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ISSUES CONCERNING THE NESTING OF OLIVE RIDLEY TURTLES IN THE COASTAL AREAS OF GOA: CONSERVATION AND PROTECTION

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ABSTRACT

Goa is the smallest state, situated in the Konkan West region of India. The state hosts a diversity of ecosystems that comprise coastal, mangrove, estuarine, grassland, wetland, and western ghat habitats. It is famous for its pristine beaches, dazzling waterfalls, and verdant spice plantations and is home to a thousand varieties of flora and fauna. Goa is blessed to have its own habitat for different marine species, one of which is the Olive Ridley turtle. Every year, Goa's coastline welcomes these sea turtles, which crawl towards the shore to nest their eggs. A couple of beaches in the north and south of Goa have been designated as turtle nesting sites. These nesting sites on various beaches were part of its environmental ecosystem before 1991. Over the last several decades, the population of Olive Ridley turtles has been reportedly decreasing. These species are federally listed or recognised as threatened and endangered and internationally listed as vulnerable on the International Union for Conservation of Nature (IUCN) red list. In spite of various efforts to preserve these species, there are many setbacks prevalent, and it needs the highest degree of attention to address these issues to save our sea turtles. Goa, one of the favourite tourist destinations, is a major concern for hindrances and disturbances caused by tourists when they visit these turtle-nesting beaches. Along with this, there are also various other natural and man-made causes that need to be looked upon and resolved with the utmost dedication and responsibility. Since these sea turtles nest only in a few locations, a slight disruption or disturbance to their environment could have a catastrophic effect on the entire population. The status of olive Ridley turtles and the need for their protection and conservation to aid

population recovery have prominently captured the interest of society in Goa. The Goa government, in view of protecting the endangered sea turtle species, has made numerous attempts and efforts to revive and protect these species. Despite these efforts, there are many inadequacies that are required to be dealt with. There is a need to create awareness about protecting these endangered species at the local and national levels. This study highlights the various issues persistent with the nesting zones of Olive Ridley turtles and also mentions the various possible measures to protect and conserve the Olive Ridley Sea turtle population.

Keywords: *Beach, Conversation, Endangered Species, Protection, Sea turtles.*

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1. INTRODUCTION

Biodiversity is the greatest treasure we have… Its diminishment is to be prevented at all cost

~Thomas Eisner

Maintaining environmental stability, improving human welfare, reducing climate change, promoting economic benefits, boosting resilience, and recognising the intrinsic value of every species depend on biodiversity conservation. We can secure a sustainable and successful future for both the environment and humanity by preserving and protecting biodiversity.

The marine ecology greatly benefits from the presence of sea turtles, which are marine reptiles. To commemorate, World Turtle Day is annually celebrated on May 23. Seven species of sea turtles are found worldwide. Olive Ridley Turtles, scientifically known as Lepidochelys olivacea, are one of the smallest sea turtle species found in the world. These ancient reptiles have been swimming in the world's oceans for millions of years, and they continue to play an important role in the marine ecosystem. All seven species of sea turtles share similar life-cycle patterns. Sea turtles are known for their distinctive features, such as their streamlined bodies, paddle-like flippers, and hard protective shells. To lay their eggs, sea turtles are highly dependent on the well-being of sandy beaches. Some sea turtle species even live up to 80 years and more; that is why sea turtles are known for their long life span. Sea turtles are vulnerable to numerous issues today, both directly and indirectly, including habitat loss, pollution, overfishing, etc. Ensuring that these magnificent sea creatures thrive and survive for generations to come, governments, conservationists, scientists, etc. are working diligently to protect sea turtles and their habitats by swiftly addressing the various challenges and issues.

2. OBJECTIVES OF RESEARCH

- To know the issues persistent with nesting and protection of Olive Ridley Turtles in the state of Goa.
- To know the various remedies that can deal with the current issues of nesting and conserve the sea turtle population.

3. METHODOLOGY OF RESEARCH

Preliminary information was gathered from non-governmental organisations, Forest Department officers, locals, workers, lifeguards, and trawlers by way of interviews. This research draws out the issues persistent to the beaches situated at the north and south of Goa that are notified for nesting and protection of Olive Ridley turtles.

4. OLIVE RIDLEY TURTLES

Olive Ridley Turtles are commonly known as Pacific Ridley Sea Turtles. They are found in the tropical regions of the Pacific, Atlantic, and Indian oceans. The turtles got their name owing to their coloured, heart-shaped carapace. Adult turtles measure about 2 to 2.5 feet in Carapace. These turtles weigh about 35–50 kg and have a lifespan of up to 50 years. The Olive Ridley Turtles are omnivorous. They consume both plants and animals, like seaweed, algae, jellyfish, crabs, rock lobsters, snails, bryozoans, and a variety of fish and their eggs. These turtles mate just above sea level. Female turtles come to the shore to lay their eggs; they dig a pit with their flippers, lay their eggs, and cover them with sand. Numerous efforts are being made to revive and protect the Olive Ridley Sea turtle population around the globe[1].

5. ROLE AND IMPORTANCE

Sea turtles are an essential part of the planet's food web and are crucial to maintaining the health of the oceans. They manage a variety of other creatures simply by ingesting them. Olive Ridley's preserves the stability of the food chain and supports the management of numerous populations. The distribution of significant amounts of nutrients from feeding areas to coastal ecosystems close to nesting beaches helps these turtles play a crucial role in

[1] *Information About Sea Turtles: Olive Ridley Sea Turtle – Sea Turtle Conservancy*, SEA TURTLE CONSERVANCY (Dec 08, 2023, 4:45 PM), https://conserveturtles.org/information-about-sea-turtles-olive-ridley-sea-turtle

nutrient transport. Unhatched eggs and empty eggshells left in the sand in nests on beaches act as fertiliser for coastal vegetation, providing nourishment for plant growth and helping to stabilise the coastline while also providing food for a range of plant-eating animals as well as invertebrates and microorganisms 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[2].

6. LEGAL STATUS AND PROTECTION

6.1 Wildlife Protection Act, 1972

Schedule I of the Wildlife Protection Act, 1972[3], lists the endangered species that are in need of the highest level of protection. It is an important piece of legislation that protects wildlife species and their habitats in India. Olive Ridley turtles are protected under Schedule I of the Wildlife Protection Act 1972, prohibiting hunting, poaching, and trade of these species.

6.2 Coastal Regulation Zone (CRZ) Notification

The Coastal Regulation Zone (CRZ) 2019 Notification also offers protection to sea turtle nesting beaches by classifying such nesting areas as Ecologically Sensitive Areas (ESA) and categorising them as CRZ 1. The notification prohibits and regulates developmental activities in CRZ-I areas so as to conserve turtles and turtle nesting grounds[4].

6.3 IUCN – Red List

The International Union for Conservation of Nature (IUCN) Red List is a global database that assesses the conservation status of species of animals, fungi, and plants. By providing a comprehensive and standardised assessment of the conservation status of species, the red list

[2] Lenin Cáceres-Farias, Eduardo Reséndiz, Joelly Espinoza, Helena Fernández-Sanz and Alonzo Alfaro-Núñez, *Threats and Vulnerabilities for the Globally Distributed Olive Ridley (Lepidochelys olivacea) Sea Turtle: A Historical and Current Status Evaluation*, 12(14) ANIMALS (BASEL) (2022)
[3] Wildlife Protection Act, 1972, No. 53, Acts of Parliament, 1972 (India)
[4] CRZ Notification, 2019

helps to promote global biodiversity conservation. The IUCN Red List of threatened species lists Olive Ridley turtles as vulnerable[5].

6.4 The Convention on International Trade in Endangered Species of Wild Fauna and Flora

The Convention on International Trade in Endangered Species of Wild Fauna and Flora is a multilateral treaty between governments aiming to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The Olive Ridley turtle is included in Appendix I of CITES. This listing provides a framework for countries to work together to protect these turtles and prevent their extinction[6].

6.5 Goa Tourism Shack Policy 2022 -23

The Goa Beach Shack policy mentions the terms and conditions for the erection of temporary seasonal structures such as beach shacks, deck beds, umbrellas, huts, and other structures. It also mentions guidelines with regards to Olive Ridley turtles. It mentions that no beach beds should be set up in the intertidal zone. It mentions the precise locations of shacks on beaches, which shall be fixed in consultation with the Forest Department, which may identify turtle nesting sites. The policy prohibits the playing of loud music and the flashing of artificial lighting. It also mentions that the shack allottee should cooperate with forest staff relating to the protection of turtle nesting sites, turtle eggs, etc[7].

7 PRESENCE OF OLIVE RIDLEY TURTLES IN THE STATE OF GOA AND ITS CONSERVATION

Goa, the smallest Indian state, has a coastline of about 120 km, of which around 65km are sandy beaches. Goa is not only visited by a large number of international or national tourists but is also visited by Olive Ridley turtles every year. Goans are deeply rooted in a love for the environment and biodiversity. Olive Ridley is found to be nesting along the Mandrem, Morjim Agonda, and Galgibaga coastlines. There are two main nesting sites in Goa that are

[5] IUCN Red List of Threatened Species
[6] Convention on International Trade in Endangered Species of Wild Fauna and Flora
[7] Goa Tourism Shack Policy 2022-23

notified for protecting and facilitating turtle nesting: one in the north, i.e., Morjim Beach, and one in the south, i.e., Galgibag Beach. The nesting season of Olive Ridley turtles in Goa usually begins in October and ends in May.

8 HISTORY OF OLIVE RIDLEY TUTLE CONSERVATION IN GOA

The turtle nesting activity on Goan beaches has been part of its environment since 1991. Poaching of Olive Ridley Turtles was a rampant activity prevalent in those days. Turtle eggs were poached heavily by locals, and their meat was sold in local markets. The turtle eggs fetch a local market price of Rs. 3 to 4 per egg. At a later stage, people started realising the importance of conserving these endangered species. The turtle conservation movement in Morjim began in 1995–96. Locals and fisherfolk were involved in this movement. The conservation movement was a gradual process that made the public aware of the need to conserve and protect the sea turtle population. These movements later caught the attention of the State Forest Department, whereby their active participation boosted the conservation movement in the subsequent years. Locals were discouraged from poaching turtle eggs. In 1996–97, the forest department joined the movement by deploying forest guards to patrol the beaches during nesting seasons, and they also assisted the village youth in nabbing the poachers. The conservation movements gradually started having their effects on the south beaches in Goa. The locals realised that there are many other issues with which they will have to deal in the future in protecting and conserving the Olive Ridley Sea turtle population in the state of Goa[8].

9 ISSUES

There are many issues persistent with the nesting and protection of Olive Ridley turtles in the state of Goa. There is a need to address these issues to conserve our sea turtle population. Following are the issues:

[8] Roshni Kutty, *Turtles and Tourists – A coastal village in Goa shows the way*, SEA TURTLES OF INDIA (Dec 10, 2023, 6:30 PM), https://www.seaturtlesofindia.org/wp-content/uploads/2017/04/Kutty-R.-2000.-Turtles-and-tourists-a-coastal-village-in-Goa-shows-the-way.-Kachhapa-3-3-5..pdf

9.1 Tourist Disturbances

The tourist season in the state of Goa ultimately coincides with the Olive Ridley turtle nesting season. It so happens that the tourists crowd up on the turtle nesting beaches, which makes the female turtle afraid to come ashore and lay their eggs. Another issue that is concerning is the use of vehicles on the beaches. Tourists ride or drive their vehicles on the turtle-nesting beaches, causing grave turmoil. Also, when the female turtles come ashore to lay their eggs, beach visitors often touch, lift, and transport the turtles back to the water. Often at night, when these turtles come to lay their eggs, cases have been reported where tourists flash lights and click photographs whereby the female turtle returns back to the sea without laying their eggs. Turtle hatchlings are extremely sensitive to artificial illumination. Even a small flashlight can disorient these hatchlings.

9.2 Temporary Structures

Man-made developments along the coastline pose a threat for these vulnerable species. Beach shacks, deck beds, huts, etc. are examples of temporary structures erected on the turtle-nesting beaches. Though there is cooperation from shack owners, there are many hindrances that need to be looked at. Large-scale development projects like hotels, resorts, and restaurants begin constructing walls that act as obstructions, thereby preventing the turtles from climbing up the beach and nesting their eggs. Concrete structures and physical barriers installed on a turtle nesting beach are a major challenge. Hatched eggs get trapped in the crevices between the wall and the beach.

9.3 Blaring Music and Glaring Lights

Excessive noise pollution and light pollution often result in a delay in the arrival of Olive Ridley turtles on these turtle nesting beaches. Many instances of continuous glaring lights and blaring music have been reported, which have disturbed the Olive Ridley Sea turtle habitat. Various activities conducted on beaches, i.e., loud music parties played by event organisers and beach resorts, along with excessive lighting, are an issue that should be looked into[9].

[9] *Blaring music and glaring lights at Ashvem beach driving Olive Ridleys away*, HERALD GOA (Dec 11, 2023, 5:40 PM), https://www.heraldgoa.in/Goa/Blaring-music-and-glaring-lights-at-Ashvem-beach-driving-Olive-Ridleys-away/201629

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9.4 Plastic Pollution

One of the major issues concerning the protection of these sea turtles is the plastic disposed of in the sea. Locals and tourists dispose of their plastic waste in the sea. Olive Ridley turtles often feed on jellyfish, and they may mistake floating plastic bags for jellyfish, algae, or any other species that make up a large component of their diet. Ingestion of floating plastics often results in death. Many instances of the mortality of sea turtles have been reported, either due to the consumption of plastic waste or being trapped or entangled in plastic waste. Consumption of microplastics also affects their metabolism severely.

9.5 Fishing Net Traps

Fishing is one of the primary activities on Goan beaches. Many instances have been reported wherein these sea turtles get trapped and entangled in trawler fishing nets. It is said that these sea turtles cannot breathe underwater for a long time; they have to come up every 40 minutes in case they get tapped in these fishing nets, making it impossible to escape, which ultimately results in their death. Also, at times they develop major cuts and bruises; their flippers get injured or are chopped off, which renders them impossible to swim. Eventually, in this type of situation, they drown. Carcasses of Olive Ridley turtles being washed ashore have been reported on these turtle nesting beaches.

9.6 Poor Surveillance

Locals, tourists, or beach visitors are not aware of these endangered species, or it can be said that there is not enough awareness in society about these sea turtles. Female turtles are disturbed by people when they come ashore to lay their eggs. Also, instances of stray dogs chasing these turtles have been reported; unfortunately, they return to the sea without laying their eggs. There is not enough manpower for surveillance of these turtles on the turtle nesting beaches.

9.7 Translocation from Natural Habitat

Turtle eggs are shifted from the natural habitat to major nesting sites and hatcheries. The reason being that there is not enough manpower and adequate infrastructure, depriving these hatchlings of their natural habitat. In Goa, the two major turtle nesting beaches, situated at the

North Morjim Beach and the South Galgibag Beach, receive turtle eggs hatched from other beaches where there is no provision made for hatcheries. Adequate hatcheries, manpower, and technology should be used to make the north and south beaches turtle nesting sites and not translocate them from their natural habitat.

9.8 Inadequate Infrastructure of Hatcheries

Heat on the turtle nesting beaches is so intolerable and unbearable, which makes it impossible for turtle embryos to survive. The turtle-nesting beaches in the north and south of Goa lack the facility of roofing. No adequate roofing facilities are provided to these hatcheries to protect them from extreme heat. If the sand temperature increases, it can result in the birth of exclusively females, which would ultimately modify the ratio of male and female sea turtle hatchlings. Also, at times, such inadequate structures give opportunities to stray dogs to dig up the nested turtle eggs.

9.9 Climate Change

Climate change also has a drastic effect on the Olive Ridley Sea turtle population. The sex of offspring depends on the temperature at which the fertilised eggs are incubated. If the temperature is on the higher side, the eggs will hatch into females. If it is on the lower side, the eggs will hatch into males. If the temperature drops due to unseasonal rainfall, there will be more males than females, which will cause a disbalance in the turtle population.

10 NEED FOR A TURTLE CONSERVATION, MANAGEMENT PLAN/ POLICY

10.1 Sea Turtle Nesting and Habitat Management Plan (TNMP) 2020 – Analysis

The Sea Turtle Nesting and Habitat Management Plan is a draft prepared by the Centre for Environment Education (CEE Goa State Office). The draft serves as a guideline to design a system and framework for the planning and implementation of activities for the conservation and protection of turtle nesting sites in the State of Goa. The plan focuses on the protection of turtle nesting sites on the beaches of Mandrem and Morjim in the north of Goa and Agonda and Galgibag in the south of Goa. The plan is to be administered by the Forest Department of Goa, which has the responsibility to conserve and protect the sea turtle population in Goa.

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The main purpose of this plan is to direct the formulation and establishment of protection and management measures for the conservation and protection of turtles and their nesting habitat. The plan seeks to provide guidance for the formulation of a management framework for the conservation of turtles and their nesting habitat. The plan mentions beach-specific recommendations for carrying out conservation and protection of turtle nesting habitats.

Along with the Forest Department of Goa, the plan seeks the collaborative efforts of the various departments to make the conservation movement more efficient and robust. It includes the Department of Tourism, the Department of Environment and Climate Change, the Department of Education, the Goa Police Department, the Village Panchayat, the Department of Fisheries, the Captain of Ports, the Goa Waste Management Corporation (GWMC), the Goa Tourism Development Corporation (GTDC), the Goa Coastal Zone Management Authority (GCZMA), and the Goa State Pollution Control Board (GSPCB).

10.2 Sea Turtle Nesting Habitat Management Policy- A Need of the Hour

The principal interest is to strengthen sustainability and conserve the environment, along with determining the various factors that impact the turtle nesting beach habitat and its environment.

The policy mentions the following suggestions to protect and conserve the sea turtle population and its habitat:.

It includes complying with all necessary compliance obligations, legal requirements, and regulations pertaining to the conservation of turtles and turtle nesting sites, including relevant environmental regulations and guidelines issued by the central, state, and local governments. The goal is to adopt best practices, standards, and guidelines that will aid in our efforts to ensure that turtle nests and hatchlings have a high survival rate. The policy looks to make it possible for beach space users, such as shack owners, resort owners, transportation companies, etc., to abide by applicable environmental, health, and safety laws and regulations, including those that pertain to sustainable or responsible tourism. The policy focuses on encouraging and developing the capacity of beach stakeholders, such as shack owners, resort managers, etc., to be watchful and aware of any environmental risks that might arise in and around the turtle nesting areas as a result of their activities. The policy seeks to

take a collaborative and scientific approach to managing turtle nesting beaches, involving the right stakeholder representatives to determine, choose, and put into action the best management practices for the efficient preservation of turtles, nesting locations, and the overall beach habitat. The policy aims to create a Turtle Nesting Beach Management Committee (TNBMC) with representation from the local community, shack owners, hotel owners, experts, government departments, civil society, etc. It seeks to develop an appropriate code of conduct for visitors to the beach to forbid littering, the use of single-use plastics, dumping, and other acts that could pose a risk to the environment and have a detrimental impact on the management and conservation of turtle nesting areas. The policy focuses on creating a rescue and rehabilitation centre for turtles at the beach. It looks to identify setbacks, preserve buffer zones, appropriate local vegetation, and formulate and preserve applicable setbacks for infrastructure and facilities erected on the beaches. The policy aims to identify sources of light pollution and eliminate artificial lighting on the beaches during the nesting season. To ensure a safe and secure nesting process, the policy seeks to implement a system to remove obstacles to the nesting of sea turtles to keep the nesting beaches free from debris, and pollution monitoring procedures and measures should be implemented. It mentions that the use of vehicles on turtle nesting beaches, bringing pets, horse riding, stray animal movement, and sea-based sport activities on the beach and around the nesting areas during the nesting season should be strongly discouraged. The policy seeks to support sea turtle research, report all sorts of harm and harassment incidents involving sea turtles, Develop a CSR programme for turtle-nesting beaches. The policy seeks to promote the adoption of environmentally friendly products, building materials, clean energy, recyclables, and, whenever possible, locally available environmentally friendly products and services by visitors to beaches, shack owners, resort owners, facilities, and service providers in and around the turtle nesting beach area. For public and private beach-related works and activities, the policy seeks to locate contractors or outsourcing parties and assign work to those who have established benchmarks in the areas of sustainability, safety, and the environment. To strengthen environmental, social, or sustainable development initiatives while fostering public engagement and support for turtle conservation, the policy seeks to work with other local organisations, environmental organisations, etc. The policy mentions the prohibition of public events or mass gathering events or functions on the turtle nesting beaches. In order to achieve management objectives, it seeks to work with local administration to issue notifications or orders. The policy aims to take steps to encourage

community participation and social responsibility, build long-lasting relationships with local stakeholders and residents, and take advantage of their interests and engagement opportunities. The policy looks to create awareness among the associate personnel who are involved with the Morjim turtle nesting beach area about the possible environmental effects of beach activities and the requirements of this environmental policy. It seeks to encourage the team members responsible for managing the beach and protecting turtle nesting areas to offer their opinions or feedback on environmental, sustainability, and social responsibility issues. Also, the management, beach operating staff, and other associates shall be dedicated to maintaining and protecting the environment's quality in the beach area. Monitoring, measurement, and evaluation of environmental management performance and compliance with the turtle nesting beach management policy, including taking preventive and corrective actions, shall be undertaken. Lastly, it calls for documentation and availability of turtle nesting beach management policy and performance in its reports.

10.3 Onshore Beach Habitat Management[10]

The plan mentions the following measures to be executed on the turtle nesting beaches of Goa:

- **Nesting Space/Habitat Protection and Conservation:** The plan seeks to identify the extent of sea turtle nesting along the length and width of the beaches based on historical nesting data and trends. False nesting and the analysis of the lifecycle and behavioural aspects of the particular turtle species arriving for nesting on the beach shall also be taken into consideration. It mentions that to strengthen the conservation management plan, the Goa Forest Department must display boundary and sensitive nesting areas through maps and display boards in order to make tourists or beach visitors aware of the same.

- **Nesting period and time:** It highlights that the turtle nests must be correctly marked with a GPS location by trained workers, and they must be given a name as per scientific nomenclature or recording protocol. It recommends the development of an application to later visualise and geo-reference data. It mentions protecting the nest with the right number of guards and making sure that there is a clear sign or warning

[10] *Id.*

signal advising daytime beach visitors not to disturb the turtle nests. It recommends daytime and nighttime patrolling of the beaches.

- **Rescue, Rehabilitation & Hatchery management:** It recommends that a dedicated rescue and rehabilitation centre be established with all advanced facilities for treatment, care, and rehabilitation, as there are many incidents of turtles being washed ashore with major or minor injuries, and currently there is no adequate provision to deal with them swiftly. For the survival and health of eggs laid due to false nesting, carried away on the shore, or in the intertidal area owing to rain or waves, erosion, natural risks, etc., it is recommended that a rescue and rehabilitation centre be created at the beach. Hatchlings that are injured should be immediately rescued and rehabilitated. It seeks that the rescue and rehabilitation centre be instituted in both districts of Goa.
- **Setting up of turtle hatcheries for ex-situ conservation:** The relocation of nests to a hatchery, where the hatchlings are then released into the sea, is a practice that the Goa Forest Department follows. Despite the fact that these activities are undoubtedly beneficial, the hatcheries are not managed in a systematic or effective manner. There are a number of regulations for hatcheries around the world, particularly the fact that the sex ratio of hatchlings is based on the temperature at which they develop. On all beaches, the Department has implemented an in-situ conservation strategy. This would necessitate enhancements to hatchery management and capabilities, as well as nest handling and transportation improvements. It suggests that Morjim's current hatchery could be upgraded. The nests are currently being protected by fishing nets. It is recommended that the ICZMP project include an appropriate protocol as well as any necessary physical infrastructure, training, and capacity-building elements. It also mentions that in order to support and assist the Beach Conservation (Range Officer) in charge of the nesting beaches, volunteers must be trained, skilled, and certified in a variety of scientific handling procedures for turtles, nests, eggs, hatchlings, track identification, interpretation capabilities, rescue, and rehabilitation.

- **Beach space and Shack management:** In Goa, the tourist season and the nesting season both run concurrently, creating a problem of conflict over beach space use. Goa's turtle nesting sites have all experienced conflicts with space use. Beach spaces

must be identified and separated into go-and-no-go areas by the Goa Coastal Zone Management Authority, working along with the Goa Forest Department, local stakeholders, and other line departments. It mentions that shacks that are allowed in the "Sustainable Tourism Area," where commercial operations are allowed, must adhere strictly to the prescribed norms and criteria. It recommends that the spacing between each of the shacks be at least 20 metres. If a sea turtle decides to nest in this region, it must have access to enough room without any physical impediments so that she can move around and find a suitable place to lay her eggs. It mentions that beach space management must be inclusive.

- **Lighting Management:** Light pollution can severely affect the turtle's behaviour. It recommends annual lighting checks and implements suggested corrections if necessary. It mentions that any outside lighting fixtures that emit light and are visible from the nesting beach should be shielded, pointed only where needed, and typically located as low as possible. It insists on the use of long-wavelength lamps and black baffles. Also, the use of bright white light, such as metal halide, halogen, fluorescent, mercury vapour, and incandescent lamps, should be avoided. It recommends turning off balcony lights when not in use. During the turtle nesting season, campfires or fire pits on the beach should be prohibited. It insists on making a commitment to limiting the amount of light that comes from hotels, restaurants, and other inside places that reaches the nesting beach. blackout curtains or shade screens if needed, and the lights should be turned off when not in use.

- **Regulation of beach developmental activities for safe and sustainable development:** In order to assure conservation and improvement of local livelihood along the nesting beach stretch, the plan offers some of the management measures that the state must implement.

- **Enabling effective interdepartmental coordination:** The plan calls for periodic meetings and data sharing among line departments for better networking and coordination for the conservation and protection of sea turtles.

- **Nearshore water space and habitat (offshore)**: There is a need to determine the size of the marine ecosystem and nearshore seawater region that sea turtles use for their feeding, foraging, conglomeration, and migrating needs as they arrive for nesting and also while they remain in the nearshore water.

- **Research and monitoring of the nesting behaviour**: The plan seeks to involve the community and the higher education institutions in Goa to undertake research activities to study the coastal morphological changes. It insists that the Forest Department undertake study by involving scientific institutions.

- **Training and Education**: It insists that the Forest Department must organise periodic training for their employees, including forest guards, turtle guards, foresters, etc., for the conservation and protection of these sea turtles. The Goa Forest and Education Department has partnered with CEE and numerous other organisations to carry out our education and awareness campaigns among schoolchildren, the general public, and tourists. It intends that each of these selected nesting sites must have a full-fledged interpretation centre established by the Department of Forest as part of the ICZMP. Also, to run the interpretation centre, the department needs a dedicated education officer.

- **Community involvement in Sea Turtle Conservation**: As the community has played an important role in turtle conservation, it suggests that frequent meetings and consultations be held so that community participation and support in conservation are ensured.

- **Community Benefit sharing and incentivization**: It insists that communities living around the nesting sites must be compensated for their sacrifices and commitments to making conservation a successful movement. For their tireless efforts to conserve turtles, the local turtle guards that the Goa Forest Department appoints should be honoured. It suggests that locals must be given preference by the Goa government in all economic and livelihood activities related to turtle protection.

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10.4 Authorities-Roles and Responsibilities for Implementing Management Plan

The proposed management structure and participatory decision-making process allow for the comprehensive conservation of the turtle nesting beach ecosystem.

10.4.1 The Turtle Nesting Beach Management Committee (TNBMC)

The Turtle Nesting Beach Management Committee (TNBMC), which will represent important local stakeholder groups and officials who can help sustainably conserve the habitat of turtle nesting beaches and safeguard turtles, is what the TNMP proposes to establish. It seeks to assist the TNMP by enabling multi-stakeholder involvement, coordination, accountability, transparency, and monitoring at the local level. For efficient turtle nesting management, it will assist in giving advisory and management decision inputs. The committee will define the environmental policy, objectives, and goals, as well as the targets to be met, in cooperation with the Goa Forest Department, and will make sufficient resources available to implement the TNMP. TNBMC must also carry out instructions for remedial and preventive actions as well as upgrades to the TNMP. According to their duties and responsibilities, they might assign authority to certain employees. To assist the Beach Conservator (Range Officer responsible for daily operational management and compliance), TNBMC may, as necessary, assign different specialists, supervisors, or personnel.

10.4.2 The Beach Nesting Habitat Conservator (Range Officer)

The plan proposes the appointment of a range officer who shall be a personnel or trained person authorised by the Goa Forest Department. The person will be in charge of ensuring optimal resource utilisation to carry out the management plan. While implementing TNMP, the person will be responsible for maintaining and controlling processes and systems for proper performance, regular monitoring, and alerting the necessary authorities and team members about concerns, difficulties, and solutions. In order to handle turtles, turtle nests, eggs, hatchlings, etc., the conservator will have close support on the ground from trained guards of the Forest Department and certified volunteers. They will also receive assistance from designated personnel, representatives from the local fishing community, and shack owners and resorts.

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11 SUGGESTIONS

- **Technological Means:** It relates to making the best use of technology to protect and conserve the Olive Ridley Sea turtle population.

- **Artificial Intelligence Surveillance:** Turtle hatching areas may be observed using artificial intelligence surveillance. Artificial intelligence can aid in monitoring and analysing the Olive Ridley Turtle habitat and the environmental conditions that impact it. Trends, patterns, and anomalies in water quality, temperature, beach erosion, and other factors affecting turtle life may be identified using AI algorithms. Artificial intelligence (AI) may be used to identify possible issues for Olive Ridley Turtles and their nesting environment, including illegal fishing, poaching, habitat damage, etc.

- **Satellite Tagged Turtles:** Insights into turtle behaviour, migration patterns, and habitat use have been gained through the use of satellite tags on turtles. It aids in the mapping of turtle migration routes and helps researchers track turtle movements over vast distances. Critical habitats, migration routes, and regions with a high conservation value can all be found using this information. It also aids in comprehending the interconnectedness of various populations and any potential risks associated with migration. Planning and management strategies for conservation can be influenced by data from turtles that have been satellite-tagged. Additionally, it aids in locating regions where activities like fishing or coastal development may conflict with efforts to conserve turtles. With the aid of information provided by satellite-tagged turtles, we can better understand their ecological needs and interactions with their surroundings. Additionally, it sheds light on their social interactions, predator avoidance techniques, and feeding habits. This will also aid in keeping track of changes in ocean currents, sea surface temperatures, and the availability of food. Estimating turtle population sizes and distribution also benefits from the use of satellite tags.

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- **Use of Drone Technology:** Drones can be used to monitor the turtle nesting sites. The use of drones will help to precisely count the number of nests, detect possible dangers or harm to turtles, look for pollution, and evaluate nesting success rates. The data derived will help in conservation and protection strategies.

- **Turtle Application:** Common turtle applications can be created focusing on the conservation and protection of Olive Ridley Sea turtles, and they can be quite effective at increasing public awareness, facilitating research and monitoring efforts, and encouraging active engagement in conservation activities. The application can offer in-depth details about various turtle species, their habitats, legal protection, conservation issues they face, and the significance of their preservation. The application can allow users to report several problems at the turtle nesting places or details about an injured turtle. The government, conservation groups, and researchers can use this information to track turtle populations, migration patterns, nesting habits, and crucial habitats that require protection. The application can make it easier for conservationists, researchers, and members of the public to communicate and work together. Users can participate in discussions where they can exchange information regarding turtle conservation, share experiences, and ask questions. This motivates group efforts for turtle protection and fosters a sense of community.

- **Dedicated Hatcheries:** Dedicated hatcheries can protect the turtle embryos from extreme weather conditions. Hatcheries provide optimal conditions for egg incubation, including proper temperature, humidity, and protection from extreme weather events. By keeping a check on these conditions, the hatching success rate can be increased when natural conditions are not always favourable due to climate change or other environmental factors. Dedicated hatcheries also provide a controlled environment where nests can be protected from predators and stray animals, increasing the chances of successful hatching. Dedicated hatcheries provide a safe space away from human interference, reducing the risk of turtle nest destruction or accidental damage caused by tourists or beach visitors.

- **Use of Turtle Excluder Devices (TEDS):** The purpose of turtle excluder devices (TEDs) is to lessen the accidental death and capture of sea turtles in fishing nets, thereby lowering their mortality in fishing activities. TEDs enable sea turtles to escape after being mistakenly caught in fishing nets, lowering their risk of drowning or injury. The use of turtle excluder devices will aid in reducing the death rate of turtles caught in trawler fishing nets and thus should be promoted by governments.

- **Need for Awareness:** Many people are not aware of these endangered species. There is a need to educate the locals and tourists about the importance of conservation and protection of Olive Ridley turtles and their habitats. This can be done through awareness campaigns, educational programmes, and adequate signage displayed at the turtle nesting beaches.

12 CONCLUSION

For sustaining life on the planet, preserving and maintaining the earth's environment is important for conserving biodiversity. Ensuring the well-being and survival of endangered species will contribute to the sustainable future of our planet, which will safeguard the invaluable benefits that marine biodiversity provides. Olive Ridley turtles form an important part of the food web. In India, several key strategies with regards to conservation and protection should be implemented at the Olive Ridley turtle nesting sites. Adequate and active measures should be taken to address the issues persistent to the protection of these turtles. Collaborative efforts between governments, locals, NGO's, and conservation organisations are crucial in raising awareness about these vulnerable species. If there is no availability of manpower, governments should make the best use of technology. Research and monitoring should be conducted in every state to gather data on their migratory patterns and behaviours, which will help in the effectiveness of conservation activities and will help to maintain the ecological balance of our marine ecosystem. Lastly, if there is no blue, there will be no green. It's high time we save our sea turtles today.