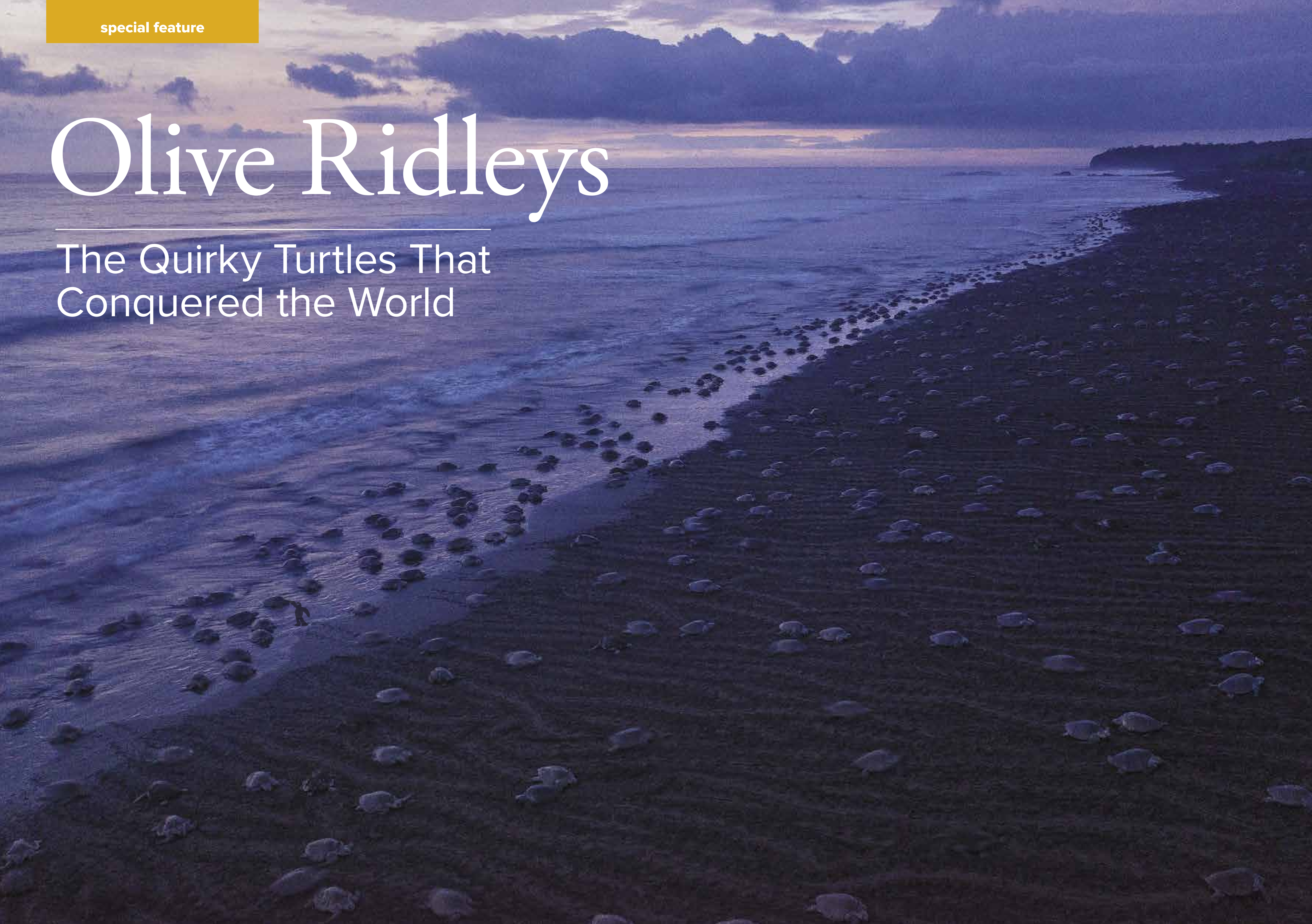
Olive Ridleys

The Quirky Turtles That Conquered the World



AT LEFT: A local resident watches an arribada nester at the Rushikulya rookery in Odisha, India. © Arghya Adhikary; PREVIOUS SPREAD: Ostional, Costa Rica – To an untrained eye, this may look like a shot taken from the beach of hundreds of sea turtle hatchlings. In fact, it was taken from hundreds of feet in the air. A drone, coupled with a slow shutter speed, provided a unique and different perspective of what is a well-documented and often-photographed event. © Thomas P. Peschak

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EVOLUTIONARY HISTORY

The ridley turtles have interesting origins. Approximately 3 million to 5 million years ago, the formation of the Isthmus of Panama separated the Atlantic and Pacific Oceans and drove marine populations on either side onto separate evolutionary paths. This profound transformation shaped the phylogeography of many marine species, including sea turtles. The role of the isthmus in separating Kemp's and olive ridleys was first hypothesized by the late Peter Pritchard in the 1960s and was later confirmed by genetic studies.

Molecular studies of specific mitochondrial DNA sequences of olive ridleys show two main genetic clusters. One of these clusters, which comprises a particular sequence called "K" and others closely related to it, is found in olive ridleys in India and Sri Lanka. Because of the similarity of the DNA sequence with Kemp's ridleys, this is thought to be the ancestral type. The other cluster has a sequence called "J" and, with its relatives, and is found in olive ridleys throughout the Indian and western Pacific Ocean basins, as well as in the eastern Pacific and Atlantic Oceans. Olive ridleys sharing this sequence are therefore likely to have served as the evolutionary sources for their current populations in the Pacific and Atlantic Oceans.

The climatic stability of the Indian Ocean during the original split might explain why it is the probable source of global olive ridley populations. Ancestral olive ridleys may have dispersed there from the East Pacific and persisted because of favorable environmental conditions. Another possibility is that warm climates facilitated the survival of an ancestral ridley population in the Indian and North Atlantic Oceans, from which the two species that we know have evolved. Either way, the Pacific and Atlantic Oceans have probably been colonized many times over by olive ridleys, with the most recent event being just 100,000 years ago.

Thus far, only a tiny portion of the ridley turtles' fascinating genealogical history has been revealed, and new techniques will improve our understanding of the evolutionary history of this and other sea turtle species and populations.

GLOBAL DISTRIBUTION AND TRENDS

Olive ridleys are the most ubiquitous and abundant of the world's seven sea turtle species. Solitary nesting beaches can be found throughout the tropics on all continents and in most island groups. Beaches that each host hundreds to thousands of nests per year can be found throughout the Pacific coasts of Mexico and Central America, the Atlantic and Pacific coasts of South America, the west coast of Africa, all of South Asia, and parts of Southeast Asia.

However, a handful of mass nesting (*arribada*) beaches account for the largest numbers of nesting females. The term *arribada* has been used to refer both to a physical place (a nesting beach and nearshore waters) and to the synchronous nesting behavior of a large number of ridleys (more than 1,000 females) over just a few days (see p. 29). Olive ridley arribada sites are restricted mainly to Pacific Mexico and Central America, and to India's east coast. Today there are 5 major sites (greater than 100,000 nests per year) and 8–10 minor sites (10,000–100,000 nests per year) globally. Many beaches in those regions, but also in Suriname and French Guiana, have (or had) mini arribadas with a few hundred or up to 1,000 nests on some nights. (See the map on p. 29 for trends and relative abundance at the sites.)

The largest arribada sites on Earth have historically been in Mexico, with the largest occurring on Playa Escobilla. Beginning in the 1960s and continuing for three decades, tens of thousands of turtles were killed annually in Mexico to provide olive ridley hides to a burgeoning international trade, which used the hides as a substitute for scarce crocodile leather. Following a global outcry over the declining abundance of turtles and the collapse of arribadas at Mismaloya, Tlacoyunque, and Chacahua, the infamous turtle slaughterhouse at San Agustinillo was shut down in the 1980s. A permanent ban on sea turtle exploitation in Mexico was established in 1990. Nesting at Playa Escobilla subsequently increased fivefold, from approximately 200,000 nests per year in the 1990s to more than 1 million by the year 2000; this number is currently stable with about nine arribada events per year. The nearby beach at Morro Ayuta also hosts more than 1 million nests each year (see the map on pp. 32–33).

In Central America, arribadas are known to occur in three countries. Of the three, Panama has the lowest abundance, while Nicaragua has large aggregations at La Flor and Chacocente. Costa Rica has regular arribadas at Ostional and Nancite, and it is witnessing the origins of two new arribada rookeries at Corozalito and Camaronal. The arribada at Nancite is a curious case. This location is a small beach that lies within Santa Rosa National Park, so the arribada is essentially free from the anthropogenic threats that typically affect turtles—yet there has been a 90 percent collapse in nesting abundance there since the early 1970s. Large numbers of turtles nesting atop one another at this tiny beach likely led to high numbers of broken eggs and a significant microbial load on the entire beach. A decrease in oxygen because of microbial activity can suffocate developing embryos and result in low hatching success. The resulting low recruitment to the population over the course of many years may have caused the collapse at Nancite.

In India, the major mass nesting beaches are in Odisha on the east coast. Unlike in the Americas, one or two major arribadas occur there in most years, typically during the dry season between February and April. Mass nesting was first reported at Gahirmatha in 1974. The beaches in this region are sand bars that erode and accrete over time; they have undergone dramatic changes in the past few decades. With the advent of mechanization in the 1970s, tens of thousands of ridleys were caught in Odisha and shipped by road and rail to Kolkata, where the meat was widely consumed. Concerns expressed by international and local conservationists led to the implementation of wildlife laws with support from then Prime Minister Indira Gandhi, ending this practice.

Further south, mass nesting was reported at the Devi River mouth in the 1980s, but no arribadas have been reported there since 1997. Rushikulya, the southernmost of Odisha's mass nesting sites, has remained relatively stable topographically over the past 20 years. Nesting there increased from between 25,000 and 50,000 nests in the 2000s to more than 200,000 nests in a single arribada in the 2010s.

Trends in the locations and sizes of arribada rookeries are highly dynamic. For example, nesting at Ixtapilla, Mexico, began in the late 1990s; by 2009 this arribada had increased to more than 200,000 nests per year. In Costa Rica, at the two new arribada beaches (Corozalito and Camaronal), nesting has increased from approximately 1,000 nests per year in 2008 to more than 47,000 in 2019. In India's Andaman archipelago, a new rookery appeared in the early 2010s and now hosts 5,000 to 10,000 nests per year.

Although sea turtle biologists initially believed that the disappearance of arribadas was entirely human induced, there may be more influences at play. Given the ephemeral nature of beaches, the vast fluctuations in numbers of nests over short periods, and the negative impact on hatching rates from the buildup of organic matter resulting from broken eggs, perhaps arribada rookeries blink on and off depending on conditions, as has been suggested for Nancite. Most arribada nesters, as well as solitary turtles, appear to prefer beaches near river mouths. Because seasonal flooding "cleans" those beaches of organic buildup, they may be the most optimal nesting sites, thus enabling long-term resilience of turtle populations. However, the dynamic nature of the beaches may also cause fluctuations in the presence and size of arribadas. Precisely how and why arribadas are born, expand, and contract remains a mystery.

MIGRATIONS

Sea turtles are migratory, and they spend most of their time engaged in some sort of movement—either for breeding or for foraging. Olive ridleys exhibit a great deal of behavioral plasticity in this regard; they can be nomadic oceanic migrants feeding on surface fauna, or they may stick to the coast while feeding on shallow-water invertebrates.

Satellite tracking studies in recent years have shed much light on the movements of olive ridleys. A diversity of patterns can be seen even within the same population. Post-nesting olive ridleys that were tracked from their nesting grounds in Sergipe, Northeast Brazil, moved north and south along the continental shelf, but also east into oceanic waters toward West Africa. In the Pacific, although some males were tracked from Sinaloa, Mexico, and remained close to breeding zones, some females swam directly up the coast to rich foraging grounds off Baja California Sur; still others stayed close inshore or meandered in oceanic gyres.

In India, some post-nesting females migrated to the coast of Sri Lanka and the Gulf of Mannar, while others followed gyres in the Bay of Bengal. In contrast, some long-term data sets show olive ridleys widely distributed in pelagic zones, with no evidence of migration corridors at all. Australian ridleys seem to remain mainly in nearshore areas after nesting, and the same behavior has been recorded for rookeries in French Guiana and Oman.

Distinct migration patterns may reflect different reproductive or foraging strategies among individuals. Forensic analyses of stable isotopes of carbon and nitrogen have been used to draw further inferences about migratory patterns and connectivity of individual turtles. For olive ridleys, those studies have confirmed what was found by satellite tracking studies: the turtles use both nearshore and oceanic habitats, with high individual variability.

The variety of migratory behaviors in this species across the world is remarkable. The nomadic behavior of many olive ridleys does not mean they lack navigation abilities; rather it represents a successful mode of opportunistic searching for prey, which is patchily distributed. Such flexibility could be a strategy to cope with unpredictable changes in highly dynamic environments, suggesting that olive ridleys might prove to be resilient to threats such as climate change. This flexibility may also help to explain why olive ridleys are the most abundant of all sea turtles.

CULTURAL SIGNIFICANCE

Historically, olive ridleys have had great commercial value, and they have been harvested for their meat, oil, and eggs across much of their range. But they also figure prominently in a variety of traditional cultures because they have held salient roles in diet, materials, medicine, religious beliefs, and spiritual values.

In much of Central America, turtle eggs are still believed to possess sexual enhancement powers and are sold as snacks in bars, where they are prized as a side dish to accompany a shot of rum or *aguardiente*. Although this belief may have no basis in fact, it nonetheless fuels an enormous legal and illegal trade in turtle eggs—mostly those of the olive ridley, given its relative abundance. This claim is just one of the countless and widespread cultural beliefs prevalent in coastal Latin America that presume sea turtle parts have aphrodisiac or sexual enhancement properties.

In parts of Guyana, the leatherback turtle is believed to be the "Mother of All Turtles," and it is said that "if her blood is spilled, then the beach will wash away." Those communities favor olive ridleys over leatherbacks as food. In French Guiana, Kali'na Amerindian coastal communities ate mostly olive ridley eggs during the 1980s and 1990s, but this consumption shifted to leatherback eggs around 2010, the reasons for which are not known.

In much of India, turtles are believed to be an incarnation of the god Vishnu and are therefore not killed or consumed. Indeed, there is a temple for Kurma (the turtle avatar) at Srikurmam, just south of Rushikulya. However, turtle eggs were widely consumed as food and for various purported medicinal properties along much of the country's coast until the implementation of wildlife laws and conservation programs. In Gahirmatha, turtle eggs were dried and used as cattle feed until the 1970s.

Harvest of olive ridley adults and eggs also occurs in Australia's Northern Territory. As traditional owners of local land and sea estates, the indigenous groups are at the forefront of olive ridley conservation and management, particularly concerning threats from ghost fishing gear. Aboriginal (Yolngu) rangers have identified ghost fishing gear hotspots, from which they remove debris and release entangled turtles.

In southwest Madagascar, the indigenous Vezo people have a long history of traditions that are associated with sea turtles and that involve offerings to ancestors as well as ceremonies and rituals for preparing and eating turtle meat. Although olive ridleys are rarer than greens there, they are included in Vezo spiritual practices. Indigenous groups in the Andaman and Nicobar Islands have similar spiritual relationships with sea turtles, which form an important part of their food traditions and culture.

Olive ridleys are highly valued for their medicinal qualities by the Wayúu people of the Guajira Peninsula in Venezuela and Colombia. Sea turtles are considered gifts from the ancestral God Maleiwa; olive ridleys are believed to be a kind of rare green turtle and their parts are used to treat various conditions, including hypertension, diabetes, rheumatism, and menstrual disorders. Those traditions are passed on orally through stories told by healers and play a vital role in preserving the cultural identity of the Wayúu.

Although olive ridleys have been used by many cultures for food, materials, and medicine, their relationship with some ethnic groups in Ghana is entirely different and is based instead on a system of traditional social taboos. The Dangme people of Ada believe that a turtle once saved their ancestors' lives during a war with the Ashante; hence, all turtles are sacred to them and are off limits for hunting. Olive ridley turtles are now protected across most of their global range, although various uses remain an essential cultural practice in some countries.

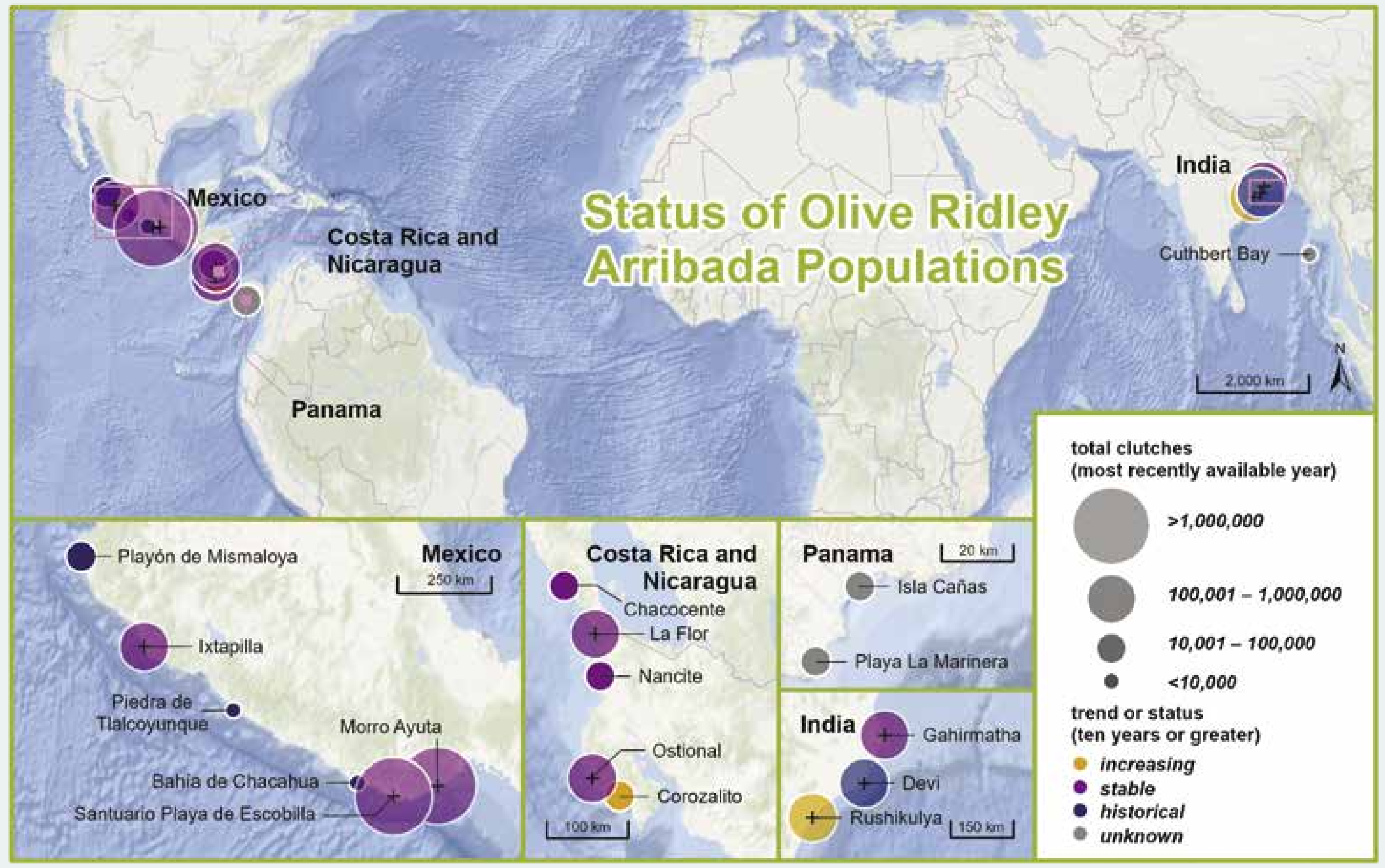
THE ARRIBADA

Derived from the Spanish word for arrival, arribada refers to the phenomenon of synchronized nesting of thousands of ridley turtles, one of nature's most impressive and mysterious wildlife spectacles.

Prior to an arribada, thousands of female turtles aggregate in front of the beach before hauling out at once to lay their eggs. Studies have examined the cues that may elicit emergence, ranging from oceanographic and atmospheric features, lunar phases, and possibly even pheromones or other agents released by the gravid females. As yet, however, there are no definitive answers. No matter how it is triggered, the consequence is a dramatic onset of synchronous nesting by thousands of ridleys depositing millions of eggs over a few nights, followed by a rapid tailing off. At any given site, this phenomenon may repeat several times each year.

Arribada behavior likely evolved as an antipredator strategy. As the smallest of all sea turtles, ridleys lay relatively shallow nests, which tend to be susceptible to depredation. Indeed, on many solitary nesting beaches, more than 80 percent of nests are taken by predators. An arribada ensures predator glut, as mammals, birds, crustaceans, fish, and others are unable to consume more than a fraction of the brief surfeit of prey in the form of adults and eggs, and—roughly seven weeks later—hatchlings. Thus, the population's chance of survival is increased.

This survival advantage has a price, because hatching rates at arribada beaches may be significantly lower than at solitary nesting beaches. Though there are trade-offs, the strategy seems to have worked well for the olive ridley, the world's most abundant sea turtle species.



This map shows the locations and trends or statuses of arribada nesting populations. Trends were calculated using data from the past 10 years. If data from the past 10 years were not available, the status of the population was categorized as "unknown" and is represented by a gray dot. Increasing trends are represented by yellow dots, stable trends by purple dots, and populations that historically nested in arribada events but no longer do are categorized as "historical" and are represented by a blue dot. Dots are scaled to their relative nesting abundance, the values for which were calculated from the average number of clutches for the years available. Data and sources are listed starting on p. 52 under their respective beach names with the exception of Playón de Mismaloya, which is a combination of four nesting beaches (Mismaloya–sección El Playón, La Gloria, Playa Majahuas, and Chalacatepec).

Olive ridley turtles mate off the coast of the Osa Peninsula in Costa Rica. © Philip Hamilton Photography

GLOBAL STATUS, THREATS, AND CONSERVATION

The abundance of olive ridleys was once believed to be so great that they were immune to overexploitation. This belief was hardly true. In fact, the large scale of industrial extraction from the 1960s to the 1980s brought such alarming crashes in many rookeries, particularly in Mexico, that the species rose to the category of Endangered on the *IUCN Red List of Threatened Species*.

Evaluating a species' risk of extinction is complex and requires knowledge of global trends over generational time frames. In the case of olive ridleys, however, it is changes in their massive arribada populations that drive global status. Although monitoring arribada sizes has proven to be highly challenging, local programs now provide reliable data for status evaluation. Decades of conservation effort from nesting beach protection, together with policies banning sea turtle commerce and direct capture on land and at sea, have led to very encouraging results from current trend data. Overall trends in most arribada rookeries are positive or stable over the past two decades (see the map on p. 29).

Nonetheless, causes for concern remain, including the following: low hatching success at some arribada sites; decreased survival of all age classes due to plastic ingestion; climate change; and, above all, fisheries impacts. The overlap of olive ridley at-sea distribution with fisheries makes this species particularly vulnerable to entanglement in fishing gear. Although bans on trawl fishing and strict enforcement of the use of Turtle Excluder Devices in some areas have decreased this pressure, fisheries remain the primary threat to ridleys worldwide. Large-scale mortality (approximately 10,000 turtles per year) in trawl fisheries still occurs in India's Odisha state and elsewhere in the world where enforcement is lax.

Olive ridley behavior also increases the likelihood of encountering abandoned, lost, or discarded fishing gear, known collectively as *ghost gear*. A study of ghost gear in the Maldives found that 97 percent of entangled turtles were olive ridleys. Addressing threats from ghost gear requires strong collaboration between multiple stakeholders, including national governments, regional fisheries management organizations, and local communities.

Though many olive ridley nesting beaches are located in protected areas, threats to nesting habitats persist, particularly from coastal development for tourism, aquaculture, urban growth, or industrial activities. The construction of Dhamra Port near the Gahirmatha mass nesting site in India may have caused significant changes to the geomorphology of the nesting beach, in addition to causing increased light and water pollution. In Gabon, the nesting habitat is affected by the accumulation of beached timber lost from commercial logging activities, thereby changing the erosion and accretion dynamics of the beach system and blocking access to nesting areas. Such large-scale threats are difficult to address and require sustained, high-level engagement with decisionmakers.

At many sites, conservation programs conduct beach patrols and relocate olive ridley nests to hatcheries to protect them from human and natural predators. At many solitary nesting beaches, upward trends in olive ridley populations are probably the result of such long-term efforts. Community-based conservation programs exist in many parts of the world, including Brazil, Colombia, Guatemala, Kenya, and Mexico. In India, every coastal state has multiple NGOs working on the conservation of olive ridleys. Besides their importance for conservation, research, and education, beach projects take advantage of sea turtles as a flagship species and provide opportunities to conserve species and habitats that are less charismatic.

The abundance of eggs laid at mass-nesting sites and solitary beaches serves as food and as an income source in some marginalized coastal communities. In the 40 years since its establishment, the legal, community egg harvest program at the Ostional National Wildlife Refuge in Costa Rica has been largely successful, with long-term monitoring studies suggesting that the rookery nesting there remains stable. Furthermore, studies on the illegal egg trade suggest that these eggs may play an important role in swamping out the black-market egg trade. The community egg harvest program continues to generate substantial funding and resources for conservation as well as to support local family incomes. Turtle tourism is also on the rise, providing sustainable income for the community. With stable or increasing populations, some conservationists have suggested that such approaches can be transferred to other arribada sites, but this strategy remains controversial.

CONCLUSION

Olive ridleys may be abundant and widespread, but they remain an enigma in many ways. Their large arribadas drive not only global trends and status, but also public imagination about the turtles. The disappearance of arribadas at many sites, the precipitous decline at Nancite, or the failure of the arribada to occur during a particular year at Gahirmatha or Rushikulya can lead to greatly exaggerated reports of their impending demise. But then new arribada rookeries appear, such as those at Camaronal, at Corozalito, and in the Andaman Islands. Even more interesting is the role that beaches with solitary nesters play. Are they future arribada sites, producers of male hatchlings in cooler areas, or perhaps a source of genetic variation?

To best determine future management strategies for the olive ridley, local studies on habitat use, incidental capture, and genetics must be expanded. As new arribada sites emerge and the species recovers, monitoring protocols and conservation strategies must be adapted accordingly. Solitary nesting rookeries need more conservation and research attention. On the whole, olive ridleys are doing rather well, but larger-scale global and development threats still loom. Sustainable fishing practices need to be implemented wherever sea turtle interactions occur if we are to ensure a safe future for the animals. As some of the most effective ambassadors for conservation worldwide, these turtles have an important role to play in the future of coastal and marine ecosystems. •

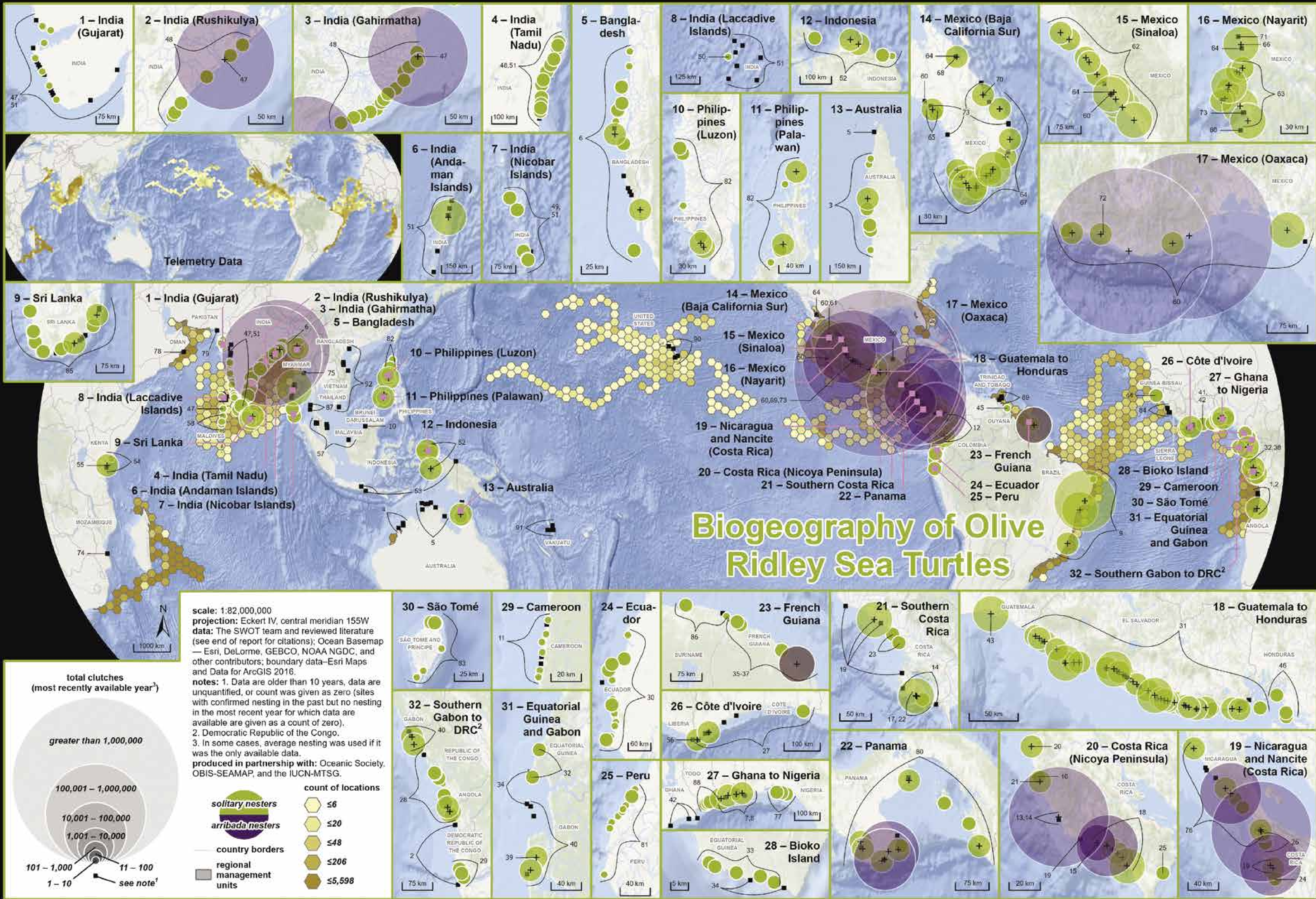
BIOGEOGRAPHY OF OLIVE RIDLEY SEA TURTLES

The map on pp. 32–33 displays available nesting and satellite telemetry data for olive ridley sea turtles. The data include 774 nesting sites and 283 satellite tags, compiled through a literature review and provided directly to SWOT by data contributors worldwide. For metadata and information about data sources, see the data citations beginning on p. 52.

Solitary (non-arribada) nesting sites are represented by green dots and arribada sites by purple dots, both of which are scaled according to their relative nesting abundance in the most recent year for which data are available. Black squares represent nesting sites for which data are older than 10 years, data are unquantified, or the nest count for the most recent year was given as zero. For the purposes of uniformity, all types of nesting counts (e.g., number of nesting females, number of crawls) were converted to number of clutches as needed. Conversion factors were as follows: a ratio of 3.00 nests to each nesting female in the East Pacific, 1.40 nests to each nesting female in the Wider Caribbean and Southwest Atlantic, and 2.20 nests to each nesting female in all other regions, plus a ratio of 0.74 nests for every crawl in all regions.

Satellite telemetry data are represented as polygons that are colored according to the number of locations. 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.

We are grateful to all of the data contributors and projects that participated in this effort. For details, please see the complete data citations beginning on p. 52.



Biogeography of Olive Ridley Sea Turtles
1 – India (Gujarat)
2 – India (Rushikulya)
3 – India (Gahirmatha)
4 – India (Tamil Nadu)
5 – Bangladesh
6 – India (Andaman Islands)
7 – India (Nicobar Islands)
8 – India (Laccadive Islands)
9 – Sri Lanka
10 – Philippines (Luzon)
11 – Philippines (Palawan)
12 – Indonesia
13 – Australia
14 – Mexico (Baja California Sur)
15 – Mexico (Sinaloa)
16 – Mexico (Nayarit)
17 – Mexico (Oaxaca)
18 – Guatemala to Honduras
19 – Nicaragua and Nancite (Costa Rica)
20 – Costa Rica (Nicoya Peninsula)
21 – Southern Costa Rica
22 – Panama
23 – French Guiana
24 – Ecuador
25 – Peru
26 – Côte d'Ivoire
27 – Ghana to Nigeria
28 – Bioko Island
29 – Cameroon
30 – São Tomé
31 – Equatorial Guinea and Gabon
32 – Southern Gabon to DRC[2]
Telemetry Data
scale: 1:82,000,000
projection: Eckert IV, central meridian 155W
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.
notes: 1. Data are older than 10 years, data are unquantified, or count was given as zero (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. Democratic Republic of the Congo.
3. In some cases, average nesting was used if it was the only available data.
produced in partnership with: Oceanic Society, OBIS-SEAMAP, and the IUCN-MTSG.
total clutches (most recently available year[3])
greater than 1,000,000
100,001 – 1,000,000
10,001 – 100,000
1,001 – 10,000
101 – 1,000
11 – 100
1 – 10
see note[1]
solitary nesters
arribada nesters
country borders
regional management units
count of locations
≤6
≤20
≤48
≤206
≤5,598