Biology Conservation of Olive Ridley Marine Turtles

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Marine turtles are considered to be necessary for a healthy ocean, as they have a direct impact on other species. The olive ridley (*Lepidochelys olivacea*) is the most abundant of all seven sea turtles, found across the tropical regions of the Atlantic, Pacific, and Indian Oceans in over 80 different countries all around the globe.

olive ridley habitat sea turtle

1. Introduction

The olive ridley turtle (*Lepidochelys olivacea*), often known as the Pacific ridley, belongs to the Cheloniidae family of turtles. The olive ridley takes its name from the colour of its heart-shaped shell, skin, or carapace, which resembles an olive green. The olive ridley is the world's second-smallest species [1] of marine turtle. The olive ridley is closely related to its smaller sister the Kemp's ridley, with the main behavioural difference being that they exclusively reside in warmer waters, endemic to and uniquely found in the Gulf of Mexico. This turtle is well known for its arribadas, or mass nesting sites, when thousands of female turtles congregate on the same beach to lay eggs [2]. Worldwide, with a yearly estimated population of at least 800,000 nesting females, the olive ridley turtle is considered the most prolific sea turtle on the planet [3].

2. Global Distribution

The olive ridley turtle is widely distributed throughout the tropical and subtropical waters of the Pacific, Atlantic, and Indian Oceans, predominantly in the Indo-Pacific region [4][5]. In the Pacific, this species has been reported from northern Mexico to Chile, including central Pacific islands [6][7][8][9], while in the Atlantic, there are reports of olive ridleys from the Azores Islands, in the North Atlantic, to Uruguay [10][11].

Olive ridley turtles have a highly flexible migratory lifestyle and use a wide variety of habitats [6]. In the Pacific region, they spend most of their life in the oceanic zone, whereas Atlantic turtles are commonly found in neritic areas [12][13][14]. Between pelagic feeding and coastal breeding areas, olive ridleys traverse from a few to thousands of kilometres, depending on the ecological conditions of these sites [6][15][16][17]. Adult olive ridleys have been observed nearly 4000 km from land in the Pacific, according to fishermen observations [18].

The synchronized event of massive numbers of nesting females (above 1000 females) on a single location over a short period of time, or arribadas, is unique to olive ridley sea turtles [19]. However, similar pattern behaviour has also been observed during the large green turtle (*Chelonia mydas*) nesting seasons at Tortuguero, Costa Rica [20]. There are currently at least five main sites producing more than 100,000 nests per year, and 8–15 minor sites producing 10,000–100,000 nests per year [21] around the world. The Pacific coasts of Mexico and Central America, the Atlantic coasts of South America, the west coast of Africa, and the South and Southeast coast of Asia all have beaches that house hundreds to thousands of nests per year [22][23]. However, the main arribada nesting areas are located on the Pacific coast of Mexico, in Costa Rica, and in northeast India [24][25][26]. There are also several beaches reported as olive ridley solitary nesting spots in these regions [27][28], as well as in the Central African Atlantic Coast [29][30], Australia [31], French Guiana and Brazil in the western Atlantic [14][17], South American Pacific [32], South and Southeast of Asia [33], and on most island groupings throughout the tropics [21][34].

Historically, Mexico has had the largest arribada sites on the planet, with the greatest occurring on Playa La Escobilla [21]. However, between the 1960s and 1990s, the sea turtle fishery in conjunction with the shrimp fishery caused the overexploitation of the olive ridley turtles [35]. During this period, tens of thousands of olive ridleys were slaughtered annually in Mexico to supply hides as a substitute for rare crocodile leather to a developing international commerce [36]. The famed turtle butcher in San Agustinillo, Oaxaca, was shut down in the 1980s after a global uproar about the declining abundance of turtles and the collapse of arribadas at Mismaloya, Tlacoyunque, and Chacahua. In 1990, Mexico enacted a permanent ban on the exploitation of sea turtles [37]. After that, nesting at Playa Escobilla increased fivefold, from around 200,000 nests per year in the 1990s to over 1 million by 2000; the number is now stable, with about nine arribada events each year. Every year, almost 1 million nests are found on the adjacent beach of Morro Ayuta [38].

Arribadas are known to exist in three countries in Central America: Panama, Nicaragua and Costa Rica with the largest arribada events in the region. Panama has the smallest population of the three, but Nicaragua has considerable aggregations near La Flor and Chacocente [39][40]. Costa Rica has regular arribada rookeries in Ostional (the largest arribada in the region and third largest in the world) and Nancite, and two new arribada rookeries are forming at Corozalito and Camaronal [41]. Nancite's arribada is a peculiar case. The arribada is located on a small beach within Santa Rosa National Park, so it is largely free of the manmade hazards that generally harm turtles, yet there has been a 90% decline in nesting abundance there since the early 1970s [42]. The large numbers of turtles nesting on top of each other on this tiny beach (less than 1 km long) are likely to have resulted in a high number of broken eggs and a high microbial load across the entire beach [43]. Because of microbial activity, a lack of oxygen might suffocate developing embryos, resulting in low hatching success [44]. The ensuing poor population recruitment over a long period of time may have caused the collapse at Nancite. On the other hand, the Ostional nesting site also represents a unique set of very different conditions from the ones describe above at Nancite. Since 1987, a unique and controversial community conservation program has been operating in Ostional, which aimed to generate income exclusively for the community by promoting the protection of olive ridleys through the legal harvest and trade of eggs [45]. Despite the importance of this nesting site, only a few studies have evaluated the population trend in the area and its relationship with the program's activities. Long-term studies suggest that from the 1980s to the early 2000s, the population remained stable or increasing despite egg harvest [46][47], while short-term studies have proposed a possible decrease in the population trend [48]. Nevertheless, the causes of these oscillations of population size still remain unknown.

The major mass nesting sites in India are located in Odisha, on the east coast. In this region, usually during the dry season, one or two significant arribadas occur there every year [49]. The beaches along this region are made up of sand bars that erode and accumulate over time. However, that have changed dramatically in recent decades, and it could potentially be affecting these mass-nesting events. During the 1970s, tens of thousands of olive ridleys were captured in Odisha and shipped to Kolkala (formerly Calcutta), the capital of India's West Bengal state, where the meat was widely consumed. Concerns raised by international and local conservationists led to the passage of wildlife regulations putting an end to this practice [21]. In the 1980s, mass nesting was recorded near the mouth of the Devi River, but no arribadas have been seen there since 1997. Over the last 20 years, the topography of Rushikulya, the southernmost of Odisha's mass nesting locations, has remained largely unchanged. As a result, in the 2010s, arribada nesting increased to more than 200,000 nests in a single event [21].

The locations and sizes of arribada rookeries are changing rapidly [24]. For instance, nesting began in the late 1990s in Ixtapilla, Mexico, and by 2009, this arribada had grown to over 200,000 nests every year. Nesting has expanded from around 1000 nests per year in 2008 to over 47,000 nests in 2019 in Costa Rica's two new arribada beaches, Corozalito and Camaronal [21][50]. In the early 2010s, a new rookery formed in India's Andaman archipelago was reported that now supports 5000–10,000 nests per year. On rare occasions, several beaches in those regions, as well as in Suriname and French Guiana, have small arribadas with a few hundred nests [21].

Although sea turtle scientists previously assumed that the extinction of arribadas was solely due to human activity, there could be other factors at work [51]. The changing nature of the beaches, together with the large swings in nest numbers over short times, and the detrimental influence on hatching rates caused by the build-up of organic debris from broken eggs, may create oscillations in the presence and size of arribadas, which rely on environmental conditions, as Nancite rookeries have historically proven [52]. It has been observed that solitary turtles and most arribada nesters appear to prefer beaches near river mouths. Seasonal flooding removes organic accumulation cleaning the beaches, which may be the best nesting places, allowing turtle populations to thrive in the long run. Nevertheless, it is still a mystery how and why arribadas are born, expand, contract and collapse [50].

3. Habitat, Food and Feeding Behaviour

Olive ridleys are generally found in coastal bays and estuaries, but certain portions of its range might be highly oceanic. The majority of observations occur within 15 km of mainland coasts in protected, somewhat shallow marine waters of approximately 22 to 55 m deep [53]. Every year, olive ridley travel hundreds or even thousands of kilometres to join the arribada, when vast groups of females return to the beaches where they were previously believed to be born to lay their eggs [54].

During the non-reproductive period, this species uses a variety of habitats for feeding, showing a preference for sites with high levels of biological productivity on the coast, continental shelf, and continental slope [55]. They can use diverse feeding strategies, either foraging in open waters off the coast, descending to depths of 150 m to feed on bottom-dwelling crustaceans, meandering over neritic areas using various feeding grounds, or settling directly at specific feeding sites at river mouths [12][55].

Olive ridleys present a generalist feeding behaviour [18]. They have strong jaws that enable them to crush their food. The olive ridley is primarily a carnivore, especially in its early phases of development, and can feed on pelagic or benthic prey [56]. They are also omnivorous, which means they eat both plants and animals. Marine invertebrates found in shallow seawaters or estuary settings represent the most regular type of diet for olive ridleys [57]. Thus, jellyfish, tunicates, sea urchins, bryozoans, bivalves, snails, shrimp, crabs, rock lobsters, echinoderms and sipunculid worms are all common prey [58][59]. Consumption of jellyfish, as well as adult and juvenile fish (e.g., Sphoeroides) and fish eggs, may indicate a pelagic feeding behaviour also observed in this species [53][56]. In regions where there are no other food sources available, the olive ridley is reported to eat filamentous algae (seaweed). Studies in captivity have revealed that this species is capable of cannibalism, in particular of small hatchlings [60]. Because the olive ridley turtle eats a wide variety of foods, marine litter such as plastic bags and styrofoam poses a significant danger to these animals.

4. Ecological Rolls

Marine turtles are an integral element of the planet's food web chain, and they play a key role in keeping the world's oceans healthy. They have the ability to manage a wide range of other creatures just by ingesting them [61][62]. Olive ridley turtles eat invertebrates and are thought to play a vital role in both open coastal and marine ecosystems [5]. Additionally, as consumers, olive ridleys maintain the balance of the food web and favour the control of many populations [63]. Olive ridleys play also an essential role in nutrient transport, disseminating large amounts of nutrients from feeding areas to nutrient-depleted coastal ecosystems near nesting beaches [62][64].

Unhatched eggs and empty eggshells left at the sand in nests on beaches act as a fertilizer for coastal vegetation, providing nourishment for plant growth and helping to stabilize the coastline while also providing food for a range of plant-eating animals [62][65], as well as invertebrates and microorganism living in the sand. Sea turtles play a vital role in producing and sustaining diversity in the world's waters by transferring creatures that reside on reefs, seagrass meadows, and the open ocean [66]. In order to ensure healthy marine ecosystems, and given the range of functions sea turtles have, people must sustain, protect and rebuild their populations.

5. Source of Food for Humans

There are centuries of records reporting the use and consumption of several species of sea turtles, olive ridleys within them. Sea turtle eggs are regarded as a delicacy all over the world. Because egg harvesting has the potential to boost local economies, numerous communities have experimented with the novel practice of allowing a sustainable (legal) egg harvest [67]. As mentioned above, it has been documented that the legal egg harvest in Ostional, Costa Rica, is both biologically and economically viable, despite the unpopularity of such practice by conservationists. Local people have been able to harvest and sell roughly three million eggs each year since egg harvesting became legal in 1987. They are allowed to collect eggs for the first 36 h of the nesting cycle since later nesting females would destroy the big majority of these eggs. Over 27 million eggs are left unharvested, and villagers have played a significant role in preserving these nests from predators (such as snakes and birds), resulting in higher hatching success [48][60]. In other areas where coastal communities and sea turtles coexist, residents also find benefit from working in community-based conservation programs, where they carry out activities such as nesting beach patrolling, nest collection, and hatchling release. In fact, this strategy has been essential for the recovery of olive ridley populations in many nesting beaches around the world [68][69][70].

In addition to its ecological and livelihood importance, and the subsistence benefits associated with olive ridley turtles, historically, this species represents an important figure in a variety of traditional cultures as they have played a prominent role in medicine, religious beliefs, and spiritual values. Nevertheless, the olive ridley, like any other sea turtle, may present a nuisance to commercial fishermen, who frequently discover these turtles entangled in their nets [71].

6. Habitat and Food Source for Other Marine Organisms

Many marine creatures benefit from the presence of sea turtles. Barnacles, algae, and epibionts in general attach themselves to the turtle shell, which the turtle then carries around as a source of food for fish and shrimp. In fact, olive ridley turtles host a greater diversity of epibionts compared to other sea turtle species, and several fish species rely solely on epibionts found in this turtle to survive [62][72][73].

Sea turtles are a vital food source for other organisms, particularly in their early phases of development. Unhatched turtle eggs are reported to be dug up by ants, crabs, rats, raccoons, foxes, coyotes, feral cats, dogs, mongoose, and vultures; the egg yolks are a nutrient-rich source of food. A variety of sea birds, fish, and invertebrates feed on hatchlings, whereas several species of sharks and killer whales feed on juvenile and adult sea turtles [62][73].

7. Past and Current Status of Olive Ridley Population Decline

It has been estimated that only 1 to 8% of eggs laid during the arribadas hatch, as a direct result of illegal egg poaching, turtle hunting, and nest destruction by humans [74]. Between 1988 and 2008, the population of olive ridley turtles was estimated to have a worldwide decrease by 28 to 32%. The last estimate for this species made in 2013 indicates that although olive ridley turtles are the most common, their numbers have decreased by more than 30% globally [75], following the same trend from the previous decade. Because of the relatively few surviving breeding locations in the globe, these turtles are considered endangered.

Prior to the age of mass exploitation, the population of Pacific Mexico was estimated to be at least 10 million. The IUCN Red List classified olive ridleys as vulnerable, and the Wildlife Protection Act of 1972 was further established to protect them. On 28 July 1978, the breeding colony in Mexico was designated as endangered in the United States (U.S.) [57]. Later, by 2004, the global population of annual nesting females had been lowered to around two million [76], and by 2008 it had been further reduced to approximately 852,550 individuals [2][67]. This meant that the global population dropped alarmingly in just one generation (i.e., 20 years) [21][75].

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