for multiple sea turtle species (see maps in this issue and in past *SWOT Reports*).

And we're not done yet. We have big goals for supporting sea turtle conservation around the world. SWOT is partnering with Duke University's Marine Geospatial Ecology Lab on a project to define marine migratory corridors around the world to help international policymakers see the importance of those areas for marine management outside national jurisdictions. SWOT has also helped launch an effort to define Important Marine Turtle Areas, akin to BirdLife International's Important Bird Areas, to fill a major data gap in marine conservation policy.

For SWOT to reach our long-term goals, we need the continued contributions of the SWOT team—you! So, please keep those data coming, tell us how we're doing, and suggest what we can do better.

Who knows? You might even like the feeling you get when you share. ■

Acting Globally

SWOT Small Grants 2017

SWOT small grants have helped field-based sea turtle research and conservation partners around the world realize their goals since 2006. To date, 73 grants have been awarded to over 50 applicants in 42 countries and territories for work addressing three key themes: (1) networking and capacity building, (2) science, and (3) education and outreach. The following are brief updates from our 2017 grantees. Visit **www.SeaTurtleStatus.org** to apply for a 2018 SWOT small grant!

CABO VERDE

Projeto Biodiversidade

Cabo Verde is home to the third-largest loggerhead subpopulation in the world. However, illegal harvesting of turtles and eggs remains a serious threat to these endangered animals. Recognizing that community engagement is a crucial element to conservation success, Projeto Biodiversidade has been working to educate and empower local people for many years. This SWOT grant will help to train five prominent community members in conservation techniques, data collection, and conflict management skills.

DEMOCRATIC REPUBLIC OF CONGO

ACODES

Four species of sea turtles are found in the DRC's Muanda Mangrove and Marine Park, where they face pressures from poaching, beach erosion, and fishery bycatch. Since 2006, ACODES has led an awareness campaign for children to encourage environmentally friendly values and behaviors and to teach sustainable fishing practices. This SWOT grant will support an effort to reach roughly 6,000 schoolchildren and 350 fishermen in nearby communities that total 100,000 inhabitants.

GREECE

Kostas Papafitsoros

The Greek island of Zakynthos is a popular tourist destination and is renowned for its nesting and foraging loggerheads. Wildlife-watching operators rely on tours focused on seeing turtles, yet laws protect turtles on the beach only during nesting season (May–October). This SWOT grant will be used to examine foraging behavior of resident turtles, measure tourism pressure, develop best practice guidelines for wildlife operators, and expand regulations to include protection of turtles in foraging areas.

INDIA

Wildlife Institute of India

There is limited information on olive ridley nesting in northwestern India, where peak nesting coincides with the monsoon season. That unique characteristic may indicate a distinct subpopulation. This SWOT grant will support intensive beach monitoring in underexplored areas in the state of Gujarat that are known nesting sites for greens and olive ridleys. The research will serve as a model for other nongovernmental organizations and government agencies working in this little-known region.

MALDIVES

Atoll Ecologists Programme

The Maldives is home to five species of sea turtles that are threatened by poaching and the capture of turtle hatchlings as pets. Through hands-on educational activities with schoolchildren, the Atoll Ecologists Programme seeks to change the way Maldivians perceive sea turtles and marine life. This SWOT grant will help reach 130 students to motivate positive behaviors and habits and to empower them to influence their families and others to commit to sustainable behaviors relating to the oceans.

NIGERIA

Wildlife Africa

In Nigeria, too little is known about where the main nesting areas are for the four turtle species found on the beaches adjacent to Lagos's rapidly expanding urban sprawl. Direct take of animals for meat and eggs is an ongoing threat, and although turtle protection laws exist in Nigeria, enforcement is ineffective without knowledge about the location of specific beaches and of communities that harvest turtles. This SWOT grant will identify where monitoring and enforcement efforts should be directed.

PHILIPPINES

Large Marine Vertebrates Research Institute (LAMAVE)

The Philippines Apo Island Protected Landscape and Seascape (ALPLS) is a popular snorkeling and diving destination for turtle-dedicated tourism. LAMAVE conducts research on turtle habitat use and tourism interactions and has photo-identified dozens of green and hawksbill turtles. This SWOT grant will deploy time-depth recorder tags and expand on LAMAVE's past studies to include new partner NGOs and government agencies with the aim of establishing more sustainable tourism practices.

TUNISIA

Maissa Louhichi

Loggerheads, leatherbacks, and greens suffer impacts on beaches and from bycatch throughout the Mediterranean, and in Tunisia, little has been done to understand their situation. This SWOT grant will support researcher Maissa Louhichi in conducting a comprehensive assessment of fishing and sea turtle bycatch rates in Tunisia. She will be using interviews and on-board observation in various ports and will create a database and GIS maps to design fisheries mitigation measures.

SWOT Data Citations

NESTING BIOGEOGRAPHY OF SEA TURTLES IN JAPAN

We are grateful to the Sea Turtle Association of Japan, which generously allowed us to re-create its map of 2016 sea turtle nesting in Japan for inclusion in this volume (pages 28–29). We are especially grateful to Yoshi Matsuzawa and Kei Okamoto for their assistance in sourcing data, translating, and developing the maps. Thank you.

GUIDELINES OF DATA USE AND CITATION

The data that follow correspond directly to the map on pages 28–29. To use data for research or publication, you must obtain permission from the data provider

DATA RECORD 1

Data Source: Map data were digitized and adapted from Figures 1 and 2 in: Matsuzawa, Y. (editor), *Proceedings of 27th Japanese Sea Turtle Symposium in Muroto (2016).* Osaka: Sea Turtle Association of Japan.

Year: 2016

Data Contributors: The following people and institutions provided nesting data used to create the maps: Akaumigame-wo-mamoru-kai, Akabane-juku, Ibaraki Prefectural Oarai Aquarium, Satoshi Asou, Shinpachiro Asaka, Hiroshi Asakawa, Niijima Shizen Aikoukai, Anan-City Office Shimin-bu Bunka-shinkou-ka, Toshihiro Abe, Naoki Abe, Amami Marine Life Research Association, Amami Umigame Jouhou Network, Amami Wildlife Center, Shun Amamiya, Takashi Igarashi, Shigeru Ikemura, Masayuki Ishii, Ishigakijima Umigame Kenkyu-kai, Tohru Izumiguchi, Isumi-City Sea Turtle Conservation Observers, Isen Town Office, Tokunoshima-Amagi Town Office, Ichinomiya Umigame-wo-mimamoru-kai, Ichikikushikino-City Office, Idea Consultants, Inc., Ai Ito, Kotaro Ito, Naoshi Inoue, Nishinoomote-City Office, Turtle Crew, Nishinoomote-City Sea Turtle Conservation Observers, Yumi Iwasaki, Toshitaka Iwamoto, Ayaka Yagi, Kei Uchida, Saori Uchiyama, Umigame Otasuke-tai, Umino-nakamichi Marine Ecological Science Museum Co. 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下記のデータは28～29ページの地図と一致しています。研究や文献にこれらのデータを用いる場合は、必ず下記のデータ提出者からの許可を取らなければなりません。

記録データ1

データの出典：地図データは下記文献の図1と図2のものを用いてデジタル化されたものです。

文献：松沢慶将(編). 2016. 日本ウミガメ誌2016 (第27回日本ウミガメ会議室戸大会会議録). 日本ウミガメ協議会: 大阪.

年：2016年

これらのデータに関わる産卵調査をされた方々：アカウミガメを守る会、あかばね塾、アクアワールド茨城県大洗水族館、朝生哲、浅香新八郎、浅川 弘、新島自然愛好会、阿南市市民部文化振興課、阿部年博、阿部直樹、奄美海洋生物研究会、奄美大島ウミガメ情報ネットワーク、奄美海洋生物研究会、奄美野生生物保護センター、雨宮俊、五十嵐隆、池村茂、石井雅之、石垣島ウミガメ研究会、泉口透、いすみ市ウミガメ保護監視員、伊仙町役場、徳之島町天城町役場、一宮ウミガメを見守る会、いちき串木野市役所、いであ株式会社、伊藤愛、伊藤幸太郎、井上尚志、西之表市　タートルクルー、西之表市ウミガメ保護監視員、岩崎由美、岩本俊孝、八木彩香、内田桂、内山五織、ウミガメお助け隊、㈱海の中道海洋生態科学館、うみまーる企画、NPO 法人カイフネイチャーネットワーク、NPO 法人おおいた環境保全フォーラム、NPO 法人屋久島うみがめ館、NPO 法人表浜ネットワーク、エビとカニの水族館、えらぶ年寄り組、大磯町郷土資料館、大梅謙治、大木清、大里松原うみがめを守る会、岡垣ウミガメ倶楽部、岡翔太、岡田幸生、沖永良部島ウミガメネットワーク、興克樹、沖縄美ら海水族館、沖永良部ウミガメネットワーク、奥山隼一、御前崎市ウミガメ保護監視委員会、御宿海亀連絡網、恩納読谷ウミガメ調査隊、甲斐靖郎、鹿児島大学ウミガメ研究会、加島祐二、加納知加子、(株) ヤ･シイ、亀崎直樹、亀澤亦、亀田和成、カメハメハ王国、亀人会、鴨川シ―ワールド、嘉陽宗幸、唐津の海を守ろう市民の会、川内田友紀子、河内洋子、川上孝子、川島道俊、河津勲、紀伊半島ウミガメ情報交換会、菊地ひとみ、北真嘉、北水慶一、紀宝町ウミガメ公園、吉良和夫、串本海中公園センター、九十九里浜の自然を守る会、国東市手と手とまちづくりたい、熊沢佳範、熊野の自然を考える会、黒木豊、黒潮町海亀保護委員、黒島研究所、小石尚眞、公益財団法人しまね海洋館、合田昌平、児玉嘉嗣、児玉達三、小林茂夫、小林淳一、米須邦雄、Science at Sea、阪本登、坂元育男、佐久間朋子、桜井基計、笹川二成、佐野真奈美、座間味ウミガメ会、澤瀬裕介、沢田晨輔、6DORSALS KAYAK SERVICES、志布志市役所市民環境課、島おこしNPO 法人TAMASU、志摩半島野生動物研究会、志村アリサ、下田海中水族館、新江ノ島水族館、新宮市海ガメを保護する会、鈴木清太、須磨海浜水族園、西海区水産研究所、高松明日香、武田明美、竹田洋志、田實涼、龍郷町役場生活環境課、田中雄二、田中宇輝、田中颯、田中優衣、田名瀬英朋、谷口和光、谷崎樹生、玉の浦リップルズクラブ、長楽美保、知覧町ウミガメ保護研究会、堂前康介、徳永幸太郎、徳浜集落区長、利川英樹、百々治、豊田史弥、豊橋市環境部環境保全課、中井真理子、中川道生、中村修、中種子町役場、成ヶ島を美しくする会、成瀬裕昭、西真弘、西奈美、西山桂一、日南市野生動物研究会、野崎清志、延岡市教育委員会、萩野進也、橋口和洋、八丈島インタープリテーション協会、花尻薫、濵川孝久、浜崎敏明、濱田孝、濱野兼吉、浜松市南区役所、原田英祐、春野の自然を守る会、日置市市民生活課、光俊樹、引地秀司、彦坂真、日高末盛、平井航大、平井厚志、広沢俊昭、日和佐うみがめ博物館カレッタ、日向市アカウミガメ研究会、深田和広、福津市うみがめ課、藤田健一郎、藤田健登、ペイン留美、細川隆幸、増山涼子、松浦圭太、松崎文好、松沢慶将、鞠山重子、丸野宏夏、三浦修、三重大学かめっぷり、水谷志津江、水野康次郎、溝渕幸三、みどりの地球大好き会、湊久和、みなべウミガメ研究班、南種子町役場企画課、南知多ビーチランド、嶺崎久郎、宮内貴史、宮城里奈、三宅島自然ガイド キュルル、宮崎光一、宮崎野生動物研究会、宮崎県教育庁文化財課、宮里俊輔、宮園正敏、宮地勝美、宮平聖秀、宮村英伸、村上昌吾、室戸市立元小学校、森てるみ、森下耕成、森誠憲、森谷香取、八木彩香、山口英昌、山下芳也、山本明男、山本斗士江、山本宏幸、雪浦ウミガメ見守り隊、湯舟佐和美、横濱蔵人、吉岡あゆみ、吉田嘉苗、吉田徹、吉村智範、与論町役場環境課、琉球大学ちゅらがーみー、漁師のNPO、若林郁夫、早稲田沙織、若月元樹、渡辺幸久、渡辺督郎、渡辺美佳、渡部明美 (敬省略　50 音順)

NESTING BIOGEOGRAPHY OF SEA TURTLES IN THE FRENCH TERRITORIES

GUIDELINES OF DATA USE AND CITATION

The data that follow correspond directly to the map of sea turtle nesting in the French territories on pages 22–23. Every data record is numbered to correspond with its respective point on the map. To use data for research or publication, you must obtain permission from the data provider.

DEFINITIONS OF TERMS

Clutches: A count of the number of nests of eggs laid by females during the monitoring period. **Crawl:** A female turtle's emergence onto the beach to nest. Such counts may include false crawls. **Nesting females:** A count of nesting female turtles observed during the monitoring period. **Year:** The year in which a given nesting season ended (e.g., data collected between late 2015 and early 2016 are listed as year 2016).

Nesting data reported here are for the most recent available nesting season. Beaches for which count data are not available are listed as "unquantified." A reported count of "N/A" indicates no data were reported for that species at the respective site. Additional metadata are available for many of the data records and may be found online at http://seamap.env.duke.edu/swot.

FRENCH GUIANA

DATA RECORD 1

Data Source: Berzins, R., and ONCFS. 2018. Sea turtle nesting in French Guiana: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beach: Kourou
Year: 2016
Species and Counts: *Chelonia mydas*—14 clutches; *Dermochelys coriacea*—55 clutches; *Lepidochelys olivacea*—61 clutches
SWOT Contacts: Rachel Berzins, Marie-Klélia Lankester, Johan Chevalier, Ronald Wongsopawiro, Alain Auguste, Junior Alcine, Mail Thérèse, Damien Chevallier, Marc Bonola, Jordan Martin, Benoit de Thoisy, Sébastien Barrioz, and Rodrigue Crasson

DATA RECORD 2

Data Source: Chevalier, J., and CNRS-IPHC. 2018. Sea turtle nesting in Réserve Naturelle Nationale de l'Amana, French Guiana: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beach: Awala Yalimapo
Year: 2016
Species and Counts: *Chelonia mydas*—770 clutches; *Dermochelys coriacea*—434 clutches; *Lepidochelys olivacea*—9 clutches
SWOT Contacts: Rachel Berzins, Marie-Klélia Lankester, Johan Chevalier, Ronald Wongsopawiro, Alain Auguste, Junior Alcine, Mail Thérèse, Damien Chevallier, Marc Bonola, Jordan Martin, Benoit de Thoisy, Sébastien Barrioz, and Rodrigue Crasson

DATA RECORD 3

Data Source: Chevallier, D., and CNRS-IPHC. 2018. Sea turtle nesting at Aztèque, French Guiana: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beach: Aztèque
Year: 2016
Species and Counts: *Chelonia mydas*—54 clutches; *Dermochelys coriacea*—6 clutches
SWOT Contacts: Rachel Berzins, Marie-Klélia Lankester, Johan Chevalier, Ronald Wongsopawiro, Alain Auguste, Junior Alcine, Mail Thérèse, Damien Chevallier, Marc Bonola, Jordan Martin, Benoit de Thoisy, Sébastien Barrioz, and Rodrigue Crasson

DATA RECORD 4

Data Source: De Thoisy, B., and Kwata. 2018. Sea turtle nesting at Île de Cayenne, French Guiana: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beach: Île de Cayenne
Year: 2016
Species and Counts: *Chelonia mydas*—39 clutches; *Dermochelys coriacea*—2,816 clutches; *Eretmochelys imbricata*—1 clutch; *Lepidochelys olivacea*—3,666 clutches
SWOT Contacts: Rachel Berzins, Marie-Klélia Lankester, Johan Chevalier, Ronald Wongsopawiro, Alain Auguste, Junior Alcine, Mail Thérèse, Damien Chevallier, Marc Bonola, Jordan Martin, Benoit de Thoisy, Sébastien Barrioz, and Rodrigue Crasson

ÉPARSES ISLANDS

DATA RECORD 5

Data Source: Jean, C., S. Ciccione, J. Bourjea, and M. Dalleau. 2017. Sea turtle nesting in the Éparses Islands: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: Europa, Glorieuses, Tromelin, and Juan de Nova
Year: 2016
Species and Counts: *Chelonia mydas*—16,069, 6,297, 12,443, and 186 crawls, respectively; *Eretmochelys imbricata*—0, 0, 0, and 44 crawls, respectively
SWOT Contacts: Claire Jean, Stéphane Ciccione, Jérôme Bourjea, and Mayeul Dalleau

FRENCH POLYNESIA

DATA RECORD 6

Data Source: Gaspar, C. 2018. Sea turtle nesting in French Polynesia: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: Reao Atoll, Tikehau, Mopelia, and Scilly
Year: 2017
Species and Counts: *Chelonia mydas*—unquantified at Tikehau, Mopelia, and Scilly; *Dermochelys coriacea*—unquantified at Reao Atoll
SWOT Contact: Cécile Gaspar

DATA RECORD 7

Data Source: Petit, M., C. Gaspar, G. Leport, C. Esposito, and V. Stabile. 2016. *Saisons de ponte 2014–2015 et 2015–2016 de la tortue verte* (Chelonia mydas) *sur l'atoll de Tetiaroa*. Moorea, French Polynesia Te Mana o Te Moana.
Nesting Beaches: Onetahi, Tiaraunu, and Oroatera
Year: 2016
Species and Counts: *Chelonia mydas*—65, 155, and 87 clutches, respectively
SWOT Contact: Cécile Gaspar

GUADELOUPE

At the request of the data providers, all count data for Guadeloupe are given as a three-year average (2012–14) of the estimated (modeled) number of crawls at each beach. Average modeled crawl counts are rounded to the nearest whole number. See cited data sources for model details.

DATA RECORD 8

Data Sources: (1) RTMG: Parc National Guadeloupe, Association Le Gaïac, Réseau de Bénévoles Nord Grande Terre / Association Kap Natirel. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*)—*Période 2004–2014*. Office National de la Chasse.
Nesting Beach: Secteur 1: Grand Cul-de-Sac Marin
Years: 2012–14
Species and Counts: *Chelonia mydas*—38 crawls; *Dermochelys coriacea*—85 crawls; *Eretmochelys imbricata*—1,105 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 9

Data Source: (1) RTMG: Association Le Gaïac, Association Evasion Tropicale, Association Kap Natirel. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe (incluant ses dépendances et Saint-Martin)—Période 2004–2014*. Office National de la Chasse.
Nesting Beach: Secteur 2: Basse Terre—Côte sous le vent
Years: 2012–14
Species and Counts: *Chelonia mydas*—48 crawls; *Dermochelys coriacea*—60 crawls; *Eretmochelys imbricata*—515 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 10

Data Source: (1) RTMG: Association Kap Natirel, ONCFS. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*)—*Période 2004–2014*. Office National de la Chasse.
Nesting Beach: Secteur 3: Basse Terre—Côte au vent
Years: 2012–14
Species and Counts: *Chelonia mydas*—23 crawls; *Dermochelys coriacea*—82 crawls; *Eretmochelys imbricata*—126 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 11

Data Source: (1) RTMG: Association AEVA, Réseau de Bénévoles Nord Grande Terre / Association Kap Natirel. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*)—*Période 2004–2014*. Office National de la Chasse.
Nesting Beaches: Secteur 4: Façade littorale nord-est de Grande Terre, and Secteur 5: Façade littorale sud-est de Grande Terre
Years: 2012–14
Species and Counts: *Chelonia mydas*—1 and 158 crawls, respectively; *Dermochelys coriacea*—1 and 0 crawls, respectively; *Eretmochelys imbricata*—126 and 52 crawls, respectively
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 12

Data Source: (1) RTMG: Association Tité, ONF. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*)—*Période 2004–2014*. Office National de la Chasse.
Nesting Beach: Secteur 6: La Désirade et Petite Terre
Years: 2012–14
Species and Counts: *Chelonia mydas*—701 crawls; *Dermochelys coriacea*—42 crawls; *Eretmochelys imbricata*—399 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 13

Data Source: (1) RTMG: Amicale Ecolambda, Association Kap Natirel. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*)—*Période 2004–2014*. Office National de la Chasse.
Nesting Beach: Secteur 7: Marie-Galante
Years: 2012–2014
Species and Counts: *Chelonia mydas*—5 crawls; *Dermochelys coriacea*—less than 1 crawl; *Eretmochelys imbricata*—1,976 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 14

Data Source: (1) RTMG: Conservatoire du Littoral. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*)—*Période 2004–2014*. Office National de la Chasse.
Nesting Beach: Secteur 8: Île des Sainte
Years: 2012–2014
Species and Counts: *Chelonia mydas*—4

crawls; *Dermochelys coriacea*—less than 1 crawl; *Eretmochelys imbricata*—33 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

DATA RECORD 15

Data Source: **(1)** RTMG: Réserve Naturelle de Saint Martin. **(2)** Girard, A., and M. Girondot. 2016. *Analyse des données d'activités de ponte des tortues marines en Guadeloupe* (*incluant ses dépendances et Saint-Martin*) *—Période 2004–2014.* Office National de la Chasse.
Nesting Beach: Secteur 10: Île de Saint Martin
Years: 2012–14
Species and Counts: *Chelonia mydas*—257 crawls; *Dermochelys coriacea*—0 crawls; *Eretmochelys imbricata*—107 crawls
SWOT Contacts: Caroline Cremades, Caroline Cestor, Caroline Rinaldi, Gérard Portecop, Fortuné Guiougou, Eric Delcroix, Laurent Malgaive, Alain Goyeau, Natacha Lamy, Blandine Guillemot, Simone Mege, Julien Chalifour, and Olivier Raynaud

MARTINIQUE

DATA RECORD 16

Data Source: Contributors of the Sea Turtle Network of Martinique Island: Association Kawan, Association Reflet d'Culture, association Sepanmar, Association AMEPAS, Office National de la Chasse et de la Faune Sauvage, Office National des Forêts, Association Eco-Civisme, Parc Naturel de Martinique, Association SEVE, DIREN/DEAL. 2018. Sea turtle nesting in Martinique: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: **(1)** Diamant—Grande Anse Diamant; **(2)** Le Precheur—Anse à Voile; **(3)** Le Precheur—Anse Levrier; **(4)** Lorrain—Crabiere; **(5)** Lorrain—Grande Anse Lorrain; **(6)** Sainte-Anne—Anse à Prune; **(7)** Sainte-Anne—Anse Four à Chaux; **(8)** Sainte-Anne – Anse Grosse Roche; **(9)** Sainte-Anne—Anse Laballe; **(10)** Sainte-Anne—Anse Meunier; **(11)** Sainte-Anne—Anse Trabaud; **(12)** Sainte-Anne—Grande Terre; **(13)** Sainte-Marie—Anse Charpentier; **(14)** Vauclin – Grand Macabou; and **(15)** Sainte-Anne Grande Anse Salines
Years: **(1)** 2014; **(2)** 2011; **(3)** 2011; **(4)** 2016; **(5)** 2014; **(6)** 2013; **(7)** 2011; **(8)** 2014; **(9)** 2014; **(10)** 2014; **(11)** 2014; **(12)** 2016; **(13)** 2014; **(14)** 2014; **(15)** 2016
Species and Counts:* *Chelonia mydas*—**(1)** 1; **(2)** 0; **(3)** 3; **(4)** 0; **(5)** 0; **(6)** 0; **(7)** 0; **(8)** 0; **(9)** 0; **(10)** 7; **(11)** 0; **(12)** 0; **(13)** 0; **(14)** 0; **(15)** 0 crawls. *Dermochelys coriacea*—**(1)** 2; **(2)** 3; **(3)** 2; **(4)** 47; **(5)** 84; **(6)** 111; **(7)** 2; **(8)** 9; **(9)** 18; **(10)** 5; **(11)** 19; **(12)** 22; **(13)** 172; **(14)** 6; **(15)** 150 crawls. *Eretmochelys imbricata*—**(1)** 47; **(2)** 23; **(3)** 22; **(4)** 38; **(5)** 21; **(6)** 91; **(7)** 3; **(8)** 5; **(9)** 9; **(10)** 5; **(11)** 30; **(12)** 21; **(13)** 33; **(14)** 2; and **(15)** 150 crawls

*Counts are estimated (modeled), except from Sainte-Anne—Grande Anse Salines, where average counts were provided. For modeled counts, the mean value is presented here and is rounded to the nearest whole number. Contact data providers for model details.
SWOT Contacts: Marie-France Bernard and Caroline Cremades

MAYOTTE

DATA RECORD 17

Data Source: **(1)** Quillard, M., and K. Ballorain. 2018. Sea turtle nesting in Mayotte: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018). **(2)** Philippe, J. S., S. Ciccione, J. Bourjea, K. Ballorain, S. Marinesque, and Z. Glenard. 2014. *Plan national d'actions en faveur des tortues marines des territoires français de l'océan Indien: La Réunion, Mayotte et Îles Éparses* (*2015–2020*). *Ministère de l'Écologie, du Développement Durable et de l'Énergie, Direction de l'Environnement, de l'Aménagement et du Logement de La Réunion.* BIOTOPE, Kélonia, IFREMER, Parc Naturel Marin De Mayotte, Taaf, Phaeton Traduction.
Nesting Beaches: Saziley Site and Moya
Years: 2013 and 2015, respectively
Species and Counts: *Chelonia mydas*—1,685 and 3,776 crawls, respectively; *Eretmochelys imbricata*—0 and 9 crawls, respectively
SWOT Contacts: Mireille Quillard and Katia Ballorain

NEW CALEDONIA

DATA RECORD 18

Data Source: Lafage, D., and Association BWÄRÄ. 2018. Sea turtle nesting in New Caledonia: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: La Roche Percée and Baie des Tortues
Year: 2016
Species and Counts: *Caretta caretta*—328 and 50 clutches, respectively
SWOT Contact: Dominique Lafage

DATA RECORD 19

Data Source: WWF France in New Caledonia. 2018. Unpublished data from 2006: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: **(1)** Atoll B-Beaupre—Île Beautemps; **(2)** Atoll d'Ouvea—Angemeec; **(3)** Atoll d'Ouvea—Angeu; **(4)** Atoll d'Ouvea—Hnyeekon NW; **(5)** Atoll d'Ouvea—Hnyeekon STH; **(6)** Atoll d'Ouvea—Motu Velioa NW; **(7)** Atoll d'Ouvea—Motu Velioa W; **(8)** Atoll d'Ouvea—Unnamed island STH; **(9)** Atoll d'Ouvea—Unnamed island WEST; **(10)** Atoll du Portail; **(11)** Île Art—Mid Northwest Beach; **(12)** Île de Surprise; **(13)** Île des Pins—Baie de Uamae; **(14)** Île des Pins—Pointe Kutema North; **(15)** Île Dudun —North 1 plage; **(16)** Île Dudun—North 2 plage; **(17)** Île Mare—B de l'Allier 1 plage; **(18)** Île Mare—B de l'Allier 2 plage; **(19)** Île Mare—C Roussin; **(20)** Ile Mouac; **(21)** Île Neba—North Western Beach; **(22)** Île Neba —Northern Beach; **(23)** Île Redika; **(24)** Îlot Ague; **(25)** Îlot Amere; **(26)** Îlot Atire; **(27)** Îlot Bayes; **(28)** Îlot Carrey; **(29)** Îlot Contrariete; **(30)** Îlot de la Table; **(31)** Îlot Deverd; **(32)** Îlot Double; **(33)** Îlot du Ami; **(34)** Îlot du Ana; **(35)** Îlot Gi; **(36)** Îlot Hienga; **(37)** Îlot Hiengabat; **(38)** Îlot Infernal; **(39)** Îlot Kendec; **(40)** Îlot Kie; **(41)** Îlot Koko; **(42)** Îlot Kouare; **(43)** Îlot Leroue; **(44)** Îlot Mato; **(45)** Îlot Mbore; **(46)** Îlot N'da; **(47)** Îlot Ndie; **(48)** Îlot Neangambo; **(49)** Îlot N'ge; **(50)** Îlot Noe; **(51)** Îlot Nombu; **(52)** Îlot Ongombua; **(53)** Îlot Ouao; **(54)** Îlot Pouh; **(55)** Îlot Pumbo; **(56)** Îlot Tere; **(57)** Îlot Thigit; **(58)** Îlot Ti Ac; **(59)** Îlot Tiam'boueme;**(60)** Îlot Totea; **(61)** Îlot Ua; **(62)** Îlot Uaterombi; **(63)** Îlot Uatio; **(64)** Îlot Ugo; **(65)** Îlot Uie; **(66)** Îlot Uo; **(67)** Îlot Verte; **(68)** Îlot Vua; **(69)** Îlot Yan'dagouet; **(70)** Mainland Sth of Cap Gouivain; **(71)** N'digoro; **(72)** Plage de la Roche Percée; **(73)** Pointe De Babouillet—Mid Beach; **(74)** Poum Peninsula—NW Beach 1; **(75)** Poum Peninsula—NW Beach 2; **(76)** Poum Peninsula —Southwest Beach; **(77)** Poum Peninsula—Western Beach; **(78)** Unnamed island; **(79)** Unnamed sandbank 2; and **(80)** Unnamed sandbank 3
Year: 2006
Species and Counts: *Caretta caretta*—**(1–19)** 0; **(20)** 1–10; **(21–23)** 50–100; **(24)** 1–10; **(25)** 50–100; **(26–32)** 1–10; **(33)** 50–100; **(34)** 1–10; **(35)** 50–100; **(36–41)** 1–10; **(42)** 50–100; **(43–45)** 1–10; **(46)** 50–100; **(47–51)** 1–10; **(52)** 0; **(53)** 50–100; **(54–57)** 1–10; **(58–59)** 50–100; **(60)** 1–10; **(61–63)** 50–100; **(64–71)** 1–10; **(72)** 50–100; **(73–76)** 1–10; **(77)** 50–100; **(78)** 1–10; **(79)** 0; and **(80)** 0 clutches. *Chelonia mydas*—**(1)** 100–500; **(2)** 50–100; **(3–5)** 1–10; **(6)** 50–100; **(7–8)** 1–10; **(9)** 50–100; **(10–11)** 1–10; **(12)** 500–1,000; **(13–19)** 1–10; **(20–26)** 0; **(27)** 1–10; **(28–36)** 0; **(37)** 1–10; **(38–51)** 0; **(52)** 50–100; **(53–78)** 0; and **(79–80)** 1–10 clutches
SWOT Contact: Marc Oremus

DATA RECORD 20

Data Source: WWF-France in New Caledonia. 2017. Sea turtle nesting in New Caledonia: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: **(1)** Améré; **(2)** Atiré; **(3)** Gi; **(4)** Kié; **(5)** Koko; **(6)** Kouaré; **(7)** Léroué; **(8)** M'bé; **(9)** M'Boré; **(10)** Mato; **(11)** N'Da; **(12)** N'Dié; **(13)** N'Do; **(14)** N'Gé; **(15)** Noé; **(16)** Nouaré; **(17)** Petit Koko; **(18)** Puemba; **(19)** Pumbo; **(20)** Rédika; **(21)** Téré; **(22)** Totéa; **(23)** Ua; **(24)** Uaterembi; **(25)** Uatio; **(26)** Ugo; **(27)** Uié; **(28)** Uo; and **(29)** Vua
Year: 2017
Species and Counts: *Caretta caretta*—**(1)** 9; **(2)** 48; **(3)** 48; **(4)** 14; **(5)** 6; **(6)** 12; **(7)** 8; **(8)** 1; **(9)** 29; **(10)** 1; **(11)** 50; **(12)** 1; **(13)** 8; **(14)** 20; **(15)** 0; **(16)** 0; **(17)** 9; **(18)** 2; **(19)** 0; **(20)** 7; **(21)** 3; **(22)** 4; **(23)** 8; **(24)** 6; **(25)** 21; **(26)** 0; **(27)** 4; **(28)** 1; and **(29)** 25 clutches
SWOT Contact: Marc Oremus

DATA RECORD 21

Data Source: Fretey J., and M. Girondot. 2017. Bilan de 10 années de suivi des pontes de tortues vertes sur les atolls isolés dans le Parc naturel de la mer de Corail (2007–2016). Troyes, France: Chélonée
Nesting Beaches: Entrecasteaux, Chesterfield, and Bellona
Year: 2017
Species and Counts: *Chelonia mydas*—50,000, 17,000, and 300 crawls, respectively
SWOT Contact: Marc Girondot

LA RÉUNION

DATA RECORD 22

Data Source: Jean, C., S. Ciccione, J. Bourjea, and M. Dalleau. 2018. Sea turtle nesting in La Réunion: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beach: Réunion
Year: 2016
Species and **Count:** *Chelonia mydas*—3 clutches
SWOT Contacts: Claire Jean, Stéphane Ciccione, Jérôme Bourjea, and Mayeul Dalleau

SAINT BARTHÉLEMY

DATA RECORD 23

Data Source: Natural Reserve of Saint Barthélemy, Agence Territoriale de l'Environnement de Saint-Barthélemy. 2018. Sea turtle nesting in Saint Barthélemy: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018).
Nesting Beaches: East Sector and West Sector
Year: 2014
Species and Counts: *Chelonia mydas*—1 and 2 clutches, respectively; *Dermochelys coriacea*—1 and 1 clutches, respectively; *Eretmochelys imbricata*—2 and 3 clutches, respectively,
SWOT Contacts: Sophie Lefevre and Alexandre Girard

LOGGERHEAD SATELLITE TELEMETRY IN THE PACIFIC OCEAN

The following data records refer to satellite telemetry datasets for loggerhead turtles in the Pacific Ocean that were combined to create the map on pp. 16–17. These data, consisting of more than 130,000 locations, were generously contributed to SWOT by the people and partners listed below. We are grateful to Jeffrey Seminoff and T. Todd Jones for their assistance in developing the maps and identifying datasets for inclusion, and we especially thank George Balazs and T. Todd Jones for their efforts collecting and sourcing the data provided by NOAA. In mapping the data, obviously erroneous points (e.g., on land) were removed. Some datasets were filtered prior to being shared with SWOT and those were not filtered further. The map is for illustrative purposes and should not be considered an authoritative source of tracking data for the studies cited. Records that have a SWOT ID can be viewed in detail in the SWOT online database and mapping application at **http://seamap.env.duke.edu/swot**.

For reasons of space, the following abbreviations are used in the data source fields below: (1) "STAT" refers to "Coyne, M. S., and B. J. Godley. 2005. Satellite Tracking and Analysis Tool (STAT): An integrated system for archiving, analyzing and mapping animal tracking data. *Marine Ecology Progress Series* 301: 1–7. (2) "SWOT Online Database" refers to Kot, C. Y., E. Fujioka, A. D. DiMatteo, B. P. Wallace, B. J. Hutchinson, J. Cleary, P. N. Halpin, and R. B. Mast. 2015. The State of the World's Sea Turtles Online Database: Data provided by the SWOT Team and hosted on OBIS-SEAMAP. Oceanic Society, IUCN Marine Turtle Specialist Group, and Marine Geospatial Ecology Lab, Duke University. **http://seamap.env.duke.edu/swot**. (3) "OBIS-SEAMAP" refers to Halpin, P. N., A. J. Read, E. Fujioka, B. D. Best, B. Donnelly, L. J. Hazen, C. Kot, K. Urian, E. LaBrecque, A. DiMatteo, J. Cleary, C. Good, L. B. Crowder, and K. D. Hyrenbach. 2009. OBIS-SEAMAP: The world data center for marine mammal, sea bird, and sea turtle distributions. *Oceanography* 22(2):104–115. When listed, these sources indicate that the dataset was contributed online through STAT, SWOT, or OBIS-SEAMAP.

DATA RECORD 1
Metadata: 4 adult female *Caretta caretta*; tags deployed in Japan. A total of 5 tags were deployed, but only 4 transmitted.
Data Sources: Hatase, H., N. Takai, Y. Matsuzawa, W. Sakamoto, K. Omuta, K. Goto, N. Arai, and T. Fujiwara. 2002. Size-related differences in feeding habitat use of adult female loggerhead turtles *Caretta caretta* around Japan determined by stable isotope analyses and satellite telemetry. *Marine Ecology Progress Series* 233:273–281.
SWOT Contact: Hideo Hatase

DATA RECORD 2 | SWOT ID: 1546
Project Title: Post-nesting migration of loggerhead turtles around Japan 2005
Project Partners: Atmosphere and Ocean Research Institute, University of Tokyo, and Yakushima Sea Turtle Research Group
Metadata: 2 adult female *Caretta caretta*; tags deployed in Japan in 2005.
Data Sources: (1) Hatase, H., K. Omuta, and K. Tsukamoto. 2007. Bottom or midwater: Alternative foraging behaviours in adult female loggerhead sea turtles. Journal of Zoology 273:46–55. **(2)** Hatase, H. 2017. Post-nesting migration of loggerhead turtles around Japan 2005. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/1546) on 2017-10-10. **(3)** STAT. **(4)** OBIS-SEAMAP. **(5)** SWOT Online Database.
SWOT Contact: Hideo Hatase

DATA RECORD 3 | SWOT ID: 1265
Project Title: Loggerhead turtle movements in the Southern California Bight
Project Partners: NOAA-NMFS Southwest Fisheries Science Center, NMFS West Coast Regional Office, and Aquarium of the Pacific.
Metadata: 3 *Caretta caretta*; tags deployed in southern California.
Data Source: (1) NOAA Southwest Fisheries Science Center. 2018. Satellite tracking of three loggerhead turtles in Mexico: Personal communication. In *SWOT Report—The State of the World's Sea Turtles*, vol. XIII (2018). **(2)** Seminoff, J., and T. Eguchi. 2016. Loggerhead turtle movements in the Southern California Bight. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/1265) on 2017-10-02. **(3)** OBIS-SEAMAP. **(4)** SWOT Online Database. **(5)** STAT.
SWOT Contact: Jeffrey Seminoff

DATA RECORD 4 | SWOT ID: 931
Project Title: Peru Cabezonas
Project Partners: Jeffrey Mangel, ProDelphinus, NOAA Southwest Fisheries Science Center, Peter Dutton, Jeffrey Seminoff, Denise Parker
Metadata: 15 subadult *Caretta caretta*; tags deployed in Ilo and Pucusana, Peru, from 2003 to 2007, on turtles that were bycaught in line fisheries. Only 14 tags transmitted effectively.
Data Sources: (1) Mangel, J. C., J. Alfaro-Shigueto, M. J. Witt, P. H. Dutton, J. A. Seminoff and B. J. Godley. 2011. Post-capture movements of loggerhead turtles in the southeastern Pacific Ocean assessed by satellite tracking. *Marine Ecology Progress Series* 433:261–272. **(2)** STAT. **(3)** SWOT Online Database.
SWOT Contact: Jeffrey Mangel

DATA RECORD 5
Metadata: 12 *Caretta caretta*; tags deployed in Baja California Sur, Mexico, from 1996 to 2005.
Data Sources: Peckham, S. H., D. Maldonado Diaz, A. Walli, G. Ruiz, L. B. Crowder, and W. J. Nicholes. 2007. Small-scale fisheries bycatch jeopardizes endangered Pacific loggerhead turtles. *PLoS ONE* 2(10): e1041.
SWOT Contact: Hoyt Peckham

DATA RECORD 6
Project Title: Adelita
Metadata: 1 *Caretta caretta*; tag deployed in Baja California, Mexico. This turtle, known as "Adelita," was the first loggerhead to be tracked crossing the Pacific Ocean; the tag was deployed on July 19, 1994, on the central Pacific coast of the Baja California peninsula and was recovered, dead in a set net, by a fisherman off the coast of Kyushu, Japan, 478 days later (November 9, 1995) after traveling 10,600 km.
Data Sources: (1) Nichols, W. J., A. Resendiz, J. A. Seminoff, and B. Resendiz. 2000. Transpacific migration of a loggerhead turtle monitored by satellite telemetry. *Bulletin of Marine Science* 67:937-47; **(2)** Resendiz, A., B. Resendiz, W. J. Nichols, J. A. Seminoff, and N. Kamezaki. 1998. First confirmed east-west transpacific movement of a loggerhead sea turtle, *Caretta caretta*, released in Baja California, Mexico. *Pacific Science* 52(2):151–153
SWOT Contact: Wallace J. Nichols

DATA RECORD 7
Project Partners: Data were combined from various studies carried out by the NOAA Pacific Islands Fisheries Science Center (PIFSC) in collaboration with many partners. See cited literature for project partners and other details.
Metadata: 28 *Caretta caretta*; tags deployed at various locations in the Central North Pacific Ocean on turtles caught incidentally in commercial longline fisheries.
Data Sources: (1) Polovina, J. J., D. R. Kobayashi, D. M. Ellis, M. P. Seki, and G. H. Balazs. 2000. Turtles on the edge: Movement of loggerhead turtles (*Caretta caretta*) along oceanic fronts in the central North Pacific, 1997-1998. *Fisheries Oceanography* 9(1): 71–82. **(2)** Polovina, J. J., E. Howell, D. M. Parker, and G. H. Balazs. 2003. Dive-depth distribution of loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the central North Pacific: Might deep longline sets catch fewer turtles? *Fisheries Bulletin* 101(1):189–193. **(3)** Chaloupka, M., D. Parker, and G. Balazs. 2004. Modelling post-release mortality of loggerhead sea turtles exposed to the Hawaii-based pelagic longline fishery. *Marine Ecology Progress Series* 280:285–293. **(4)** Polovina, J. J., G.H. Balazs, E. A. Howell, D. M. Parker, M. P. Seki, and P. H. Dutton. 2004. Forage and migration habitat of loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the central North Pacific Ocean. *Fisheries Oceanography* 13(1): 36-51. **(5)** Polovina, J., I. Uchida, G. Balazs, E. A. Howell, D. Parker, and P. Dutton. 2006. The Kuroshio Extension bifurcation region: A pelagic hotpot for juvenile loggerhead sea turtles. *Deep Sea Research Pt II: Top. Studies Oceanography* 53(3-4):326–339. **(6)** Kobayashi, D. R., J. J. Polovina, D. M. Parker, N. Kamezaki, I.-J. Cheng, I., Uchida, P. H. Dutton, and G.H. Balazs. 2008. Pelagic habitat characterization of loggerhead sea turtles, Caretta caretta, in the North Pacific Ocean (1997–2006): Insights from satellite tag tracking and remotely sensed data. *Journal of Experimental Marine Biology and Ecology* 356:96–114. **(7)** Howell, E. A., P. H. Dutton, J. J. Polovina, H. Bailey, D. M. Parker, and G. H. Balazs. 2010. Oceanographic influences on the dive behavior of juvenile loggerhead turtles (Caretta caretta) in the North Pacific Ocean. *Marine Biology* 157:1011–1026. **(8)** Abecassis, M., I. Senina, P. Lehodey, P. Gaspar, D. Parker, G. Balazs, and J. Polovina. 2013. A model of loggerhead sea turtle (*Caretta caretta*) habitat and movement in the oceanic North Pacific. *PLoS ONE* 8(9): e73274. **(9)** Parker, D. M., G. H. Balazs, M. R. Rice, and S. M. Tomkeiwicz. 2014. Variability in Reception Duration of Dual Satellite Tags on Sea Turtles Tracked in the Pacific Ocean. *Micronesica* 2014–03. **(10)** Briscoe, D. K., D. M. Parker, S. Bograd, E. Hazen, K. Scales, G. H. Balazs, M. Kurita, T. Saito, H. Okamoto, M. Rice, J. J. Polovina, and L. B. Crowder. 2016. Multi-year tracking reveals extensive pelagic phase of juvenile loggerhead sea turtles in the North Pacific. *Movement Ecology* 4:23.
SWOT Contact: T. Todd Jones

DATA RECORD 8
Project Partners: Data were combined from various studies carried out by the NOAA Pacific Islands Fisheries Science Center (PIFSC) in collaboration with many partners. See cited literature for project partners and other details.
Metadata: 178 *Caretta caretta*; tags deployed in Japan on animals that were captive reared by the Port of Nagoya Public Aquarium and animals that were caught incidentally in fisheries.
Data Sources: (1) Polovina, J., I. Uchida, G. Balazs, E. A. Howell, D. Parker, and P. Dutton. 2006. The Kuroshio Extension bifurcation region: A pelagic hotpot for juvenile loggerhead sea turtles. *Deep Sea Research Pt II: Top. Studies Oceanography* 53(3-4):326–339. **(2)** Kobayashi, D. R., J. J. Polovina, D. M. Parker, N. Kamezaki, I.-J. Cheng, I. Uchida, P. H. Dutton, and G.H. Balazs. 2008. Pelagic habitat characterization of loggerhead sea turtles, *Caretta caretta*, in the North Pacific Ocean (1997–2006): Insights from satellite tag tracking and remotely sensed data. *Journal of Experimental Marine Biology and Ecology* 356:96-114. **(3)** Abecassis, M., I. Senina, P. Lehodey, P. Gaspar, D. Parker, G. Balazs, and J. Polovina. 2013. A model of loggerhead sea turtle (*Caretta caretta*) habitat and movement in the oceanic North Pacific. *PLoS ONE* 8(9): e73274. **(4)** Parker, D. M., G. H. Balazs, M. R. Rice, and S. M. Tomkeiwicz. 2014. Variability in Reception Duration of Dual Satellite Tags on Sea Turtles Tracked in the Pacific Ocean. *Micronesica* 2014–03. **(5)** Saito, T., M. Kurita, H. Okamoto, I. Uchida, D. Parker, and G. Balazs. 2015. Tracking male loggerhead turtle migrations around southwestern Japan using satellite telemetry. *Chelonian Conservation and Biology* 14(1):82–87. **(6)** Briscoe, D. K., D. M. Parker, G. H. Balazs, M. Kurita, T. Saito, H. Okamoto, M. Rice, J. J. Polovina, and L. B. Crowder. 2016. Active dispersal in loggerhead sea turtles (*Caretta caretta*) during the 'lost years'. *Proceedings of the Royal Society B* 283: 20160690. **(7)** Briscoe, D. K., D. M. Parker, S. Bograd, E. Hazen, K. Scales, G. H. Balazs, M. Kurita, T. Saito, H. Okamoto, M. Rice, J. J. Polovina, and L. B. Crowder. 2016. Multi-year tracking reveals extensive pelagic phase of juvenile loggerhead sea turtles in the North Pacific. *Movement Ecology* 4:23.
SWOT Contact: T. Todd Jones

DATA RECORD 9
Project Title: Loggerhead turtle movement off the coast of Taiwan
Project Partners: Data are from the NOAA Pacific Islands Fisheries Science Center (PIFSC) in collaboration with many partners. See cited literature for project partners and other details.
Metadata: 34 *Caretta caretta*; tags deployed on turtles caught as bycatch in the Taiwanese coastal poundnet fishery from 2002 to 2008, Taiwan.
Data Sources: (1) Kobayashi, D. R., J. J. Polovina, D. M. Parker, N. Kamezaki, I.-J. Cheng, I. Uchida, P. H. Dutton, and G.H. Balazs. 2008. Pelagic habitat characterization of loggerhead sea turtles, *Caretta caretta*, in the North Pacific Ocean (1997–2006): Insights from satellite tag tracking and remotely sensed data. *Journal of Experimental Marine Biology and Ecology* 356:96–114. **(2)** Kobayashi, D.R., I.-J. Cheng, D.M. Parker, J.J. Polovina, N. Kamezaki, and G.H. Balazs. 2011. Loggerhead turtle (*Caretta caretta*) movement off the coast of Taiwan: characterization of a hotspot in the East China Sea and investigation of mesoscale eddies. *ICES Journal of Marine Science* 68(4): 707–718. **(3)** Parker, D., G. Balazs, and J. Polovina. 2015. Loggerhead turtle movement off the coast of Taiwan. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/1304) on 2017-02-23. **(4)** OBIS-SEAMAP.
SWOT Contacts: Denise Parker, George Balazs, Jeffrey Polovina, and T. Todd Jones

DATA RECORD 10
Project Partners: NOAA Pacific Islands Fisheries Science Center (PIFSC) and Aquarium des Lagons, Noumea, New Caledonia
Metadata: 52 juvenile *Caretta caretta*; tags deployed in 2008 and 2012 on animals that were captive reared by the Aquarium des Lagons in Noumea, New Caledonia.
Data Sources: (1) Kobayashi, D. R., R. Farman, J. J. Polovina, D. M. Parker, M. Rice, and G. H. Balazs. 2014. ''Going with the flow'' or not: Evidence of positive rheotaxis in oceanic juvenile loggerhead turtles (*Caretta caretta*) in the South Pacific Ocean using satellite tags and ocean circulation data. *PLoS ONE* 9(8): e103701. **(2)** Christiansen, F., N. F. Putman, R. Farman, D. M. Parker, M. R. Rice, J. J. Polovina, G. H. Balazs, and G. C. Hays. 2016. Spatial variation in directional swimming enables juvenile sea turtles to reach and remain in productive waters. *Marine Ecology Progress Series* 557:247–259.
SWOT Contact: T. Todd Jones

DATA RECORD 11 | SWOT ID: 126
Project Title: Pacific turtle tracks: Turtle-Safe Seas Project
Project Partners: Blue Ocean Institute
Metadata: 1 *Caretta caretta*; tag deployed in Baja California, Mexico.
Data Sources: (1) Nichols, W. 2014. Pacific turtle tracks: Turtle-Safe Seas Project. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/126) on 2017–02-17. **(2)** OBIS-SEAMAP. **(3)** SWOT Online Database.
SWOT Contact: Wallace J. Nichols

DATA RECORD 12
Project Title: Pacific Turtle Tracks: Grupo Tortuguero
Project Partners: Grupo Tortuguero
Metadata: 12 *Caretta caretta*; tags deployed in Mexico from 1996 to 2001.
Data Sources: (1) Nichols, W. 2016. Pacific Turtle Tracks: Grupo Tortuguero. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/317) on 2016-07-07. **(2)** OBIS-SEAMAP. **(3)** STAT.
SWOT Contact: Wallace J. Nichols

DATA RECORD 13 | SWOT ID: 1176
Project Title: Tortugas Marinas del Golfo de California
Project Partners: Instituto Politécnico Nacional CIIDIR Sinaloa, Red Tortuguera A.C., Grupo Tortuguero de las Californias A.C., Smithsonian Mason School of Conservation, Instituto de Ciencias del Mar y Limnología/UNAM, and the local fishing communities of La Reforma and Angostura.
Metadata: 6 *Caretta caretta* adults and subadults; tags deployed in the Gulf of California, Mexico.
Data Sources: (1) Zavala, A. 2016. Tortugas Marinas del Golfo de California. Data downloaded from OBIS-SEAMAP (http://seamap.env.duke.edu/dataset/1176) on 2016–07-07. **(2)** OBIS-SEAMAP. **(3)** STAT. **(4)** SWOT Database Online.
SWOT Contact: Alan Zavala

DATA RECORD 14
Metadata: 12 loggerheads; tags deployed in Baja California Sur, Mexico.
Data Source: Animal Telemetry Network. 2018. 12 loggerhead turtle tracks in Baja California Sur, Mexico. Accessed January 11, 2018 at http://oceanview.pfeg.noaa.gov/ATN/. ATN POC: Dr. Scott Eckert.
SWOT Contact: Animal Telemetry Network

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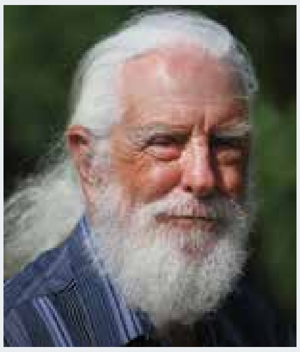
In Memoriam



Anthony F. Amos (1937–2017)

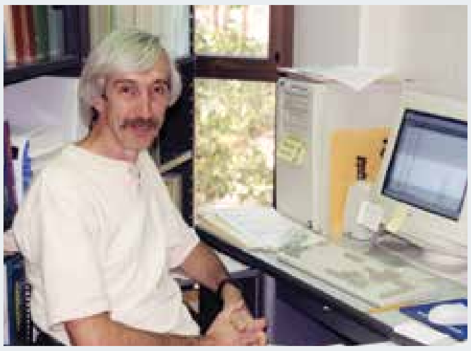
Tony was an icon in coastal wildlife conservation in Texas. He founded what ultimately became the Amos Animal Rehabilitation Keep (ARK), which has rehabilitated more than 2,500 sea turtles since 1982, and he conducted more than 40 years of wildlife studies on Mustang and San José Islands. He was included on *Texas Monthly* magazine's list of "most interesting Texans," was declared an Environmental Hero by the National Oceanic and Atmospheric Administration, and was declared a Recovery Champion by the U.S. Fish and Wildlife Service. Recently, the city of Port Aransas renamed its main beach in his honor. Tony's inspiration to conserve sea turtles and nature in Texas will leave a lasting legacy, and he will be missed by the many people whose lives he touched.

PHOTO: © SOUTH JETTY

Tobías de la Rosa Domínguez (DECEASED 2017)

Tobías de la Rosa Domínguez was born on Mexico's Costa Chica at a time when local people didn't pay much attention to life's little details like the date you were born. Although he had been a consumer of sea turtles all his life, he had the vision to understand that the sudden appearance of biologists at his door in 1996 might bring good things to his community, and he joined the movement. He became a strong supporter of sea turtle protection and helped his reluctant community of Cahuitán, Oaxaca, to embrace conservation. The Cahuitán leatherback project will not be the same without his constant support and friendship, and he will be greatly missed.

PHOTO: © ANA REBECA BARRAGAN



Peter J. Eliazar (1953–2017)

Peter was an integral member of the Archie Carr Center for Sea Turtle Research for many years, and he spent more than a quarter century as a champion for sea turtles, working quietly behind the scenes keeping the Cooperative Marine Turtle Tagging Program and network running smoothly and the sea turtle bibliography up to date. Peter was a joy to work with—always calm and willing to go the extra mile for everyone, from teaching a student how to drive a car, to working extra hours to ship turtle tags to a collaborator or conducting turtle surveys on shrimp trawlers. Peter was willing to put his hand to any task and always did so with a smile.

PHOTO: © ACCSTR

Pavlos Tsaros (1968–2017)

Pavlos began his career in sea turtle conservation on the island of Crete in 2000, working for the Greek nonprofit Archelon. He remained dedicated to the organization throughout his life, as an organizer and technician rehabilitating injured animals with remarkable devotion and care. Pavlos (or Pavloukos or Pipap) was a well-loved member of the international sea turtle community, participating in several International Sea Turtle Symposia and volunteering for turtle projects in Thailand and Mexico. He had a cheerful personality, a warm heart, and a great smile. His dedication and integrity have been an inspiration for all who knew and worked with him in the Mediterranean and elsewhere.

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SWOT report
The State of the World's Sea Turtles

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