

special features



SEA TURTLES of the
Caribbean

T

he countless tranquil beaches of the Caribbean, with their gently lapping waves and fringing palm trees, give the feeling of permanence. Although you could be excused for thinking that these ecosystems—and their sea turtle inhabitants—have remained largely untouched for millennia, this is far from the truth. Sea turtles have provided the people of the Caribbean with a source of food, wealth, and cultural inspiration for more than 2,500 years. They even helped feed the countless European explorers that arrived in the region more than 500 years ago, making foreign colonization possible.



Unfortunately, this pressure has led to considerable declines in the region's sea turtle populations. It is estimated that green turtle populations in the Wider Caribbean Region (WCR) have declined by over 97 percent since precolonial times, and local extinctions of nesting turtles have been widespread in the region. On top of this, more contemporary threats, such as fisheries bycatch, marine pollution, and coastal development, have had a major impact on the turtles of the Caribbean. Yet despite it all, some populations have exhibited impressive recoveries. Today, a devoted network of conservation initiatives are working to restore Caribbean sea turtles to their historic abundance.

The WCR is bounded to the north, west, and south by the continental American landmass, extending from the Florida Peninsula to the northern coast of South America. Running through the center and extending to the east lie a sweeping arc of island states collectively known as the Greater Antilles and the Lesser Antilles. The largest of the Greater Antilles, Cuba, divides the WCR, with the Gulf of Mexico to the northwest and the Caribbean Sea to the southeast. The Gulf of Mexico is approximately 1.55 million square kilometers (about 600,000 square miles), and the Caribbean Sea is almost twice that size at approximately 2.75 million square kilometers (about 1 million square miles). Together with the Lucayan Archipelago (The Bahamas and the Turks and Caicos Islands) to the northeast and the Guianas (Guyana, Suriname, and French Guiana) to the southwest, the Caribbean Sea and the Gulf of Mexico are united in a geopolitically complex region of 43 states and territories known as the WCR.

Six of the world's seven sea turtle species inhabit the diverse marine habitats of the WCR (only the flatback, endemic to Australia, is absent). Green turtles nest at more than 700 sites in the WCR, with Tortuguero, in Costa Rica, hosting the largest aggregation in the region, with more than 100,000 nests per year. Loggerheads primarily nest in the region's northern and southern extremes; the largest nesting aggregation of loggerheads on Earth is found in Florida, U.S.A. Hawksbill turtles nest at more than 1,000 sites, yet most of these populations are very small, and only 10 beaches host more than 1,000 crawls per year. Leatherback turtles nest at more than 450 sites; however, recent reports confirm that nest numbers are declining. The Kemp's ridley is largely confined to the Gulf of Mexico, with only minor nesting on the east coast of Florida, giving it the most restricted nesting range of any sea turtle species globally. Olive ridleys are the least common species, with significant nesting occurring only in French Guiana.

GULF OF MEXICO

The Gulf of Mexico is almost entirely encircled by the continental United States and Mexico, with a combined coastline that extends more than 4,500 kilometers (2,800 miles). The island nation of Cuba lies in the narrow mouth of the Gulf, spanning the gap between Florida and the Yucatán Peninsula. The geography of the Gulf of Mexico leaves it rather isolated from both the Atlantic Ocean and the Caribbean Sea. Thus, it may not be surprising that the Gulf of Mexico hosts its own endemic sea turtle species, the Kemp's ridley (see sidebar, p. 18), which nests predominantly in Tamaulipas, Mexico, with a secondary nesting site in Texas, U.S.A. Kemp's ridley numbers continue to slowly rise from historic lows, though the total nesting population is still a ghost of its 1947 estimated size.

The Gulf of Mexico also harbors some of the largest populations of green, hawksbill, and loggerhead turtles in the WCR. Loggerhead turtles primarily nest on both coasts of the Florida Peninsula, hawksbills are more common on the Yucatán Peninsula, and green turtles are found throughout the Gulf. Leatherbacks feed extensively in the Gulf, yet they only nest sporadically on the Yucatán and Florida Peninsulas. The olive ridley has been reported in the region, but it is considered a very rare visitor.

The region's entire continental shelf is a multispecies migratory corridor, foraging zone, and developmental habitat for hawksbills, greens, Kemp's ridleys, and loggerheads. Post-nesting turtles are also known to congregate in several common foraging areas in both the northern and southern Gulf of Mexico, sometimes sharing these feeding zones with postnesting females from the Cayman Islands, Colombia, Costa Rica, and Cuba. The intrinsic spatial dynamics of the Gulf of Mexico as a multispecies, multiuse nexus of sea turtle connectivity for the WCR makes it a unique melting pot and a critical conservation priority.

Because of the abundance and diversity of sea turtles in the Gulf of Mexico, several conservation and monitoring programs have been active in the region for more than five decades. Those ongoing efforts, including a binational head-start initiative (1978–1993) for the Kemp's ridley, have contributed key information on the biology and management of this endemic population while simultaneously helping to restore the once depleted populations of this species.

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AT LEFT: A critically endangered Kemp's ridley sea turtle, a species endemic to the Gulf of Mexico, rests on the seafloor while surrounded by remoras near Pensacola, Florida, United States. © Erin Chandler/@Girlmeetsshark. PREVIOUS SPREAD: A loggerhead turtle swims amid sargassum in Belize's Hol Chan Marine Reserve, with a remora hitching along. © Brian J. Skerry

THE GULF OF MEXICO'S ONLY ENDEMIC SEA TURTLE

The smallest sea turtle in the world, with the tiniest home range and the lowest overall population numbers, the Kemp's ridley has the dubious distinction of being the world's most critically endangered sea turtle.

The uniqueness of the Kemp's ridley stems from the fact that its biology and ecology are fully adapted to the Gulf of Mexico. It is well known for inhabiting coastal and estuarine environments at the base of the numerous river systems that contribute water and nutrients to the Gulf of Mexico. Furthermore, it feeds on invertebrates such as blue crabs that flourish in those nutrient-rich estuarine environments. But the most distinctive aspect of the Kemp's ridley is its reproductive biology. The entire species migrates to a single primary nesting beach near Rancho Nuevo, Mexico, where it exhibits a daytime mass nesting (*arribada*) behavior that can involve thousands of turtles coming ashore nearly simultaneously on one small stretch of beach. This unique phenomenon enhances the production and survival of hatchlings, which are carried by currents away from Rancho Nuevo and eventually into developmental habitats throughout the Gulf of Mexico and along the Atlantic coast of the United States.

The Kemp's ridley also has a cultural history that spans the entire Gulf of Mexico. Although all major nesting occurs in the far western Gulf of Mexico, this species was initially described far to the east, in the Florida Keys, in 1880. The discovery started a scientific riddle (an abundant species with no known nesting beach?) that took more than 80 years to solve. By the time the Kemp ridley's remote Mexican nesting beach was finally discovered by the scientific community in 1963, the population was already in steep decline, and by the mid-1980s the species was on the brink of extinction, with only a few hundred females nesting each year at Rancho Nuevo. Its spiral toward extinction launched one of the most comprehensive and successful conservation efforts on record.

The binational program included heroic efforts by a wide variety of agencies, organizations, and individuals; an expensive and risky binational experiment to establish nesting beaches in Texas, U.S.A.; and even a massive program to implement the use of turtle excluder devices on shrimp boats throughout the Gulf and southeast Atlantic coast of the United States. By the early 2000s, the effects of these valiant efforts were obvious; the Kemp's ridley was on an exponential recovery trajectory that was expected to continue for decades. However, the recovery hit an unexpected slowdown in 2010. The reasons for this latest riddle in the ridley story are not clear, but the binational conservation efforts are continuing, and for now, the Gulf of Mexico continues to embrace its own unique species of sea turtle, the Kemp's ridley.

Yet, as in the rest of the WCR, sea turtles in the Gulf of Mexico still face a variety of cumulative and growing threats, ranging from fisheries bycatch to sometimes extreme recreational use of beaches; urban and coastal infrastructure; pollution (solids, chemicals, and even light and sound); climate change impacts (increasingly intense storms, beach erosion, coral bleaching, and more); and devastating stony coral tissue loss disease. Perhaps the most alarming threat is the specter of large-scale hydrocarbon exploration and extraction, which in 2010 resulted in the disastrous Deepwater Horizon oil spill (see *SWOT Report*, vol. VI, pp. 16–21). The scale of that event was such that, even a decade later, its impacts on sea turtles are not yet fully understood.

CENTRAL AMERICA

The Caribbean coastline of Central America, stretching south about 3,875 kilometers (2,400 miles) from Cancún, Mexico, on the Yucatán Peninsula through Belize, Guatemala, Honduras, Nicaragua, Costa Rica, and Panama, forms the western boundary of the Caribbean Sea. In general, this coastline hosts relatively small nesting turtle populations, with the major exceptions of Costa Rica and Panama. In Costa Rica, Tortuguero hosts more than 100,000 nests each year, making it one of the largest green turtle nesting sites in the world. The conservation and research program at this site was initiated by Dr. Archie Carr and has been carried out continuously by the Sea Turtle Conservancy since 1959, making it the longest-running and one of the most iconic sea turtle conservation initiatives in the world. In Panama, a cluster of beaches in the Bocas del Toro region hosts large nesting populations of both hawksbill and leatherback turtles. A monitoring program carried out by the Conservancy documents more than 2,000 hawksbill nests and more than 5,000 leatherback nests each year in the region.

The Caribbean coastline of Central America features countless estuaries, nearshore islands, coral reefs, and deep-ocean habitats, providing vital migratory corridors, nesting beaches, and foraging areas for sea turtles. The Mesoamerican Barrier Reef, which stretches more than 1,000 kilometers (620 miles) along the northernmost four countries of the region and the expansive continental coast of Nicaragua, provides extensive shallow-water foraging habitats for marine turtles. Indigenous and ethnic coastal communities have been fishing turtles for hundreds of years for subsistence, trade, and commerce, and very likely turtles were the first fishery export for many Caribbean nations. Although some of this activity is legal, illegal take also persists well beyond the exemptions for traditional use granted by authorities in Belize and Nicaragua. Today, at least 7,000 green turtles are killed annually in the Nicaraguan fishery, down from a high of 10,000 annually in the mid-1990s. Turtles captured with tags from research and conservation programs throughout the WCR are carefully monitored by a dedicated team from the Archie Carr Center for Sea Turtle Research at the University of Florida.

Of particular concern for both sea turtles and their protectors is the overlap between sea turtle nesting and narcotics trafficking. In 2013, a dedicated volunteer, Jairo Mora Sandoval, was brutally murdered in Costa Rica while protecting leatherback nests. Drug trafficking in other Central American nations also hinders regular monitoring of nesting beaches and is often associated with illegal sea turtle commerce. Recent investigations by SEE Turtles and its "Too

The conservation and research program ... was initiated by Dr. Archie Carr and has been carried out continuously ... making it the longest-running and one of the most iconic sea turtle conservation initiatives in the world.

Rare to Wear" campaign found that the hawksbill shell trade remains a threat in Costa Rica and all countries in the region, even though the species is protected by law in most.

In general, active threats mirror those encountered elsewhere in the WCR, including unsustainable (and often illegal) fisheries bycatch; direct take for meat and eggs; habitat loss and degradation; and the less quantifiable impacts of climate change, pollution, and disease. In recent years, the region has experienced dramatic influxes of *Sargassum*, a genus of brown algae that has blanketed pelagic waters and beaches. These blooms, likely a result of increases in agricultural runoff, have smothered many WCR nesting beaches, caused turtle drownings, and made it difficult for adults to nest and hatchlings to crawl to the ocean. Long-standing issues with urban expansion and beachfront development continue to displace nesting females, artificial coastal lighting lures thousands of hatchlings to their deaths, and

shoreline erosion and the erection of sea walls contribute to the disappearance of historic nesting grounds.

Many government agencies, nonprofits, and community organizations are working diligently to conserve the Mesoamerican sea turtle fauna; still, population recovery efforts often face seemingly insurmountable challenges and opposition from stakeholders, as well as legal loopholes that make protecting sea turtles and their habitats difficult. Making the case for conservation increasingly requires collaborative research—such as that undertaken by Pronatura Península de Yucatán, Cinvestav Unidad Mérida, Universidad Autónoma del Carmen, ECOMAR, Marymount University, Hawksbill Hope, ProTECTOR Inc., Wildlife Conservation Society, and Sea Turtle Conservancy—into using satellite telemetry to monitor sea turtle migrations. Data from such research have helped to focus attention on migratory hotspots and other critical habitats.

NORTHERN SOUTH AMERICA

Extending east from the Isthmus of Panama, the nations of Colombia and Venezuela form the southern border of the Caribbean Sea. The annual southern Caribbean upwelling system brings nutrient-filled waters from the deep ocean onto the continental shelf, nurturing highly productive commercial and artisanal fisheries. While providing an important local source of nutrition and income, many of these fisheries also incur substantial sea turtle bycatch. Tackling this issue while safeguarding depleted nesting populations is among the many complex problems that must be addressed before sea turtle recovery can be achieved.

Historical reports indicate significant numbers of nesting sea turtles on the coasts of Colombia and Venezuela, yet today these numbers are very low and, despite persistent conservation efforts, continue to decline. For example, on the Paría and Guajira Peninsulas, several hundred loggerheads were estimated to have nested annually in the first half of the 20th century, yet today fewer than 50 individuals nest there annually. The widespread harvest of eggs and intentional take by artisanal fisheries are implicated in the demise (see pp. 34–35).

Current sociopolitical and economic challenges in Venezuela are hampering sea turtle conservation efforts nationwide. Nonetheless, several university groups, conservation organizations, and government agencies are striving to maintain vital protection efforts through a combination of nest monitoring, environmental education, and general outreach efforts. These organizations include the Ministerio del Poder Popular para el Ecosocialismo (formerly the Ministerio del Ambiente); the Centro de Investigación y Conservación de Tortugas Marinas (CICTMAR, the lead organization for the Wider Caribbean Sea Turtle Conservation Network [WIDECAS] in Venezuela); ConBiVe (Asociación Civil para la Conservación de la Biodiversidad Venezolana); Fundación La Tortuga; Grupo de Trabajo en Tortugas

Marinas del Golfo de Venezuela; the University of Zulia; and other organizations in Colombia.

Offshore to the northwest of Venezuela's capital city, Caracas, lie the "ABC" islands, the Dutch islands of Aruba, Bonaire, and Curaçao. All three islands have strong local sea turtle research and conservation histories led by WIDECAS affiliates TurtugAruba, Sea Turtle Conservation Bonaire, and Sea Turtle Conservation Curaçao, respectively. The longest running of these organizations has led in-water and nesting beach monitoring programs for decades in Bonaire and is now working to curtail the invasive seagrass *Halophila stipulacea*. Among its many creative endeavors, Sea Turtle Conservation Curaçao is making significant strides in reducing pollution by taking local action in repurposing postconsumer plastic.

Unlike the shorelines of Colombia and Venezuela, the eastern countries of Guyana, Suriname, and French Guiana host substantial nesting populations of green, leatherback, and olive ridley sea turtles. These countries, collectively known as the Guianas, contain the largest remaining expanse of coastal wilderness in the tropics and are well known for their muddy mangrove coasts and shifting shorelines. Influenced by the North Brazil Current, entire stretches of beaches can be deposited or vanish within a matter of weeks, leading to significant geographic shifts in nesting habitat within and between seasons. Situated across the Gulf of Paría from Venezuela, Trinidad and Tobago host the hemisphere's largest remaining nesting assemblage of leatherback turtles on Trinidad's north (Grand Riviere) and east (Matura) beaches, monitored by community-based organizations.

The most significant anthropogenic threat to sea turtles along the northern tier of South America is from fisheries bycatch. Although the use of turtle excluder devices (TEDs) by shrimp trawlers has been required by law in Guyana and Suriname for more than 20 years, this requirement has only recently had the force of law in French Guiana.

Trawling has been illegal since 2009 in Venezuela, though artisanal fisheries are still responsible for notable sea turtle mortalities. Specifically, Wayuu indigenous communities capture more than 3,800 mostly juvenile green turtles each year on the Venezuelan side of the Guajira Peninsula (see *SWOT Report*, vol. XIII, pp. 34–35); the numbers may be higher on the Colombian side. Bycatch data are scarce

for Colombia, which has been one of the main drivers for the recent creation of a National Comanagement Committee for Bycatch, led by the National Fisheries Authority (Autoridad Nacional de Acuicultura y Pesca, or AUNAP) and the Marine and Coastal Research Institute (Instituto de Investigaciones Marinas y Costeras, or INVEMAR), along with a number of Colombian nongovernmental organizations.

LESSER ANTILLES AND AVES RIDGE

A sweeping island arc known as the Lesser Antilles forms the eastern boundary of the Caribbean Sea. A complex sociopolitical mix of nations and overseas territories, the Lesser Antilles provide nesting habitat for green, loggerhead, hawksbill, and leatherback turtles, as well as a variety of shallow- and deep-water habitats. The countries of the Lesser Antilles face many issues common to the WCR, including coastal development (loss of coastal vegetation and increased beachfront lighting), beach erosion, beach remediation activities that alter the incubation environment, direct and incidental capture by nearshore fisheries, pollution, and climate change. Research shows that biodiversity loss and the threat of localized extinction is heightened in small island developing states, where a diversity of cultural, political, and ecological landscapes add layers of complexity to conservation initiatives.

The coral island of Barbados hosts the largest nesting population of hawksbills in the Lesser Antilles, with more than 600 females recorded annually. The population has increased considerably over the past 30 years, a result of legislation banning direct harvest as well as ongoing conservation actions led by the WIDECAST-affiliated Barbados Sea Turtle Project (BSTP) at the University of the West Indies. Sea turtles are a major tourist attraction for the island, and BSTP's Marine Turtle Tagging Centre provides free flipper tags, equipment, and training to field projects throughout the region.

Aves Island (Venezuela) hosts nesting green turtles in numbers that exceed all other islands in the Lesser Antilles and most locations on the South American continent, along with significant numbers of males and females that congregate for courtship and mating (see *SWOT Report*, vol. XIII, pp. 10–11). In less than 30 years, monitoring data collected by FUDENA (Fundación para la Defensa de la Naturaleza), the Ministerio del Poder Popular para Ecosocialismo, and the Venezuelan Institute of Scientific Research (Instituto Venezolano de Investigaciones Científicas, or IVIC) have shown that the number of nesting green turtles on Aves Island has doubled to more than 1,000 turtles per year.

Saint Vincent and the Grenadines has made significant progress in sea turtle conservation by legally protecting all life stages of all species of sea turtles in national waters since January 2017. The Ministry of Agriculture, Forestry, Fisheries, and Rural Transformation, in collaboration with the National Parks, Rivers, and Beaches Authority and partners such as the Saint Vincent and the Grenadines Environment Fund and the Saint Vincent and the Grenadines National Trust, is using best practices developed by the WIDECAST network in education, outreach, and sustainable livelihoods.

Saint Lucia is one of only a handful of nations in the WCR that still sanctions an annual open season (October–December) for hunting sea turtles. It is based on minimum size limits and includes

all hard-shelled species. Marine protected area managers, in particular at the Pointe Sable Environmental Protection Area, are working to collect sea turtle and habitat monitoring data. The Saint Lucia National Trust shares nesting beach monitoring findings in infographic format to bring greater accessibility to data that can help to drive more sustainable sea turtle management practices.

Grenada hosts the largest population of nesting leatherbacks in the Lesser Antilles and also provides prime nesting, foraging, and developmental habitats for hawksbills, greens, and loggerheads. Over the past 20 years, several hundred leatherback nests have been recorded annually at Levera Beach by Ocean Spirits, a local nonprofit that relies entirely on volunteers. Ocean Spirits has a strong presence in local schools, and more than 7,000 students have heard its conservation message. National legislation has protected leatherback turtles since 2001, but Grenada has a seasonal fishery for hard-shelled species, and it is the only country in the region that legally allows the sale of turtle shell products.

Sint Eustatius in the northern Lesser Antilles hosts small nesting populations of green and hawksbill turtles. The island's characteristic black volcanic sand beaches are hot, which has been found to give rise to a female hatchling bias. Projections indicate that only 2.4 percent of green turtle hatchlings will emerge as male by 2030. The St. Eustatius National Parks Foundation (STENAPA) has been at the forefront of sand temperature research and the development of management strategies to artificially lower incubation temperatures by watering, shading nests, or relocating nest clutches to deeper depths.

Antigua hosts one of the region's longest-running research and monitoring programs, the Jumby Bay Hawksbill Project, a WIDECAST initiative that has studied a protected population of nesting hawksbills since 1987 with funding from a local homeowners association. Recent data suggest that after more than a decade of growth, the population may be in significant decline, and understanding the cause of this decline is a crucial direction for future research.

Further north in the British Virgin Islands, in-water monitoring of hawksbills and other species is undertaken by the Association of Reef Keepers (ARK), with the involvement of the government and private sectors. ARK emphasizes social entrepreneurship for conservation.

Alongside these diverse local scenarios, there is a persistent tension with the region's largest economic driver—tourism. “Swim with the turtles” and related hand-feeding operations are becoming an increasingly common method to artificially maintain localized turtle aggregations for viewing in water. Although these activities can bring sustainable livelihoods for local communities, turtles may suffer from improper diet, compromised migratory movements, and an affinity for humans that can lead to boat strikes, gear entanglement, injury, and disease. The social media thirst for “turtle selfies” is a complicating factor, making it difficult to manage this new tourism product.

GREATER ANTILLES

The Greater Antilles make up nearly 90 percent of the landmass of the entire West Indies, as well as over 90 percent of its population on the islands of Cuba, Hispaniola (Haiti and the Dominican Republic), Puerto Rico, and Jamaica, as well as the Cayman Islands. People in the region have been actively harvesting sea turtles for centuries, causing local extinctions in many areas.

The longest-running conservation program is in Cuba, which began monitoring the impacts of harvesting on four turtle species more than 40 years ago. Cuba closed its sea turtle fishery in 2008, and conservation efforts have increased considerably since then. Cuban and international partners have expanded outreach campaigns and undertaken studies of illegal trade, in addition to important research on genetics, migration, and climate change. Seventy-nine beaches are monitored, and upward trends are observed in some areas.

Among the islands of the Greater Antilles, Hispaniola has arguably seen the largest declines in nesting turtles. Today, only sporadic reports of nesting occur in Haiti, and a small rehabilitation center operated by the Haiti Ocean Project has recently opened to address issues of entanglement and injury. Several programs monitor and protect the

WIDECAST The Wider Caribbean Sea Turtle Conservation Network

WIDECAST, the Wider Caribbean Sea Turtle Conservation Network, is the largest regional network of sea turtle research and conservation actors in the world. Volunteer country coordinators serve in 45 nations and territories, and the network emphasizes science-based tools in research; policymaking; and community conservation, outreach, and microenterprise development.

Founded in 1981, WIDECAST is a Regional Activity Network of the United Nations Caribbean Environment Programme and serves as a framework to promote policies and practices that advance sea turtle recovery regionwide. The network develops and mentors projects, promotes standardized data collection and sharing, and promotes links between science, policy, and public participation at a variety of scales. With country coordinators strategically located throughout the Wider Caribbean Region, WIDECAST is uniquely positioned to facilitate conservation action within and between range states. By strengthening national and regional regulatory regimes, encouraging community engagement, and raising public awareness, the network has had measurable impacts on the protection and sustainable management of sea turtles.

In partnership with WIDECAST, most Caribbean nations have developed and implemented national sea turtle recovery action plans—and most important, these efforts are working. Steady declines have been seen in poaching and illegal product sales across the Caribbean, major nesting beaches are protected, and the region's largest breeding colonies are regularly monitored. Moreover, through WIDECAST's powerful network of country coordinators and local project affiliates, sea turtles are more likely to be considered in national policy debates, and alternative livelihood models are further reducing pressure on remnant populations.

A leatherback turtle finishes camouflaging her nest as the sun rises in Grande Riviere, Trinidad. © Ben J. Hicks/benjchicks.com



nests of leatherback, hawksbill, and green turtles across the border in the Dominican Republic, and in-water surveys conducted since 1997 have identified hawksbill foraging areas on the southwest coast.

Puerto Rico has seen an increase in conservation efforts since the Department of Natural and Environmental Resources began delegating sea turtle management and conservation to community-based groups in 2010. The partnership has promoted beach cleanups, developed a stranding and rehabilitation response protocol, and expanded efforts to safeguard nests and adults from poachers and invasive species. Data from these local efforts have also contributed to the designation of protected areas, and long-term in-water surveys of green and hawksbill turtles at Mona and Culebra islands have greatly increased our understanding of sea turtle population dynamics in Puerto Rico and beyond. The collaboration between government agencies and community-based groups has been a powerful force for management and conservation, which we hope will lead to measurable population recoveries.

Green, hawksbill, loggerhead, and leatherback turtles once nested throughout Jamaica. Today, only 10 Jamaican beaches receive more than an occasional hawksbill nest. Green and leatherback nesting is very rare, and loggerheads are gone. Concern over the effects of an unregulated take was expressed at an early stage in Jamaica's history

LUCAYAN ARCHIPELAGO

The Lucayan Archipelago consists of the Commonwealth of The Bahamas and the Turks and Caicos Islands (TCI), the latter a British Overseas Territory. The archipelago is instantly identifiable from satellite imagery owing to the Bahama Banks, which are shallowly submerged carbonate platforms that make the waters of the region appear a distinct peacock blue. The numerous seabed and mangrove systems are inhabited by abundant populations of juvenile green turtles. Loggerhead and hawksbill turtles are also common, although they are seen mainly in deeper coral reefs. Understandably, almost all sea turtle monitoring in the region has focused on in-water data collection. Although substantial numbers of tags have been deployed, most monitoring efforts are relatively opportunistic, and long-term datasets in fixed habitats are rare.

The Bahamas comprises 700 islands distributed over 259,000 square kilometers (100,000 square miles) of ocean. The archipelago has never been thoroughly surveyed for sea turtle nesting, but the data suggest that green, loggerhead, and hawksbill turtles nest at low densities at several sites; leatherbacks are rare. All have been fully protected since 2009. Threats include poaching of eggs and turtles, beachfront lighting, coastal development, seagrass and coral reef degradation, entanglement in fishing gear, and marine pollution. The Bahamas National Trust sponsors a broad portfolio of conservation and research projects, often in partnership with universities or the government. Such projects include a long-term study of foraging green turtles at Great Inagua, conducted with colleagues at the Archie Carr

CONCLUSION

The history of humans and sea turtles in the WCR is inextricably intertwined. Providing a staple food for both indigenous peoples and colonists, sea turtles became an important component of many local

(the first law controlling the collection of eggs was introduced in 1711), but sea turtle meat remained important to the Jamaican diet well into the 20th century. Aerial, interview, and ground surveys began in 1981 to catalog what remained, and sea turtles were fully protected in 1982. A partnership with WIDECAST produced a comprehensive national recovery plan in 2011 that continues to guide conservation efforts.

The Cayman Islands, which hosted globally important nesting populations of sea turtles over two centuries ago, has seen these populations reduced to only a few hundred individuals, and in 2013, full protection of sea turtles was mandated by law. The well-known Cayman Turtle Centre was established as a commercial turtle farm in 1968, and a captive herd annually breeds tens of thousands of green turtle hatchlings that, through a still controversial program, are released to the wild. Genetic studies have shown that the majority of wild nesting individuals in the Caymans are now related to these farm-reared individuals. Since 1998, the Department of Environment has been conducting systematic beach surveys and has learned that hawksbills hover at the edge of extinction. However, loggerhead and green turtle populations are showing signs of recovery, increasing from fewer than 50 nests in the early years of monitoring to more than 600 nests in 2017.

Center for Sea Turtle Research at the University of Florida. The Bahamian government is committed to protecting at least 20 percent of its nearshore marine environment by 2020, including many critical turtle foraging areas.

The 8 main islands and more than 22 smaller islands that make up the TCI have a total land area of only 616 square kilometers (238 square miles). There has been a long tradition of harvesting sea turtles for meat in the Lucayan Archipelago, and this practice is still legal in TCI, where a seasonal fishery for hawksbill and green turtles is bounded by minimum and maximum size limits. More progressive than the minimum size limits that typically characterize Caribbean sea turtle fisheries, maximum size limits offer a degree of protection to reproductively active adults, arguably the most ecologically valuable animals in any population.

A number of research projects have been conducted in TCI in recent years, often in partnership with the Marine Conservation Society, the Cape Eleuthera Institute, and the University of Exeter in the United Kingdom. The projects include mark and recapture; genetic sampling; mixed stock analysis; and studies of diet (stable isotopes), sex ratios, and seasonality of occurrence. The genetic sampling suggests that more than half of all foraging green turtles originate in Costa Rica, whereas the majority of hawksbills originate in Cuba and the U.S. Virgin Islands. The primary threat to stock recovery is the ongoing—legal and illegal—take of eggs and turtles. A new threat is the emergence of stony coral tissue loss disease affecting coral reefs of the territory.

cultures. Yet direct harvest over hundreds of years has driven many sea turtle populations to near extinction. In recent decades, renewed commitment to protective legislation, safeguarding of habitat, and

antipollution initiatives have reversed the fortunes of many sea turtle populations, helping put them back on the road to recovery.

The hard work of conservationists has paid off in numerous policy accomplishments. Intergovernmental meetings devoted to addressing shared management concerns have been convening in the region for more than three decades. The majority of WCR nations and territories now fully protect sea turtles both on land and at sea. All six WCR sea turtle species are on the IUCN (International Union for Conservation of Nature) Red List of Threatened Species, with loggerheads, leatherbacks, and Kemp's ridleys now listed at the regional management unit (subpopulation) scale. All species are also listed in Annex 2 (full protection) of the Protocol Concerning Specially Protected Areas and Wildlife to the Cartagena Convention, as well as Appendix 1 (full protection) of the Convention on Migratory Species and Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. They also fall under the aegis of the Inter-American Convention for the Protection and Conservation of Sea Turtles.

Although legal exceptions for traditional or subsistence use are recognized in some cases, illegal harvest is reported, to varying degrees, regionwide. That said, extraterritorial trade in turtle products (meat and shell), mainly to Asia, has stopped, and direct take is declining in many cases as a result of stronger regulations, generational shifts in conservation attitude, and greater recognition that sea turtles are generally worth more alive than dead. Other threats remain entrenched, including fisheries bycatch; coral reef, beach, and seagrass degradation; pollution (oil spills, chemical waste, and persistent plastic and other marine debris); and climate change. These are regionwide problems, and they require solutions at scale. Sea turtle survival will ultimately hinge on the success of international collaborations between the region's diverse continental states and small islands. The networking model embraced by WIDECAST is an example of a long-term, successful collaboration that has reaped considerable rewards, not only for sea turtles but also for the communities that traditionally relied on them. As collaboration continues to grow, we expect that the WCR will once again become a haven for future generations of sea turtles. •

FEATURE MAPS

Biogeography of Sea Turtles in the Caribbean Sea

The maps on pp. 24–27 display available nesting and satellite telemetry data for the six sea turtle species found in the Wider Caribbean Region.

Nesting Map

The map of nesting biogeography (pp. 24–25) is based almost exclusively on nesting data that were provided by members of the WIDECAST network (see sidebar, p. 21) to create the *Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region* (Eckert and Eckert 2019). That exhaustive digital inventory documented more than 1,341 nesting beaches representing 2,667 species-specific nesting sites among the 45 nations and territories that comprise the WIDECAST network.

For the purposes of the map on pp. 26–27, we chose to display data on all six species that nest within the Caribbean region on a single map. Although they were included in the *WIDECAST Atlas*, we chose to exclude Brazil and Bermuda in order to simplify the extent of the map (see *SWOT Report*, vol. XI, pp. 20–21 for a summary of nesting in Brazil). Additional data were incorporated from the SWOT database for large nesting sites (those with >10,000 crawls per year) to further distinguish between nesting sites with 10,001–100,000 crawls per year and those with greater than 100,000 crawls per year (from all species combined). Complete data citations for all source data can be found on pp. 46–51 of this report.

Nesting sites are represented by dots that are colored according to the species present. The proportion of nesting by each species is indicated by the colors shown within the dot. The dots are scaled according to the total nesting abundance for all species at that site.

For a more comprehensive presentation of sea turtle nesting data in the Wider Caribbean Region, including species-specific maps, trend data, and detailed supplementary information, see the *WIDECAST Atlas* at <https://widecast.org/widecast-publications>.

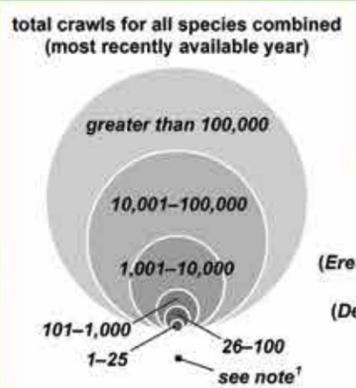
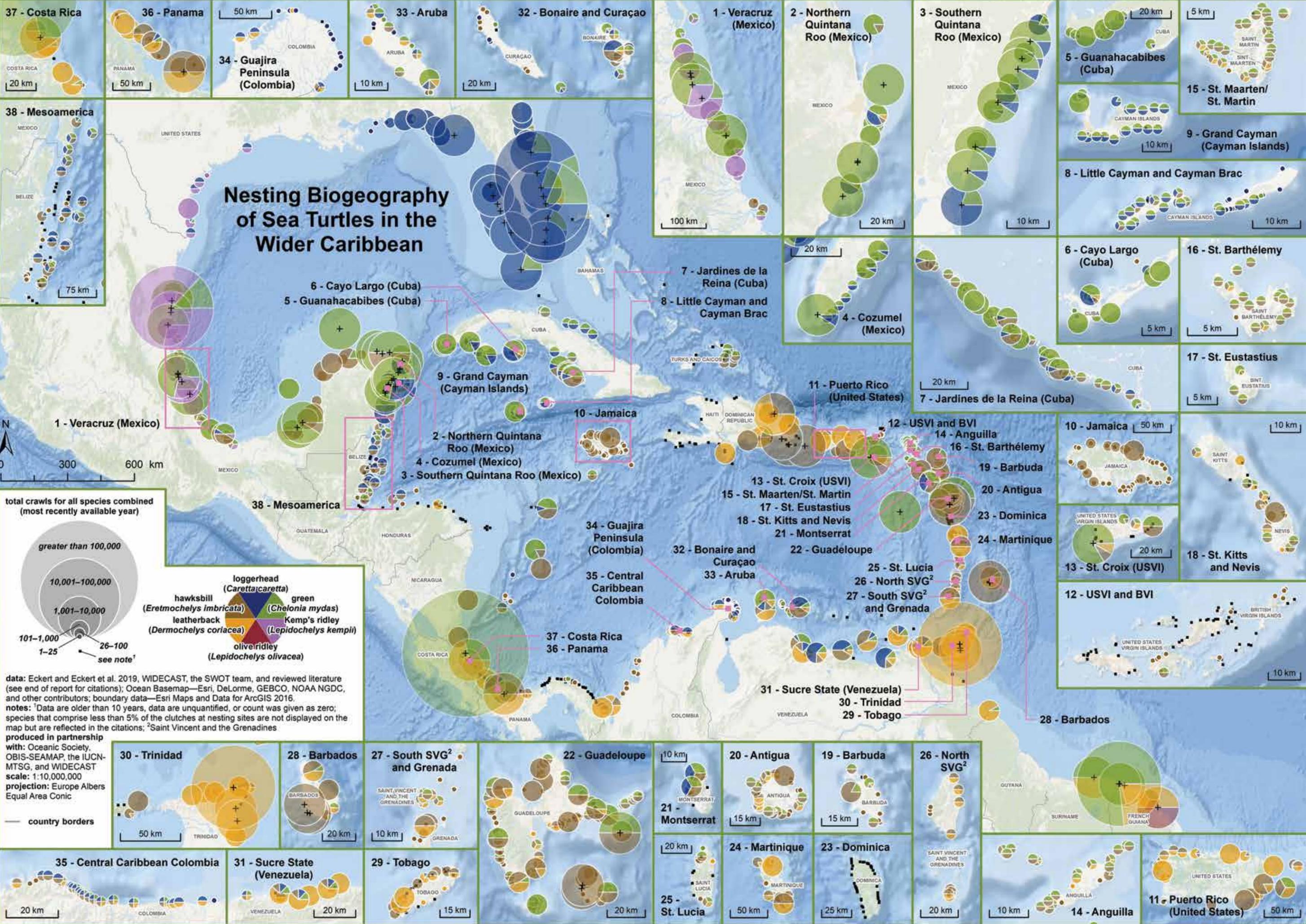
Satellite Telemetry Map

The map of sea turtle satellite telemetry data on pp. 24–25 summarizes all available telemetry data from tags deployed in the Wider Caribbean Region. The data consist of more than 350,000 locations from 626 individually tracked turtles and were contributed by more than 36 different partners (see data citations, pp. 46–51). Telemetry data are represented as polygons that are colored according to the number of locations and the composition of species they contain. Darker colors represent a higher number of locations, which can indicate that a high number of tracked turtles were present in that location or that turtles spent a lot of time in that location. Telemetry data are displayed as given by the providers, with minimal processing to remove locations on land and visual outliers. As such, some tracks are raw Argos or GPS locations, whereas others have been more extensively filtered or modeled. For a complete list of data providers and available metadata, see pp. 46–51.

The maps on the lower right of p. 27 show the six regional management units (or subpopulations) of the six sea turtles residing in the Wider Caribbean Region, overlain with species-specific satellite telemetry data. The regional management units were defined by Wallace et al. in 2010 by combining telemetry, genetics, tagging, and nesting data.

We are deeply grateful to all of the data contributors and projects that participated in this effort, and especially to the WIDECAST network, Dr. Karen Eckert, and Adam Eckert for their collaboration. Please see the complete data citations for all maps beginning on p. 46 for details.

Nesting Biogeography of Sea Turtles in the Wider Caribbean



data: Eckert and Eckert et al. 2019, WIDECAST, 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.

notes: ¹Data are older than 10 years, data are unquantified, or count was given as zero; species that comprise less than 5% of the clutches at nesting sites are not displayed on the map but are reflected in the citations; ²Saint Vincent and the Grenadines

produced in partnership with: Oceanic Society, OBIS-SEAMAP, the IUCN-MTSG, and WIDECAST scale: 1:10,000,000 projection: Europe Albers Equal Area Conic

— country borders



SWOT Data Citations

WIDER CARIBBEAN

The data citations that follow correspond directly to the maps of Wider Caribbean sea turtle biogeography on pp. 24–27. To use these data for research or publication, you must obtain permission from the data providers.

NESTING DATA CITATIONS: WIDER CARIBBEAN

The map of sea turtle nesting biogeography in the Wider Caribbean Region (pp. 24–25) was produced in partnership with WIDECAS (Wider Caribbean Sea Turtle Conservation Network), and the data were sourced almost exclusively from WIDECAS's 2019 publication: Eckert, K. L., and A. E. Eckert. 2019. *An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region*. Rev. ed. WIDECAS Technical Report 19, Godfrey, IL.

Following is a list of all of the data providers to the WIDECAS Atlas and, therefore, to the nesting biogeography map on pp. 24–25, with names organized by territory. In addition to the data sourced from the WIDECAS Atlas, supplementary data were used from the SWOT network for four nesting sites with very high nesting abundance (in Costa Rica, Mexico, Trinidad and Tobago, and the United States) to better differentiate among those sites. Those four data citations are listed at the end of this section.

For detailed nesting data citations and metadata, please refer directly to the WIDECAS Atlas, available online at <http://www.widecast.org/management/nesting-beach-atlas/>.

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ADDITIONAL NESTING DATA CITATIONS

COSTA RICA

Data Sources: (1) Harrison, E. 2014. Sea turtle nesting at Tortuguero, Costa Rica. Personal communication. In Kot, C. Y., E. Fujioka, A. 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>. (2) García Varela, R., G. López Torrents, and E. Harrison. 2016. *Report on the 2015 Sea Turtle Program at Tortuguero, Costa Rica*. Unpublished report. San Pedro, Costa Rica: Sea Turtle Conservancy.

Nesting Beach: Tortuguero
Years: 2014–2015
Species and Counts: *Chelonia mydas*—greater than 100,000 crawls per year
SWOT Contact: Emma Harrison

MEXICO

Data Source: Gladys Porter Zoo Sea Turtle Conservation Program. 2013. Sea turtle nesting at Rancho Nuevo, Mexico. Personal communication. In Kot, C. Y., E. Fujioka, A. 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>.
Nesting Beach: Rancho Nuevo
Year: 2012
Species and Counts: *Lepidochelys kempii*—greater than 10,000 crawls per year
SWOT Contacts: Patrick Burchfield and Luis Jaime Peña

TRINIDAD AND TOBAGO

Data Source: The Northwest Atlantic Leatherback Working Group. 2019. *Dermochelys coriacea* (Northwest Atlantic Ocean subpopulation). *The IUCN Red List of Threatened Species 2019*. e.T46967827A83327767.
Nesting Beach: Grand Riviere

Years: 2009–2017
Species and Counts: *Dermochelys coriacea*—greater than 10,000 crawls per year

UNITED STATES

Data Source: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute. 2019. <https://myfwc.com/research/wildlife/sea-turtles/monitoring/>. Accessed October 2019.
Nesting Beaches: Brevard County, Martin County, Palm County
Year: 2018
Species and Counts: *Caretta caretta*—greater than 10,000 crawls per year at each location

TELEMETRY DATA CITATIONS: WIDER CARIBBEAN

The following data records refer to satellite telemetry datasets from tags that were deployed on sea turtles in the Wider Caribbean Region and were combined to create the map on pp. 26–27. They are organized by the country of deployment. For information regarding data processing and filtering, see the map introduction on p. 23. These data were generously contributed to SWOT by the people and partners listed subsequently. 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>, which contains additional information about the projects and their methodologies.

To save space, we have used the following abbreviations in the data source fields: **(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. 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.

ANGUILLA

DATA RECORD 1

Project Title: Anguilla Marine Turtle Tracking
Project Partners: Anguilla Department of Fisheries and Marine Resources and Anguilla National Trust, funded by the European Union Voluntary Scheme for Biodiversity and Ecosystem Services in Territories of Europe Overseas
Metadata: 7 adult and 1 juvenile *Eretmochelys imbricata*; 14 juvenile *Chelonia mydas*
Data Source: Soanes, L. 2019. Anguilla marine turtle tracking. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Louise Soanes

BELIZE

DATA RECORD 2 | SWOT ID: 1284

Project Title: Hawksbill Turtle Tracking at Lighthouse Reef Atoll, Western Caribbean—MarAlliance
Metadata: 1 adult female, 1 female subadult, and 2 juvenile *Eretmochelys imbricata*
Data Sources: (1) Graham, R. 2019. Hawksbill turtle tracking at Lighthouse Reef Atoll, Western Caribbean—MarAlliance. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1284>). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Rachel Graham

BONAIRE

DATA RECORD 3

Project Title: Bonaire Turtles
Metadata: 5 female nesting *Caretta caretta*; 5 *Chelonia mydas*; 13 *Eretmochelys imbricata*
Data Sources: (1) Nava, M. I., and Sea Turtle Conservation Bonaire. 2019. Tracking marine turtles off of Bonaire. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XIV (2019). (2) Becking, L. E., M. J. A. Christianen, M. I. Nava, N. Miller, S. Willis, and R. P. van Dam. 2016. Post-breeding migration routes of marine turtles from Bonaire and Klein Bonaire, Caribbean Netherlands. *Endangered Species Research* 30: 117–124.
SWOT Contact: Mabel Nava

CAYMAN ISLANDS

DATA RECORD 4 | SWOT ID: 349

Project Title: Cayman Islands 2003: Loggerhead and Green Turtles
Project Partner: Marine Turtle Research Group, Cayman Islands Department of Environment
Metadata: 1 adult *Caretta caretta*; 2 *Chelonia mydas*
Data Sources: (1) Blumenthal, J. 2018. Cayman Islands 2003: Loggerhead and Green Turtles. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/349>) on December 4, 2018. (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Janice Blumenthal

DATA RECORD 5 | SWOT ID: 349

Project Title: Cayman Islands 2004: Loggerhead and Green Turtles
Project Partner: Marine Turtle Research Group, Cayman Islands Department of Environment
Metadata: 2 adult *Caretta caretta*; 3 *Chelonia mydas*
Data Sources: (1) Blumenthal, J. 2018. Cayman Islands 2004: Loggerhead and Green Turtles. Data downloaded from OBIS-SEAMAP

(<http://seamap.env.duke.edu/dataset/349>) on December 4, 2018. (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Janice Blumenthal

DATA RECORD 6 | SWOT ID 929

Project Title: Cayman Islands 2005: Green Turtles
Project Partner: Marine Turtle Research Group, Cayman Islands Department of Environment
Metadata: 3 adult female *Chelonia mydas*
Data Sources: (1) Blumenthal J. 2018. Cayman Islands 2005: Green Turtles. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/929>) and originated from Satellite Tracking and Analysis Tool (STAT; http://www.seaturtle.org/tracking/index.shtml?project_id=92). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Janice Blumenthal

DATA RECORD 7 | SWOT ID: 930

Project Title: Cayman Islands 2006: Green Turtles
Project Partner: Marine Turtle Research Group, Cayman Islands Department of Environment
Metadata: 1 adult female *Chelonia mydas*
Data Sources: (1) Blumenthal J. 2018. Cayman Islands 2006: Green Turtle. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/930>) and originated from Satellite Tracking and Analysis Tool (STAT; http://www.seaturtle.org/tracking/index.shtml?project_id=175). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Janice Blumenthal

COLOMBIA

DATA RECORD 8 | SWOT ID: 1292

Project Title: Caribbean Colombian Sea Turtle Satellite Tracking
Project Partners: Sea Turtles and Mammal Conservation Program, UTADEO—Colombian Caribbean, Universidad Jorge Tadeo Lozano (UTADEO), and Mundo Marino Aquarium, Museo del Mar Foundation
Metadata: 1 neonate, 1 juvenile, and 1 adult *Caretta caretta*; 1 adult, 1 subadult, and 3 juvenile *Eretmochelys imbricata*
Data Sources: (1) Sea Turtles and Marine Mammal Conservation Program (ProCTMM). 2018. Caribbean Colombian Sea Turtle Satellite Tracking. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1292>) on December 4, 2018. (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: ProCTMM

DATA RECORD 9 | SWOT ID: 1312

Project Title: Juveniles de la Guajira
Project Partners: College of Arts and Sciences and Department of Biology, University of Miami
Metadata: 1 juvenile *Chelonia mydas*
Data Sources: (1) Vásquez C. 2016. Juveniles de la Guajira. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1312>) and originated from Satellite Tracking and Analysis Tool (STAT; http://www.seaturtle.org/tracking/index.shtml?project_id=1132). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Catalina Vásquez

COSTA RICA

DATA RECORD 10

Project Title: Costa Rica Leatherback Tracking between 2004 and 2015
Metadata: 1 adult female *Dermochelys coriacea*
Data Source: Evans, D. 2020. Sea Turtle Conservancy leatherback tracking in Costa Rica: Personal Communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Daniel Evans

CUBA

DATA RECORD 11

Project Title: Cuban Hawksbills
Metadata: 1 adult male and 20 adult female *Eretmochelys imbricata*
Data Source: Moncada, F., L. Hawks, B. Godley, S. Manolis, Y. Medina, G. Nodarse, and G. Webb. 2012. Patterns of dispersal of hawksbill turtles from the Cuban shelf inform scale of conservation and management. *Biological Conservation* 148: 191–199.
SWOT Contact: Félix Moncada

DOMINICA

DATA RECORD 12 | SWOT ID: 890

Project Title: Sea Turtles of Dominica
Project Partners: Dominica Sea Turtle Conservation Organization, International Fund for Animal Welfare, and Disney’s Friends for Change Project Green
Metadata: 7 adult *Dermochelys coriacea*; 2 juvenile *Eretmochelys imbricata*
Data Sources: (1) Levenson, J. 2018. Sea Turtles of Dominica. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/890>) and originated from Satellite Tracking and Analysis Tool (STAT; http://www.seaturtle.org/tracking/index.shtml?project_id=773). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Jacob Levenson

DOMINICAN REPUBLIC

DATA RECORD 13

Project Title: Dominican Republic Hawksbills
Metadata: 9 nesting female *Eretmochelys imbricata*
Data Sources: (1) Hawkes, L. A., J. Tomás, O. Revuelta, Y. M. León, J. M. Blumenthal, A. C. Broderick, M. Fish, J. A. Raga, M. J. Witt, and B. J. Godley. 2012. Migratory patterns in hawksbill turtles described by satellite tracking. *Marine Ecology Progress Series* 461: 223–232. (2) Revuelta, O., L. A. Hawkes, Y. M. León, B. J. Godley, J. A. Raga, and J. Tomás. 2015. Evaluating the importance of Marine Protected Areas for the conservation of hawksbill turtles (*Eretmochelys imbricata*) nesting in the Dominican Republic. *Endangered Species Research* 27: 169–180.
SWOT Contact: Lucy Hawkes

FRENCH GUIANA (FRANCE)

DATA RECORD 14

Project Title: French Guiana Marine Turtle Tracking
Project Partner: CNRS
Metadata: 10 adult *Chelonia mydas*; 20 adult *Lepidochelys olivacea*; 19 adult *Dermochelys coriacea*
Data Sources: (1) Chevallier, D. 2020. Satellite tracking of marine turtles in French Guiana. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020). (2) Chambault, P., B. de Thoisy, M. Huguin, J. Martin, M. Bonola, D. Etienne, J. Gresser, G. Hiélaud, J. Mailles, F. Védie, C. Barnerias, E. Sutter, B. Guillemot, E. Dumont-Dayot, S. Regis, N. Lecerf, F. Lefebvre, C. Frouin, N. Aubert, C. Guimera, R. Bordes, L. Thieulle, M. Duru, M. Bouaziz, A. Pinson, F. Flora, P. Queneherve, T. Woignier, J. P. Allenou, N. Cimiterra, A. Benhailou, C. Murgale, T. Maillet, L. Rangon, N. Chanteux, B. Chanteur, C. Béranger, Y. Le Maho, O. Petit, and D. Chevallier. 2018.

Connecting paths between juvenile and adult habitats in the Atlantic green turtle using genetics and satellite tracking. *Ecological Evolution* 8 (24): 1–13. <https://doi.org/10.1002/ece3.4708>.
SWOT Contacts: Damien Chevallier and Phillipine Chambault

GADELOUPE (FRANCE)

DATA RECORD 15 | SWOT ID: 1022

Project Title: SEATAG—Guadeloupe and Saint-Martin, French West Indies
Project Partners: French State, Guadeloupe Region, European Union, and private sponsors
Metadata: 4 adult female and 5 juvenile *Chelonia mydas*; tags deployed in Guadeloupe
Data Sources: (1) Delcroix, E. 2018. SEATAG—Guadeloupe and Saint-Martin, French West Indies. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1022>) and originated from Satellite Tracking and Analysis Tool (STAT; http://www.seaturtle.org/tracking/index.shtml?project_id=942). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Eric Delcroix

MARTINIQUE (FRANCE)

DATA RECORD 16

Project Title: Martinique Marine Turtle Tracking
Metadata: 2 adult *Dermochelys coriacea*
Data Source: Chevallier, D. 2020. Satellite tracking of marine turtles in Martinique. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contacts: Damien Chevallier and Phillipine Chambault

MEXICO

DATA RECORD 17 | SWOT ID: 1197

Project Title: Movimiento Migratorio de la Tortuga Carey, Islas del Parque Nacional Sistema Arrecifal Veracruzano; Acuario de Veracruz A.C.
Metadata: 2 adult female *Eretmochelys imbricata*
Data Sources: (1) Mirón, R. 2016. Movimiento migratorio de la tortuga carey, Islas del Parque Nacional Sistema. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1197>) and originated from Satellite Tracking and Analysis Tool (STAT; http://www.seaturtle.org/tracking/index.shtml?project_id=1023). (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Raúl Mirón

DATA RECORD 18

Project Title: Yucatan Marine Turtle Tracking
Metadata: 12 adult female *Eretmochelys imbricata*; 6 adult female *Chelonia mydas*
Data Source: Cuevas, E. 2020. Hawksbill and green turtle tracking off of the Yucatan. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contacts: Eduardo Cuevas, Abigail Uribe-Martínez, and Melania C. López-Castro

PANAMA

DATA RECORD 19

Project Title: Panama Leatherback Tracking
Metadata: 7 adult female *Dermochelys coriacea*; tags deployed between 2004 and 2015
Data Source: Evans, D. 2020. Sea Turtle Conservancy tracking of leatherbacks in Panama. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Daniel Evans

PUERTO RICO (UNITED STATES)

DATA RECORD 20

Project Title: Puerto Rico Leatherback Tracking
Metadata: 1 adult female *Dermochelys coriacea*; tags deployed between 2004 and 2015
Data Source: Evans, D. 2020. Leatherback satellite tracking in Puerto Rico. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Daniel Evans

SAINT MARTIN (FRANCE)

DATA RECORD 22 | SWOT ID: 1022

Project Title: SEATAG—Guadeloupe and Saint-Martin, French West Indies
Project Partners: French State, Guadeloupe Region, European Union, and private sponsors
Metadata: 2 juvenile *Chelonia mydas*; tags deployed in Saint Martin
Data Sources: (1) Delcroix, E. 2018. SEATAG—Guadeloupe and Saint-Martin, French West Indies. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1022>) and originated from Satellite Tracking and Analysis Tool (STAT); http://www.seaturtle.org/tracking/index.shtml?project_id=942. (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Eric Delcroix

SINT EUSTATIUS (THE NETHERLANDS)

DATA RECORD 21

Project Title: Dutch Antilles Marine Tracking
Metadata: 3 adult female *Chelonia mydas*; 2 adult female *Eretmochelys imbricata*
Data Source: Esteban, N., R. van Dam, E. Harrison, A. Herrera, and J. Berkel. 2015. Green and hawksbill turtles in the Lesser Antilles demonstrate behavioral plasticity in inter-nesting behavior and post-nesting migration. *Marine Biology* 162: 1153–1163.
SWOT Contact: Nicole Esteban

TRINIDAD

DATA RECORD 23

Project Title: Trinidad Leatherbacks
Metadata: 8 nesting female *Dermochelys coriacea*
Data Source: Eckert, S. 2020. Satellite tracking of adult leatherback turtles off of Trinidad. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Scott Eckert

UNITED STATES

DATA RECORD 24

Project Title: Lost Year Neonates
Metadata: 17 juvenile *Caretta caretta*; tags deployed at sea
Data Source: Mansfield, K. L., J. Wyneken, W. Porter, and J. Luo. 2014. First satellite tracks of neonate sea turtles redefine the “lost years” oceanic niche. *Proceedings of the Royal Society B* 281 (1781): 20133039.
SWOT Contact: Kate Mansfield

DATA RECORD 25

Project Title: Mote Marine Lab Loggerheads
Metadata: 127 *Caretta caretta*; tags deployed on nesting females
Data Source: Tucker, T., and K. Mazzarella. 2018. Mote Marine Lab loggerhead tracking. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XIV (2019).
SWOT Contacts: Tony Tucker and Kristen Mazzarella

DATA RECORD 26 | SWOT ID: 1342

Project Title: Florida Loggerhead Migrations
Project Partner: National Marine Fisheries Service Office of Protected Resources
Metadata: 38 adult *Caretta caretta*; tags deployed between 1998 and 2000
Data Sources: (1) Schroeder, B. 2018. Florida Loggerhead Migrations. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1342>) on December 4, 2018. (2) STAT. (3) OBIS-SEAMAP.
SWOT Contact: Barbara Schroeder

DATA RECORD 27 | SWOT ID: 960

Project Title: Movement Patterns of Kemp’s Ridley Sea Turtles in the Northwestern Gulf of Mexico, 2004–2007
Project Partner: Sea Turtle and Fisheries Ecology Research Laboratory, Department of Marine Biology, Texas A&M University at Galveston
Metadata: 7 adult female and 15 juvenile *Lepidochelys kempii*
Data Sources: (1) Seney, E. 2013. Movement patterns of Kemp’s ridley sea turtles in the northwestern Gulf of Mexico, 2004–2007. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/960>). (2) OBIS-SEAMAP.
SWOT Contact: Erin Seney

DATA RECORD 28 | SWOT ID: 1280

Project Title: Institute for Marine Mammal Studies Kemp’s Ridley Tracks
Metadata: 51 juvenile, 16 subadult, and 1 adult *Lepidochelys kempii*; 2 juvenile *Caretta caretta*; 2 juvenile *Chelonia mydas*
Data Sources: (1) Eric Pullis. 2018. IMMS Ridley datasets 8 and 9. Data downloaded from

OBIS-SEAMAP (<http://seamap.env.duke.edu>) and originated from Satellite Tracking and Analysis Tool (STAT); http://www.seaturtle.org/tracking/index.shtml?project_id=1280. (2) Coleman, A. 2017. IMMS Ridley datasets 1–7. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1083>) and originated from Satellite Tracking and Analysis Tool (STAT); http://www.seaturtle.org/tracking/index.shtml?project_id=678. (3) STAT. (4) OBIS-SEAMAP.
SWOT Contacts: Andy Coleman and Eric Pullis

DATA RECORD 29 | SWOT ID: 1142

Project Title: Northeast Florida Green Turtle Tracking Project
Project Partners: Guana Tolomato Matanzas National Estuarine Research Reserve, Friends of the GTM Reserve, Keepers of the Coast, and Eastman Environmental.
Metadata: 3 juvenile *Chelonia mydas*
Data Sources: (1) Eastman S. 2017. Northeast Florida Green Turtle Tracking Project. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/1142>) and originated from Satellite Tracking and Analysis Tool (STAT); http://www.seaturtle.org/tracking/index.shtml?project_id=620. (2) OBIS-SEAMAP.
SWOT Contact: Erin Seney

DATA RECORD 30

Project Title: Cape Canaveral Sea Turtle Tagging
Metadata: 32 male *Caretta caretta*; 3 *Lepidochelys kempii*
Data Sources: (1) Arendt, M. D., A. L. Segars, J. I. Byrd, J. Boynton, J. D. Whitaker, L. Parker, D. W. Owens, G. Blanvillain, J. M. Quattro, and M. A. Roberts. 2012a. Distributional patterns of adult male loggerhead (*Caretta caretta*) sea turtles in the vicinity of Cape Canaveral, Florida, USA, during and after a major annual breeding aggregation. *Marine Biology* 159 (1): 101–112. (2) Arendt, M.D., A. L. Segars, J. I. Byrd, J. Boynton, J. Schwenker, J. D. Whitaker, and L. Parker. 2012b. Migration, distribution, and dive behavior of adult male loggerhead sea turtles (*Caretta caretta*) following dispersal from a major breeding aggregation in the North Western Atlantic. *Marine Biology* 159 (1):113–125.
SWOT Contact: Mike Arendt

DATA RECORD 31

Project Title: Archie Carr Green Turtles
Metadata: 19 male and 8 female adult *Chelonia mydas*
Data Sources: Bagley, D. 2019. Tracking of male and female green turtles. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Dean Bagley

DATA RECORD 32

Project Title: Archie Carr Green Turtles
Metadata: 19 male and 8 female adult *Chelonia mydas*
Data Sources: Bagley, D. 2019. Tracking of male and female green turtles. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Dean Bagley

Project Title: Archie Carr Interesting Loggerheads
Metadata: 14 adult female *Caretta caretta*
Data Sources: (1) Ceriani, S. 2019. Tracking interesting loggerhead turtles. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020). (2) Evans, D. R., R. R. Carthy, and S. A. Ceriani. 2019. Migration routes, foraging behavior, and site fidelity of loggerhead sea turtles (*Caretta caretta*) satellite tracked from a globally important rookery. *Marine Biology* 166: 134.
SWOT Contact: Simona Ceriani

DATA RECORD 33 | SWOT ID: 658

Project Title: Loggerhead Marinelife Center Tracking
Metadata: 7 adult, 3 juvenile, and 6 subadult *Caretta caretta*
Data Sources: (1) Manire, C. 2019. Loggerheads rehabilitated at Loggerhead Marinelife Center. Data downloaded from OBIS-SEAMAP (<http://seamap.env.duke.edu/dataset/658>). (2) OBIS-SEAMAP.
SWOT Contacts: Sarah Hirsch and Charles Manire

DATA RECORD 34

Project Title: Gulf of Mexico Kemp’s and Green Turtles
Metadata: 9 *Lepidochelys kempii*; 15 *Chelonia mydas*
Data Source: Metz, T. 2019. Tracking Kemp’s and green turtles in the Gulf of Mexico. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Tasha Metz

DATA RECORD 35

Project Title: Mote Additional Loggerheads
Metadata: 7 adult male *Caretta caretta*
Data Sources: (1) Mazzarella, K., R. Hardy, and D. Evans. Satellite tagged sea turtle movements associated with red tide. Poster presentation at the Annual Symposium on Sea Turtle Conservation and Biology, February 2019. (2) Mazzarella, K. Unpublished data from the Mote Marine Lab. http://www.seaturtle.org/tracking/index.shtml?project_id=1325. (3) STAT.
SWOT Contact: Kristen Mazzarella

DATA RECORD 36

Project Title: Green Turtles from Southwest Florida
Metadata: 10 adult female *Chelonia mydas*
Data Source: Sloan, K. 2020. Tracking green turtles from southwest Florida. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XV (2020).
SWOT Contact: Kelly Sloan

GLOBAL LOGGERHEAD SATELLITE TELEMETRY

The following data records refer to satellite telemetry datasets from tags that were deployed on loggerhead turtles worldwide and were combined to create the map on pp. 32–33. The data are organized first by ocean basin and then by country of deployment. For information regarding data processing and filtering, see the note on the map on p. 32. These data were generously contributed to SWOT by the people and partners listed subsequently. 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>, which contains additional information about the projects and their methodologies.

To save space, we have used the following abbreviations in the data source fields: (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. 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.

ATLANTIC OCEAN

ARGENTINA

DATA RECORD 1

Metadata: 6 *Caretta caretta*; tags deployed in Argentina
Data Source: González Carman, V., I. Bruno, S. Maxwell, K. Álvarez, D. Albareda, E. M. Acha, and C. Campagna. 2016. Habitat use, site fidelity, and conservation opportunities for juvenile loggerhead sea turtles in the Río de la Plata,

Argentina. *Marine Biology* 163: 1–13.
SWOT Contact: Victoria González Carman

BONAIRE

DATA RECORD 2

Metadata: 5 female *Caretta caretta*; tags deployed on nesting turtles
Data Sources: (1) Nava, M. I., and Sea Turtle Conservation Bonaire. 2019. Tracking marine turtles off of Bonaire. Personal communication. In *SWOT Report—State of the World’s Sea Turtles*, vol. XIV (2019). (2) Becking, L. E., M. J. A.

Christianen, M. I. Nava, N. Miller, S. Willis, and R. P. van Dam. 2016. Post-breeding migration routes of marine turtles from Bonaire and Klein Bonaire, Caribbean Netherlands. *Endangered Species Research* 30: 117–124.
SWOT Contact: Mabel Nava

BRAZIL

DATA RECORD 3

Metadata: 19 juvenile *Caretta caretta*; tags deployed at sea
Data Source: Mansfield, K. L., M. L. Mendilaharsu,

N. F. Putman, M. A. G. dei Marcovaldi, A. E. Sacco, G. Lopez, T. Pires, and Y. Swimmer. 2017. First satellite tracks of South Atlantic sea turtle “lost years”: Trans-equatorial and seasonal implications for population connectivity. *Proceedings of the Royal Society B* 284: 20171730.
SWOT Contact: Kate Mansfield

DATA RECORD 4

Metadata: 10 nesting *Caretta caretta*
Data Source: Marcovaldi, M. Á., G. G. Lopez, L. S. Soares, E. S. H. M. Lima, J. C. A. Thomé, and A. P. Almeida. 2010. Satellite-tracking of female