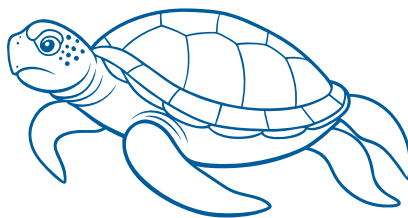


FIELD MANUAL FOR STUDY OF MARINE TURTLES IN BANGLADESH





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TABLE OF CONTENTS

MARINE TURTLES OF BANGLADESH 01

Diversity 01

Threat 07

Conservation Status 10

Conservation History of Sea Turtle in Bangladesh 12

MONITORING METHODS 15

Nesting Beach Monitoring 16

Site Selection 16

Dividing Nesting Sites 17

Preparation 17

Monitoring Procedures 18

Mark and Recapture Surveys 21

Monitoring Equipment 22

Tagging Procedures 23

Satellite Telemetry Studies 28

Tracking Equipment 29

Step-by-Step Deployment of Satellite Trackers 30

Case study: Using satellite telemetry to understand marine turtle movements in the Bay of Bengal 33

Nest Excavation and Hatchling Measurements 34

Sampling Equipment 35

Egg Measurements 35

Nest Excavation 35

Hatchling Measurements 36

Nest Protection and Predator Control 38

Planning and Site Selection 38

Nest Protection Techniques 38

Code of Conduct 39

Adult Nesting Turtles 39

Emerging Hatchlings 40

BIBLIOGRAPHY 42

ACRONYMS

Acronym	Full Form
BMZ	German Federal Ministry for Economic Cooperation and Development
CCL	Curved Carapace Length
CCW	Curved Carapace Width
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPS	Global Positioning System
ICZM	Integrated Coastal Zone Management
ID	Identification
IPA	Isopropyl Alcohol
IUCN	International Union for Conservation of Nature
MoEFCC	Ministry of Environment, Forest And Climate Change
MPA	Marine Protected Area
MTCP	Marine Turtle Conservation Programme
MTSG	Marine Turtle Specialist Group
NCSIP	National Conservation Strategy Implementation Project
NGO	Non-governmental Organizations
PIT	Passive Integrated Transponder
PVC	Polyvinyl Chloride
RMU	Regional Management Unit
SCL	Straight Carapace Length
TED	Turtle Excluder Devices
UD	Undeveloped (egg category)
UH	Unhatched (with embryo)
UHT	Unhatched Term (fully developed embryo)



Green Turtle

© Ruchira Somaweera

MARINE TURTLES OF BANGLADESH

DIVERSITY

Out of the seven marine turtle species globally, five have been recorded in the territorial waters of Bangladesh: Olive Ridley Turtle (*Lepidochelys olivacea*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*), Loggerhead Turtle (*Caretta caretta*), and Leatherback Turtle (*Dermochelys coriacea*).

These species can be identified through distinct characteristics of their carapaces (top shells) and head scales, as illustrated in of these species, only three—the Olive Ridley, Green, and Hawksbill turtles—are known to nest on the beaches of Bangladesh, although Hawksbill



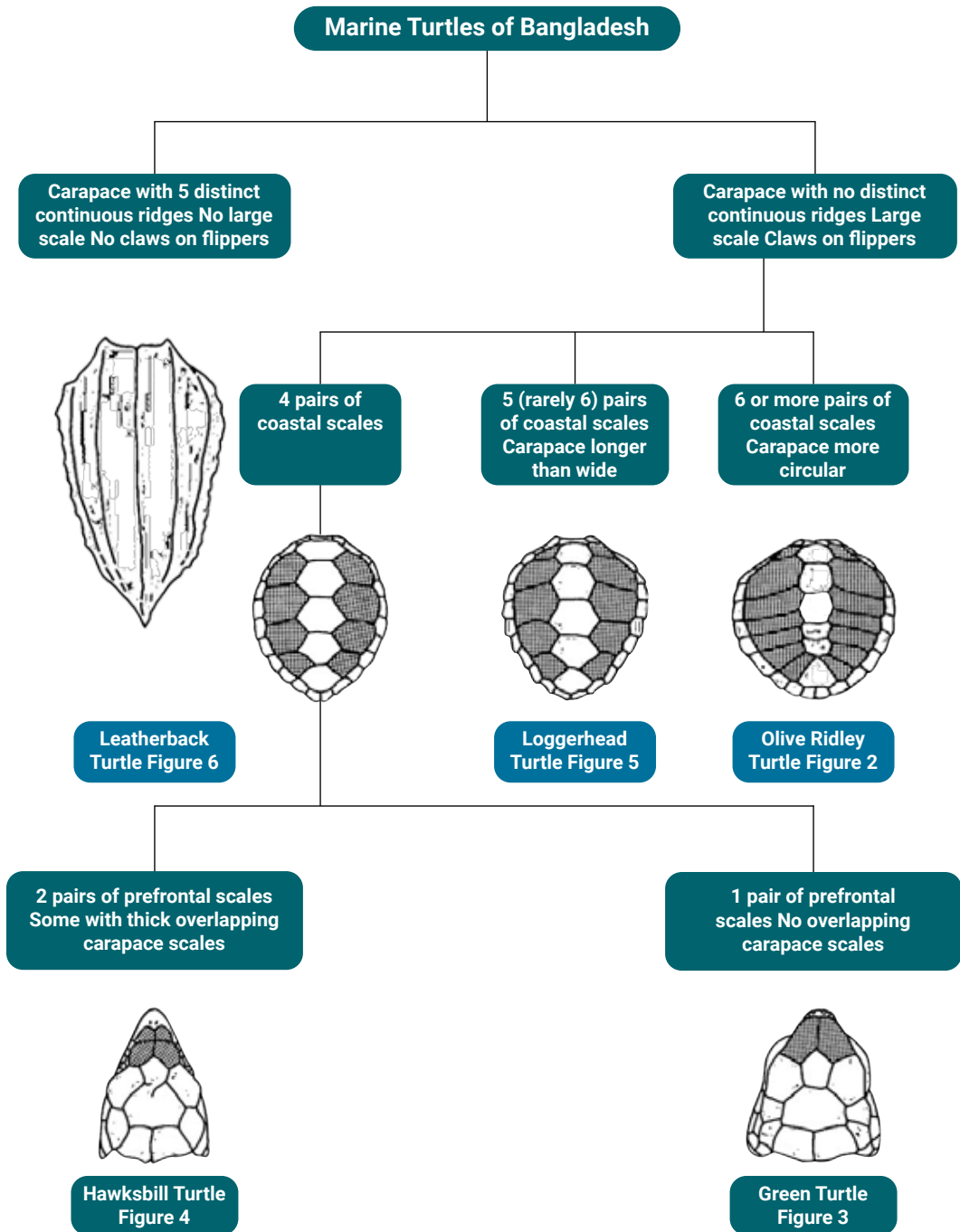
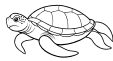
nesting is rare. The total coastline of Bangladesh extends approximately 710 kilometers (ICZMP 2003), though not all sections are suitable for nesting. Sandy beaches, which provide ideal nesting conditions, are found only in specific areas along the mainland coast. Of those, Cox's Bazar, which boasts the world's longest sandy beach (Dey *et al.*, 2015), offers approximately 140 km of nesting habitat for turtles. Additionally, numerous offshore islands with sandy beaches provide favorable nesting habitats.

The highest concentration of nesting has been observed in the southernmost part of Bangladesh, particularly at Saint Martin's Island and the Cox's Bazar belt, which includes locations such as Borodail, Inani, Sonadia Islands, Teknaf, Monakhali, and Moheshkhali. Other notable nesting areas include the southwestern region, including Kochopia, Sandweep, Dubla Island, Dim Chor, and the Sundarbans.



A returning marine turtle to the sea

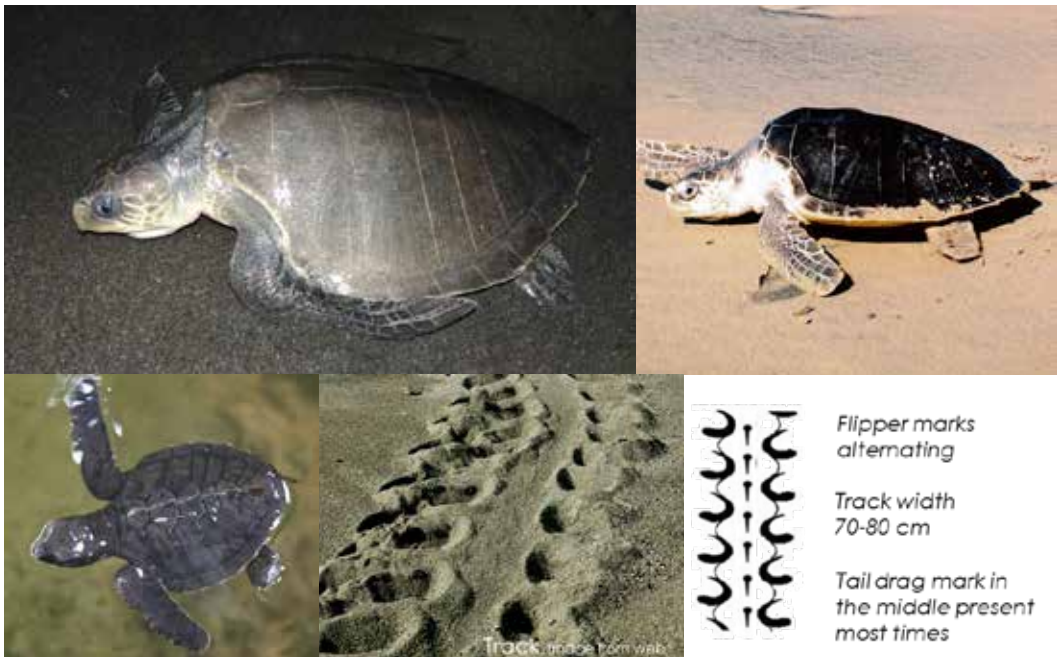
© Ruchira Somaweera



Identification of marine turtles known from Bangladeshi waters

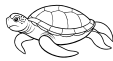


Olive Ridley Turtles are the most widespread nesting species in Bangladesh. They nest along the mainland coast and on islands, extending from the Sundarbans mangrove forests in the southwest to St. Martin's Island (locally known as Narikel Jinjira dweep) in the southeast. Documented nesting sites include Mandarbaria, Dubla, Dim chor, and Putney islands in the Sundarbans; Sandweep, Hatiya, Nijhum dweep, and Bhola islands along the southwest coast; and islands along the south-central and southeastern coasts, such as Inain, Kochopia, Borodail, Monkhali, and Teknaf on the mainland, as well as Sonadia, Kutubdia, Moheskhal, and St. Martin's islands. Several male Olive Ridley turtles have also been found entangled in fishing nets off the coasts of Hatiya, Sandweep, and Bhola islands.

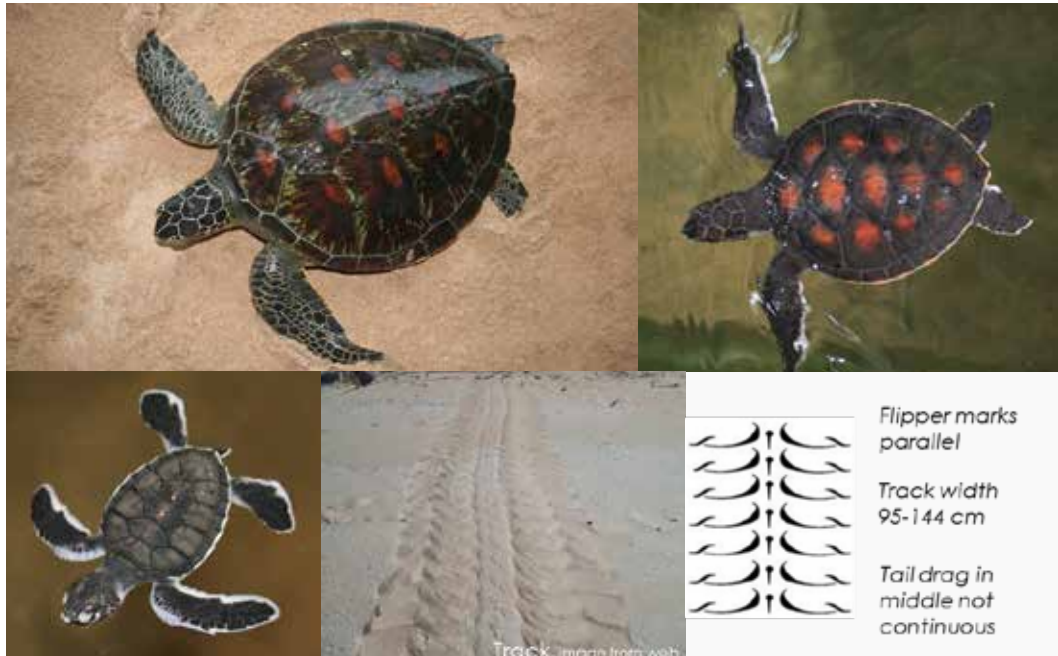


Identification of Olive Ridley Turtle (*Lepidochelys olivacea*) and tracks © Ruchira Somaweera

Green Turtles, though less widespread than Olive Ridleys, also nest on both mainland and island beaches in Bangladesh. Green Turtle nesting has been recorded in the south-central region (including Sandweep, Hatiya, and Bhola islands), along the southeastern coast (from Cox's Bazar to Teknaf), and on islands such as St. Martin's, Sonadia, Kutubdia, Hatiya, and Sandweep. However, nesting records for Green Turtles along the Sundarbans coastal



beaches are rare or absent. The shallow continental shelf in the south-central region provides a suitable habitat for immature and young Green Turtles.



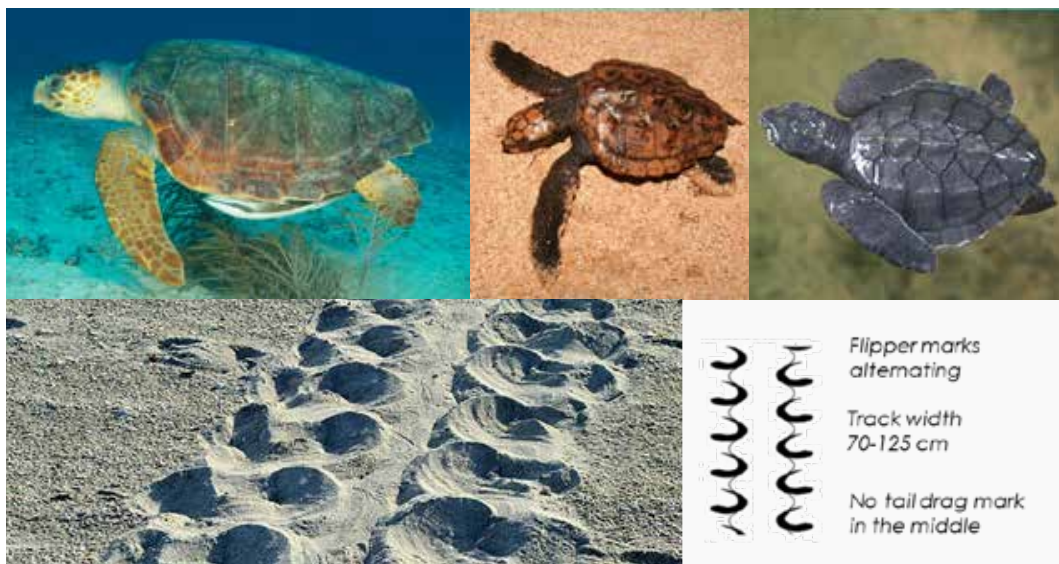
Identification of Green Turtle (*Chelonia mydas*) and tracks © Ruchira Somaweera

Hawksbill Turtles are a rare visitor to Bangladesh's beaches, with a few unconfirmed reports of nesting on St. Martin's Island, the most recent being in 1992. Local fishermen have reported that Hawksbill Turtles were more regular nesters on the island in the 1950s, but their numbers have since declined significantly. Studies under the National Conservation Strategy Implementation Project-1 (NCSIP-1) suggest that the island ecosystems are capable of supporting Hawksbill Turtles due to high abundance of sponges, which form a significant part of the Hawksbill's diet. Although there have been reports of Hawksbill sightings from 1997 to 2001, no data exists for subsequent years.

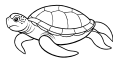


Identification of Hawksbill Turtle (*Eretmochelys imbricata*) and tracks © Ruchira Somaweera

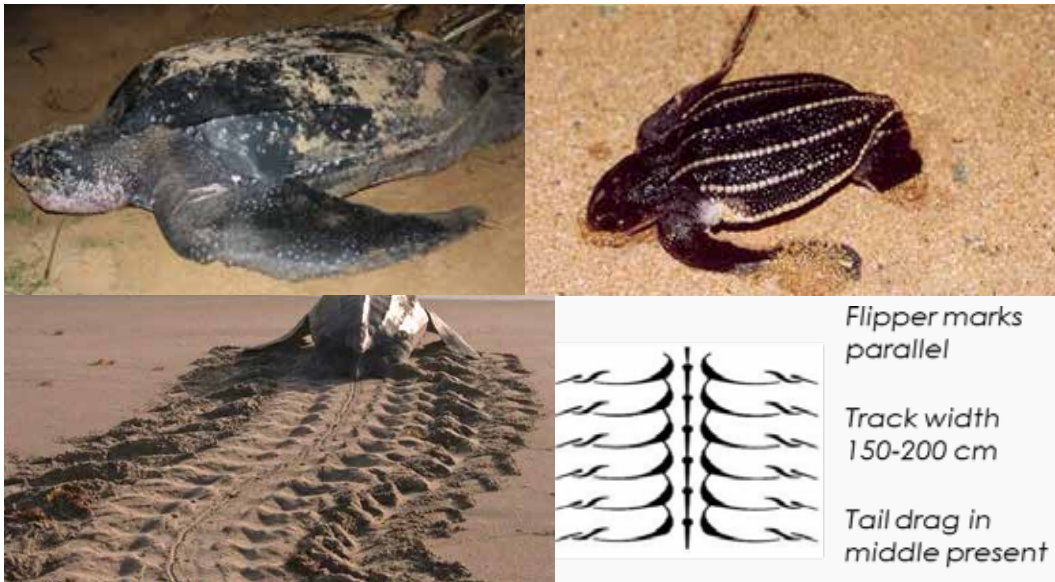
While nesting of **Loggerhead Turtles** has been reported on nearby islands off Myanmar, to the east of St. Martin's Island, there are only unconfirmed reports of this species nesting in Bangladesh (at Cox's Bazar). It is important to note that Olive Ridley and Loggerhead turtles are often confused with each other (Frazier, 1985), which complicates the verification of these reports.



Identification of Loggerhead Turtle (*Caretta caretta*) and tracks © Ruchira Somaweera



Leatherback Turtles are rarely encountered in Bangladeshi waters, and there is no historical evidence of nesting in the region. However, in April 1997, a dead adult Leatherback Turtle was washed ashore on St. Martin's Island (Rashid and Islam, 1999). During the 2000–01 breeding season, a crawl mark suspected to be from a Leatherback Turtle was observed at the southern tip of Cheradia Island.



Identification of Leatherback Turtle (*Dermochelys coriacea*) and tracks © Ruchira Somaweera

THREATS

Anecdotal evidence suggests a general decline in some marine turtle nesting populations in Bangladesh. Several key threats have been identified, including extensive egg exploitation and the accidental killing of adult turtles during fishing activities. Turtles are frequently entangled in trawl nets, drift nets, gill nets, and mesh nets, and collisions with fishing vessels have been reported in some areas.

The destruction of nesting habitats due to development projects and increasing tourist traffic has further contributed to declines in some local populations. Coastal modifications, such as the construction of embankments and shrimp farms, as well as light pollution from coastal development, have been shown to negatively affect turtle nesting habitats. Among all the coastal habitats of sea turtles in Bangladesh, the Cox's Bazar coastline has experienced the most environmental degradation due to its booming tourism industry and



regional road network construction. This area has thus become a key focal point for marine biodiversity conservation.



Long-net fishing along shoreline: one of the main threat for nesting marine turtle

©GIZ BD/IUCN

Although traditional consumption of turtle meat by local coastal communities is not considered significant, studies have shown that, in the absence of conservation efforts, over 90% of turtle nests are exploited by humans. In contrast, only 5-8% of nests are predated by



Heavy shipping though marine turtle migration route

©GIZ BD/IUCN/ Kazi Zenifar Azmiri



natural predators such as jackals, mongooses, and monitor lizards. Stray dogs in the beach are potential threats, often killing turtles and damaging nests. However, where conservation and awareness programs are active, these threats have been significantly reduced. Notably, there has been no large-scale international or commercial trade in marine turtles, or their products reported in Bangladesh.



Commercial trawl fishing at Swatch of No Ground

©GIZ BD/IUCN/ Ruchira Somaweera



Plastic pollution

©GIZ BD/IUCN/ Kazi Zenifar Azmiri

CONSERVATION STATUS

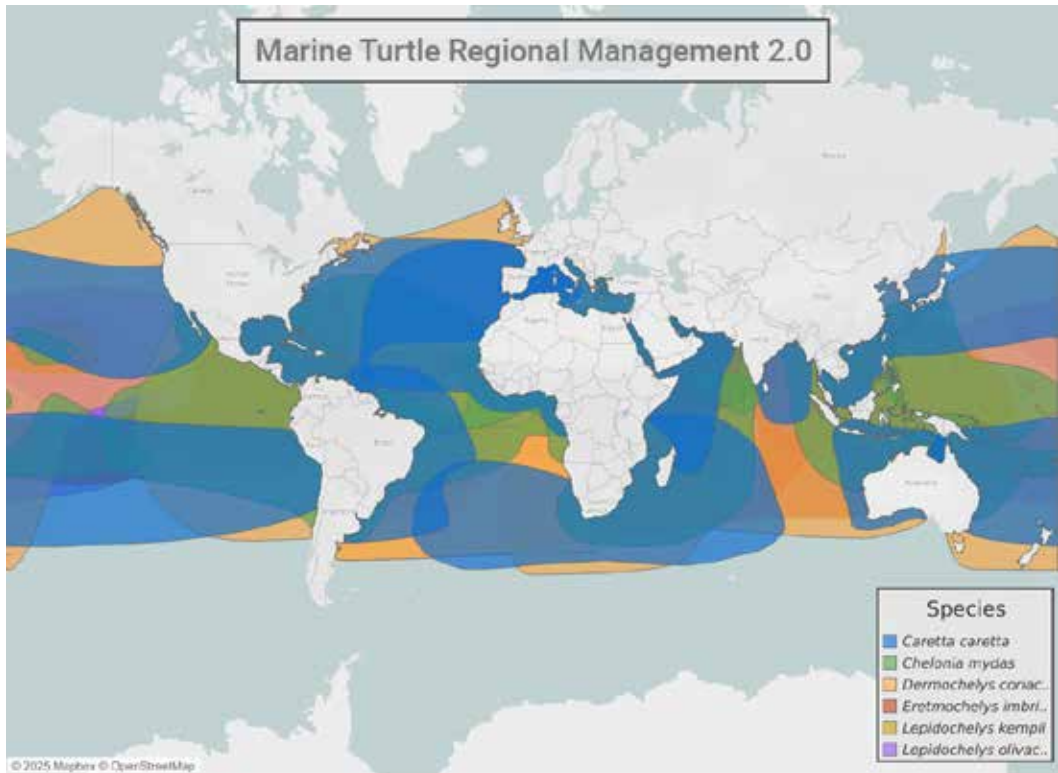
All five species of marine turtles found in Bangladesh are listed on the global IUCN Red List of Threatened Species: Hawksbill Turtle is classified as Critically Endangered, the Green Turtle as Endangered, and the Olive Ridley, Loggerhead, and Leatherback Turtles as Vulnerable. However, these global assessments do not fully capture the national and regional status of sea turtles, highlighting the need for more localized conservation efforts.

Marin turtle species	Global Red List Status (2025)
Hawksbill Turtle	Critically Endangered
Green Turtle	Endangered
Olive Ridley Turtle	Vulnerable
Loggerhead Turtle	Vulnerable
Leatherback Turtle	Vulnerable

To address this gap, the IUCN Marine Turtle Specialist Group (MTSG) developed the Regional Management Unit (RMU) model, which integrates biological and remote sensing telemetry data to assess the status of all seven marine turtle species on a national scale (Tanzer *et al.*, 2017; Wallace *et al.*, 2010). A total of 58 RMUs have been identified globally, with 19 classified as "High Risk-High Threats." Eleven of these high-risk RMUs are located within national boundaries, representing the most threatened marine turtle populations that require immediate conservation actions.



In the regional context, five of the 11 most endangered RMUs are found in the Indian Ocean, an area with the highest uncertainty regarding both threats and risks (Wallace *et al.*, 2011). Bangladesh, as part of this larger marine ecosystem, is home to three of these highly endangered RMUs:



<https://www.iucn-mtsg.org/regional-management-units>. These shapefiles were originally published in Wallace, *et al.* 2023. Marine turtle regional management units 2.0: an updated framework for conservation and research of wide-ranging megafauna species. *Endang Species Res* 52:209-223.

1. North-East Indian Ocean – Olive Ridley Turtle (Arribada) – Threatened
2. North-East Indian Ocean – Olive Ridley Turtle – Threatened
3. North-East Indian Ocean – Hawksbill Turtle – Critically Endangered

The standardization and consistent monitoring of marine turtle populations in Bangladesh have not been well-established. However, there is a wealth of anecdotal and opportunistic studies, as well as some multi-year research, particularly focused on St. Martin's and Sonadia Island of Cox's Bazar.



A marine turtle hatchery on nesting beach at Cox's Bazaar

©GIZ BD/IUCN

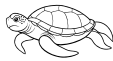
CONSERVATION HISTORY OF SEA TURTLE IN BANGLADESH

Several ongoing projects are aimed at the conservation of marine turtles in Bangladesh. Public awareness efforts have also increased through programs initiated by NGOs, including local-language publications, to reach broader audiences. The government has also launched several research initiatives and community involvement activities, planning participatory conservation programs for the near future.

Sea turtle conservation started with a small pilot project at St. Martin Island by CARINAM in 1996-98. Later by NCSIP of MoEFCC through St. Martin Pilot Project (2000-01) and later St. Martin Project (MoEFCC)(2001-2004).

Sea turtle activity started by DoE in 2005 ended without sustainable good results mostly carried out by NGOs without maintaining scientific protocols and not completely comprehensive results.

Research and conservation organization Marinelife Alliance (MLA) conducting nesting and stranding sea turtle monitoring at all spots of the coast since 2000 and maintaining the database since the beginning of work. MLA have been conducting sea turtle conservation



work at St. Martin Island, Teknaf peninsula & Sonadia Island with the support from KNCF-Japan & FWS-US since 2004 and maintaining complete status database. MLA maintaining sea turtle website for Bangladesh under which total data would be available in later days (www.seaturtlebd.org). MLA also started satellite tracking project of sea turtle in Bangladesh in 2010. (Islam 2013).

In 2013, SRCWPP (Strengthening Regional Co-operation for Wildlife Protection Project) under Forest Department, supported MLA to conduct sea turtle conservation and monitoring in Bangladesh. The project title is- "Conservation of Sea Turtle in Bangladesh Coastal & Marine Territory". It is the most comprehensive work in Bangladesh sea turtle monitoring and conservation. MLA allocated almost 100 local communities for sea turtle nesting monitoring along the entire coast except the largest mangrove forest of the Sundarbans. After one season 2013-14 monitoring the nesting frequency raise around 650 olive ridleys from South Central Beach Kuakata to Southeast most St. Martin Island. (Islam, 2014).

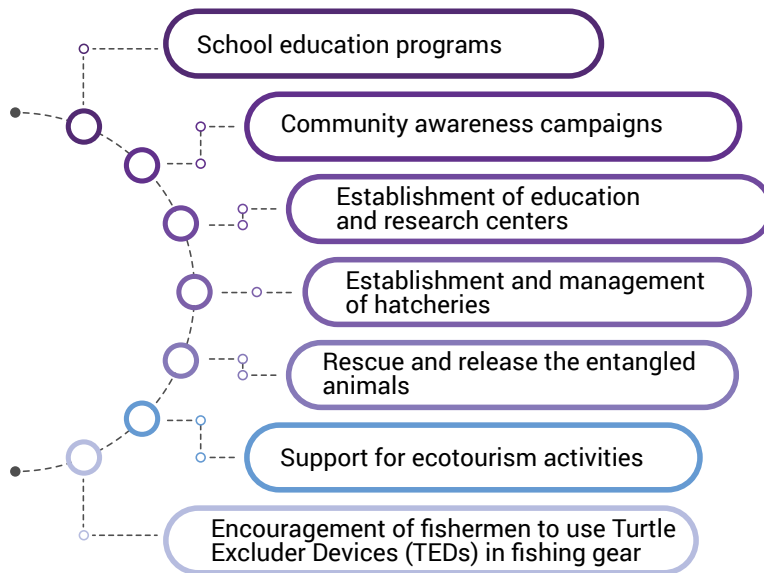
The Forest Department, under the Ministry of Environment, Forest and Climate Change (MoEFCC), is the sole authority for the protection, conservation, and management of wildlife in Bangladesh. Wildlife Preservation Act 2012 included sea turtle in the protected list and banned trade related to sea turtles.

In terms of on-the-ground conservation, sea turtle hatchery has been established by both the government (*eg-DoE*) and various NGOs (CODEC, NACOM, Arannayak Foundation) in Cox's Bazar, close to the nesting grounds. Both in-situ and ex-situ conservation strategies have been implemented. In-situ conservation, including the fencing of nests, has been practiced on a small scale, though data collection by NGOs and the government has been inconsistent. Ex-situ conservation, involving the collection and hatching of turtle eggs in hatcheries, has been the primary focus of conservation efforts in the region.





The government's conservation and management activities include the declaration of Ecologically Critical Areas, the development of sustainable resource management plans, and the establishment of ecotourism operations in local areas. Key actions undertaken by NGOs and international organizations include:

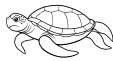


These combined efforts, both governmental and non-governmental, play a critical role in the conservation of marine turtles in Bangladesh. However, continued attention is needed to mitigate ongoing threats and enhance the effectiveness of conservation measures in this region.



A marine turtle hatchling

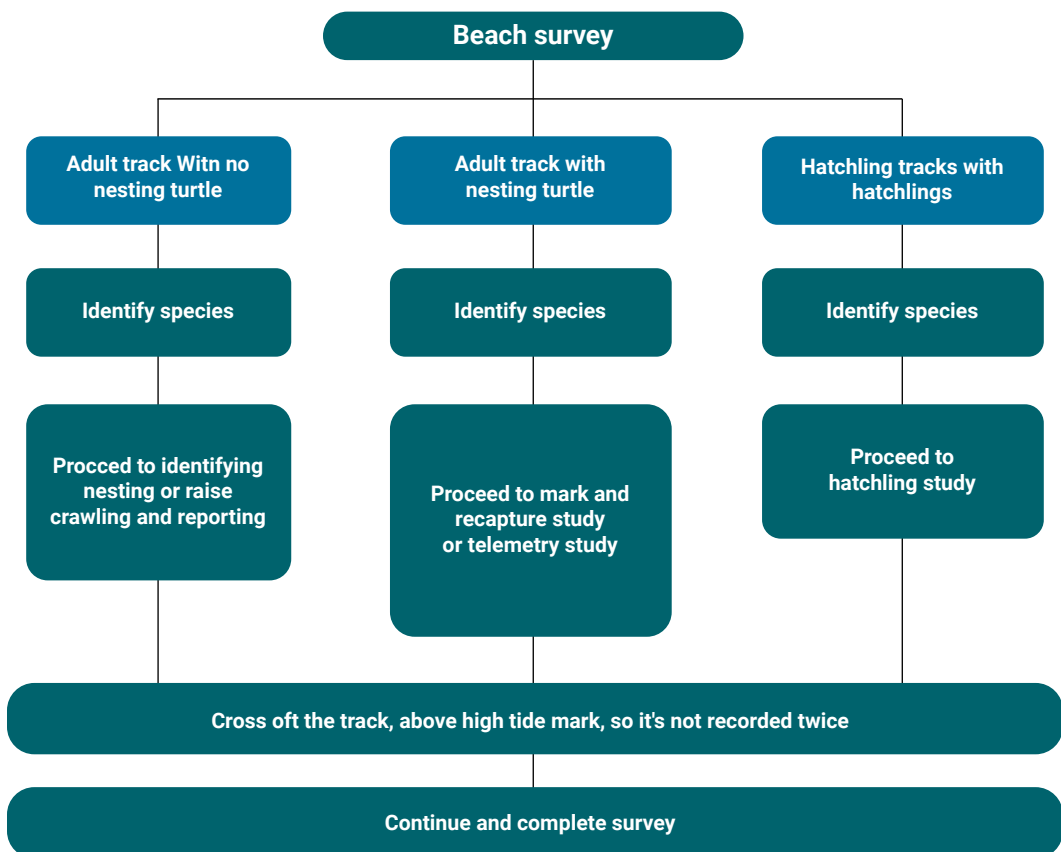
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MONITORING METHODS

The methods used to monitor turtle populations can vary significantly depending on factors such as the country, specific location, objectives of the monitoring program, availability of trained personnel, allocated budget, and the accessibility of the area. Given the diversity of these factors, different monitoring approaches are employed to best meet the specific needs of each project. Below are some of the more commonly used methods for monitoring sea turtles, each of which can be tailored to suit specific objectives and constraints.

The methodologies outlined here are primarily based on those used in northern Western Australia to monitor Flatback Turtles (*Natator depressus*), where routine, large-scale, and long-term turtle monitoring programs are implemented. These approaches can be adapted and applied to local contexts. Following figure provides a basic breakdown of different surveys conducted based on tracks and animals encountered during a beach survey.



Different survey paths based on the tracks and animals encountered



NESTING BEACH MONITORING

Nesting beach monitoring is essential for evaluating turtle nesting attempts, primarily through track counts and direct observations of nesting behavior.

Turtle track and nest surveys can be conducted during the day as a standalone activity or at night in combination with mark-and-recapture surveys (Section 2.2). Daytime surveys offer better visibility and are most effective when conducted at first light in the morning. Early morning provides optimal lighting conditions, as the angle of the light casts shadows, making tracks easier to detect. Additionally, the cooler temperatures in the morning make it a more comfortable time for conducting surveys. Surveys can be carried out on foot or using all-terrain vehicles, particularly on long beaches, as has been done in some parts of the world.



Turtle tracks as seen in drone imagery

© Ruchira Somaweera

SITE SELECTION

Before initiating a turtle monitoring or protection program, it is essential to gather basic information about the nesting population on the targeted beaches, such as whether turtles nest there regularly, and the rough number of individuals involved. If such information is unavailable, conducting a pilot study is crucial to identify areas with the highest nesting densities. This can be efficiently done using drones during morning hours, preferably at low tide, to observe and count visible tracks and determine where they are most concentrated (Figure 8). Identifying beaches with a measurable amount of turtle activity is important for long-term monitoring, as beaches with very few or occasional nesting may not provide sufficient data for statistical analysis and identify long-term population trends. This could limit the effectiveness of management and conservation programs.



DIVIDING NESTING SITES

Each nesting site should be spatially divided into manageable subsections, which may vary depending on turtle nesting activity and accessibility. Typically, each subsection spans a few hundred meters, and a given beach may have multiple subsections Figure 9. For statistical analysis and modelling, this approach is preferred over studying a long stretch of beach as a single unit. The sections should be clearly marked using identifiable permanent markers (e.g., stakes, piles of rocks, etc.), with GPS coordinates recorded and mapped to ensure consistency over time. The GPS locations of the markers should be stored in the GPS units used during fieldwork.



Sub-sectioning a beach for surveys. The white dots are permanent markers on the beach and lines show imaginary boundaries of the subsections.

Sections should be prioritized based on turtle activity, ensuring that higher-priority subsections are monitored continuously throughout the season, if resources are limited. Continuity is critical for data analysis, as gaps in monitoring could compromise the quality of the data.

PREPARATION

Before monitoring begins, the project lead should assign each field staff member to a specific subsection. It is important for each team member to walk the entire designated subsection unless alternative arrangements have been made. The monitoring team should be provided with standard kits and clipboards. Each team is responsible for signing out the kits and checking their contents against a provided checklist to ensure all necessary items are present.



Monitoring Kit Contents:



Clipboard with datasets



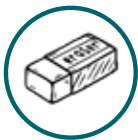
GPS



Camera (or mobile phone to take images)



Pencils



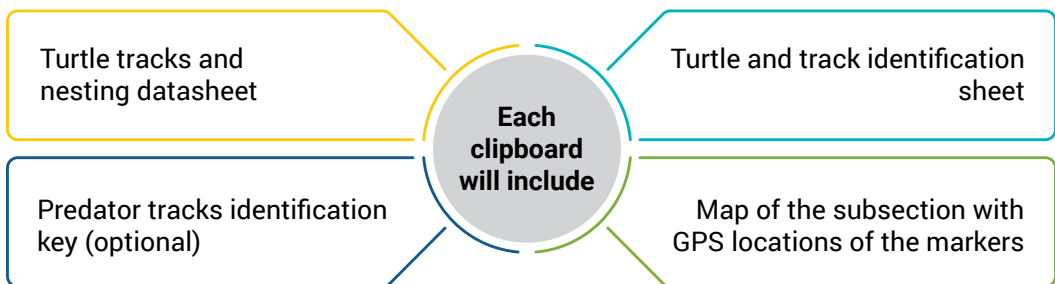
Eraser



Disposable gloves



Tape measure



MONITORING PROCEDURES

Preparing the Subsection

1. **Record details:** Document the field staff member names, date, starting time, and location name.
2. **Defining boundaries:** If surveying a subsection, draw an imaginary line perpendicular from the section marker to the water's edge (Figure 8). Do not include nests or tracks south of this line, as they are part of a different section.
3. **Start walking the beach:** Begin at the most recent high tide line. If the survey is combined with mark and recapture studies, monitoring should ideally take place 2-3 hrs before high tide until 2-3 hrs after high tide, when turtle nesting activity peaks. During this time (4-6 hrs) each field staff patrols the subsection assigned.



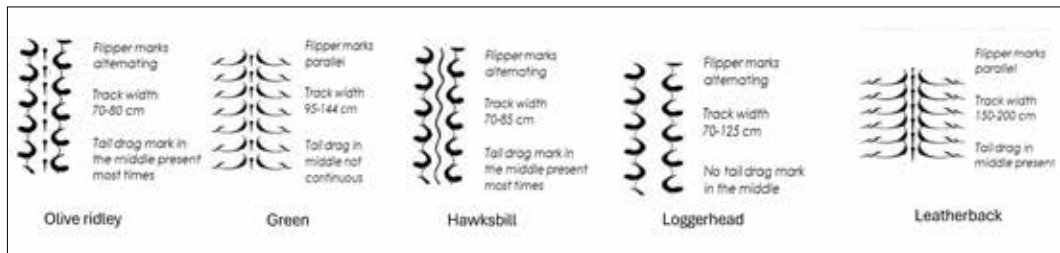
Identifying Travel Direction of Tracks

To distinguish between the incoming (emerging) track and the outgoing (returning) track, observe the direction in which the sand is pushed. The following five observations will help:

1. As a turtle crawls, it pushes sand backward with each flipper stroke.
2. The emerging track may be shorter than the returning track.
3. When tracks are overlapping, the returning track will be on top.
4. Sand is often thrown back over the emerging track at a digging site.
5. Arrow theory: For green turtles, draw a line along the angle of the front flipper mark to the center of the track to find the direction of travel.

Identifying the Species by Track Type

Follow the clearest parts of the turtle track to identify the species. Bangladesh is home to five species of marine turtles, but only three species are known to nest on Bangladeshi beaches (see Section 1.1), each with distinct track patterns, as illustrated in Figures 2-6). Additionally, the width of the track (measured between the outer edges of the marks) can provide further indication of the species.



Source: DBCA (2023) Turtle monitoring field guide

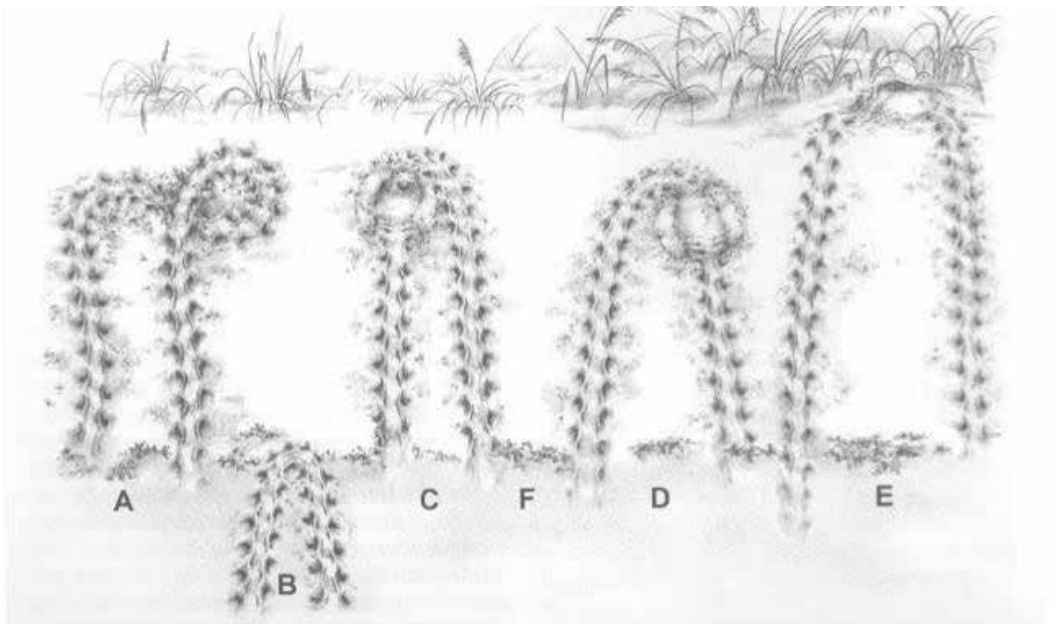
- Olive Ridley Turtle: 70–80 cm
- Green Turtle: 95–144 cm
- Hawksbill Turtle: 70–85 cm
- Loggerhead Turtle: 70–125 cm (average ~95 cm)
- Leatherback Turtle: 150–200 cm

If in doubt, take a photograph for later identification. When photographing a turtle track, position the clipboard across the track with the ruler on the landward side. Ensure the camera is facing landward when taking the photo. Record the photograph frame numbers on the datasheet.



Determining Nesting or False Crawls

- When walking along the beach, once a track is encountered, it should be followed to determine whether a female is nesting at the end or if the track leads back to the water.
- On many occasions, turtles may crawl onto the beach and return to the water without nesting (false crawls), or they may dig to test a location but not lay eggs (false diggings) (Figure 10). Since these are still considered nesting attempts, the GPS location of any false crawl, along with the species, should be recorded.



False crawl made (A, B) by a turtle where the female has returned to the water without nesting. Source: IUCN/SSC Marine turtle Specialist Group. Research and management techniques for the Conservation of Sea Turtles.

- A GPS location should only be recorded at one point (ideally at the downward track near the high-water mark) per track.
- A nest should only be marked if a female is observed actively laying eggs. Digs and mounds without should not be recorded as nests unless eggs are observed inside.
- Once a track has been checked, cross it off with a line in the sand (by dragging the foot deeply across both the upward and downward tracks) to avoid duplication in reporting. In areas with heavy nesting activity, cross tracks in several places to prevent confusion.



Position of Nest on the Beach

Record the position of the nest by identifying one of four zones on the beach:

1. Intertidal (I): Below the high-water mark, up to the high tide line.
2. High Water Mark to Vegetation (H): From the high tide line to the edge of the vegetation.
3. Edge of Vegetation to Base of Dune (E): From vegetation to the base of the fore dune.
4. Base of Dune and Beyond (D): From the base of the fore dune inland.

For a nest on the boundary between two zones, choose the position closest to the sea.

Record the location of the nest.

1. Turn on the GPS and allow it to acquire satellite signals.
2. Ensure the GPS is accurate within 0–8m and set to pre-agreed coordinate system, consistent across all subsections/ sites.
3. Hold the GPS over the egg chamber and record the coordinates.
4. Write the coordinates as well as the waypoint number on the datasheet.
5. Save the record on the GPS.

NOTE. If eggs are to be counted for additional studies, refer to Section 2.4.2 for detailed instructions. In such cases, it is recommended to mark the nest by inserting a small rope or colored tape into the egg chamber, ensuring that it extends to the beach surface. The other end of the rope or tape should be attached to a stake. This method will facilitate the identification and location of the nest during future studies, such as nest success surveys that may require excavation of the hatched nest.

Fate of the Nest

- Predated nests may have yolk eggshells or partially consumed eggs scattered around. Any damage to the nest due to predators (e.g., monitor lizards, jackal, mongoose) should be documented with a detailed description, including prints or other evidence.
- A hatched nest can be identified by hatchling tracks fanning out from the emergence crater. If hatchlings are still present or there are empty eggshells, record the location and any species identification.

MARK AND RECAPTURE SURVEYS

Mark and Recapture is a population sampling technique used to estimate the size of turtle populations. Marine turtles can be individually marked using flipper tags and/or Passive Integrated Transponder (PIT) tags and then recaptured at a later stage (e.g. next nesting season). The process involves two stages:



- 1. Tagging Phase:** A random sample of turtles is initially captured and tagged.
- 2. Recapture Phase:** A second random sample of turtles is captured. Some will already have tags, while others will not. This data is then analyzed using a mathematical equation to estimate the total population size.

In addition to population estimates, Mark and Recapture studies provide valuable insights into growth and survival of individual animals, nesting biology, residency etc. Tagging is most commonly, and easily, done on nesting beaches but can also be conducted at foraging grounds, where turtles are caught from boats.

MONITORING EQUIPMENT

To ensure the availability and readiness of all required materials, standard monitoring kits and clipboards should be provided to each field team.

- Flipper tags and tagging pliers
- PIT tags, applicator (if relevant) and scanner
- Long-nosed pliers
- Tape measures
- Pencils, sharpener, and eraser
- Gloves
- Paint marker pen or spray paint
- A container to dispose PIT tag applicators

Each clipboard contains:

- Tagging datasheet
- Turtle and track identification sheet
- Map of the monitoring subsection
- Attached pencil and ruler

Ensure that all equipment is regularly calibrated and in proper working condition before use.



Examples of PIT tag applicators, tags and readers © Ruchira Somaweera



TAGGING PROCEDURES

Preparing the Subsection

1. **Inventory Tags:** Record the number of tags in the kit. Ensure all tags are accounted for. This is ideally done before heading to the field.
2. **Record Information:** Log the field staff member's name, date, time, and subsection name.
3. **Survey Boundary:** If surveying a subsection, use an imaginary line from the marker to the water's edge, excluding turtles south of this line. If the marker is missing, use GPS coordinates to delineate the section boundary. Report missing markers to the coordinator.
4. **Begin Survey:** Start walking the beach.

Locating and Approaching Turtles

1. **Survey Conditions:** Walk along the beach using low-intensity lights, avoiding shining lights directly into the water or over the beach to prevent disturbing the turtles. In most parts of the world, red lights are used when working with turtles at night.
2. **Approach:** If a turtle is emerging from the water, stay still or slowly retreat until the turtle is further up the beach. If a turtle track is found, follow it and approach from behind.
3. **Optimal Tagging Time:** Species identification, checking for tags, and tagging should be done during egg-laying or after egg-laying when the turtle is least sensitive to handling.
4. **Handling Equipment:** Keep tools in a bag or tool belt, or place them at a safe distance from the turtle to avoid interference.
5. **Turtle Identification:** Look for any drag lines along the track to avoid disturbing or re-recording a previously recorded turtle.
6. **Nesting Phase:** Confirm the species and the nesting phase (e.g., laying or post-laying) and record on the datasheet.

Checking for Tags

Checking for tags should ideally be done when the female is laying eggs (during her trance-like state), when she is covering the nest, or while she is returning to the water.

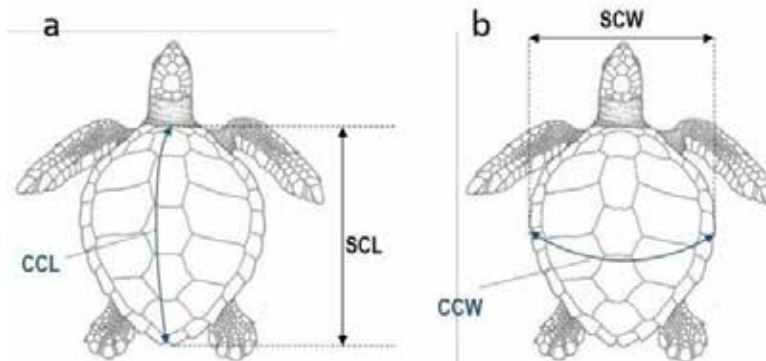
1. **Flipper Tag Check:** Quietly approach the turtle from behind and inspect the area along the rear margin of the front flippers for any flipper tags (Figure 11). Some turtles could have filler tags on their rear flippers too.
2. **PIT Tag Scan:** Use the PIT tag scanner over the turtle's body (the standard place to PIT tag are the shoulders), scanning at different angles. If a tag is found, record the tag number (Figure 13). If no tag is detected, continue scanning until the "no tag found" message appears.



3. **Record Tag Numbers:** Write down the tag number accurately and clearly, ensuring there are no errors.

Measuring and Inspecting the Turtle

1. **Preparation:** Using the pliers (or a scraper), clean barnacles from the centerline of the carapace to ensure accurate measurements.
2. **Measurements:** Measure curved carapace length (CCLmin) and curved carapace width (CCW).
 - CCLmin: Measure along the midline of the carapace from the nuchal scute to the posterior notch.
 - CCW: Measure across the widest part of the carapace, adjusting the tape to find the widest point.
3. **Accuracy:** Record measurements to the nearest millimeter, and ensure they are verified by another team member if necessary.
4. **Additional Observations:** Check for injuries, fibropapillomas (tumors on face and skin), and other notable features, and record them on the datasheet.



Measuring the carapace of a turtle © DBCA and online sources



Restraining a Turtle

Restrain the turtle only if necessary. If restraint is required, cover its eyes while ensuring the nostrils remain exposed and gently guide the head into the carapace. Be cautious when positioning your hands near the turtle's mouth, as it may bite in self-defense. Turtles are strong, so multiple individuals may be needed to assist in restraining a single turtle.

1. Approach the turtle from the front, kneeling on the ground while being mindful of any hazards such as rocks.
2. Place one hand on the carapace and the other on top of the turtle's head, fingers pointing upward and away from the mouth. Gently push the head back into the carapace using your body weight, keeping arms and knees away from the mouth.
3. Ensure all body parts, especially hands and feet, are kept as far from the turtle's mouth as possible, remaining directly in front of the turtle to avoid contact with the front flippers.
4. If the turtle moves too close or the restrainer feels uncomfortable, retreat carefully without placing hands near the head. Repeat the process if necessary.

Tagging a Turtle

Tagging should be carried out in accordance with a national or regional plan, ensuring that standard tags are issued for the program. Haphazard tagging without central coordination may complicate long-term projects, as the identification of turtles may not be shared across regions or projects. Flipper tags typically include the program name and an ID number. It is essential to first confirm whether an existing regional tagging program is underway and to understand the tagging standards in use.

Once these details are clarified, animals may be marked with either PIT tags and/or flipper tags. Flipper tags have the advantage of being easily readable without equipment, but they are prone to being lost or falling off. In contrast, PIT tags are more permanent and less susceptible to damage, though they require a scanner to be read. Using a combination of both tagging methods would enhance the security and reliability of long-term monitoring programs.

Procedure for Applying a PIT Tag to a Turtle:

1. Pre-Tagging Checks:

- Scan the new PIT tag packet before opening to ensure it's functional.
- Confirm the number on the scanner matches the number on the PIT tag.
- Ensure the PIT tag needle is securely attached to the applicator.

2. Restrain Turtle (if needed):

- Restrain the turtle as required (refer to Section 2.2.2.5).



3. Locate Application Site:

- Identify the application site on the shoulder, approximately one finger width below the carapace, between the neck and flipper.

4. Tagging Process:

- Face the turtle, ensuring feet are away from the head.
- Hold the needle horizontally.
- Ensure the turtle is stationary (e.g., during nest covering or returning to water).
- Insert the needle swiftly and confidently into the shoulder muscle, maintaining a horizontal angle (Figure 16). Avoid tagging from behind.
- Depress the plunger quickly to deploy the PIT tag.
- Withdraw the needle carefully, ensuring no movement inside the turtle.
- Dispose of the syringe and needle into a closable container.

5. Verify and Record:

- Scan the turtle with the PIT tag scanner to verify successful deployment.
- Ensure the tag number matches the datasheet and record it.



Inserting a PIT tag in to the shoulder of a turtle



6. Documentation:

- Attach the PIT tag sticker (if available) to the datasheet.
- If no PIT tag is detected after application, check surrounding sand, needle tip, or wrapper. Record and mark as "dud" if needed, and apply a second tag if required.

Procedure for Applying a Flipper Tag to a Turtle:

1. Tag Selection and Preparation:

- Select the appropriate tag and record the tag number on the Tagging Datasheet. Tags should be applied in sequential order (lowest to highest).
- Ensure the tagging pliers are free of sand. Place the tag into the pliers and keep the second tag ready if required.



Applying a flipper tag to a turtle © Ruchira Somaweera

2. Restraint:

- Restrain the turtle if necessary (refer to Section 2.2.2.5).

3. Tag Application:

- Check the pliers orientation and ensure the tag is positioned correctly.
- Extend the front flipper to avoid unnatural alignment of the skin and tissue.



- Align the tag over the largest scale on the trailing edge of the front flipper, near the body. If the first large scale is unsuitable (e.g., damaged), use the other flipper or the second large scale, but make sure this procedure is consistent across sites.
- Position the tag 3-5 mm from the trailing edge of the flipper.
- Firmly squeeze the pliers to close the tag securely. Ensure the piercing end is through the hole, no sharp edges are felt, and the tag is properly fixed (Figure 17).
- If the tag is not secure, remove and reapply a new tag. Only attempt this twice, then release the turtle.

4. Verification:

- After tag application, re-read the tag number to the recorder to verify accuracy.
- Confirm the tag number matches the datasheet.
- If any tags are damaged, record the tag number and remove the damaged tag from the project.

Check Recorded Data

Ensure that all data is clearly and accurately recorded, including tag numbers, species, measurements, and observations before the turtle is left. Incomplete or illegible forms should be corrected.

SATELLITE TELEMETRY STUDIES

Satellite transmitters and data loggers are integral to advancing our understanding of turtle life cycles and supporting conservation efforts. These devices capture essential data, including location, surfacing intervals, ambient temperature, swim speed, dive depth, dive duration, and activity patterns. The following guidelines provide a comprehensive overview of the equipment, preparation, and procedural steps for deploying satellite tags on turtles.

Satellite tags are manufactured by various producers, each with distinct deployment procedures. It is imperative to always consult the specific manufacturer's guidelines for precise instructions. The following procedure is based on trackers produced by Wildlife Computers®, which were deployed in Bangladesh in January 2025.



TRACKING EQUIPMENT

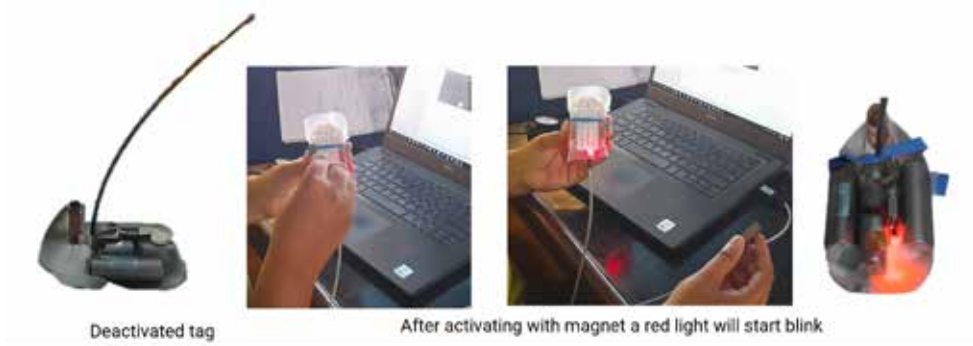
A typical satellite tagging kit includes the following items:



1. Plastic Tub/Wooden Box – Large enough to contain the turtle during the process to restrict movement; collapsible/foldable boxes are preferred.
2. Bright-colored Electrical Tape – For covering the sensors on the satellite tag.
3. Soft Bristle Brushes – E.g., a strong toothbrush, to clean the carapace.
4. Acetone or Isopropyl Alcohol – For cleaning the carapace (acetone preferred).
5. Two-Part, Quick-Setting Marine Epoxy – For attaching the satellite tag.
6. Disposable Paper Mixing Cups – For mixing epoxy.
7. Wooden or Metal Sticks – For mixing epoxy in the cups.
8. Brushes for Applying Epoxy.
9. Fiberglass Cloth – For reinforcement during tag attachment.



10. 80 Grit Sandpaper – For preparing the carapace surface.
11. Towel and Cloths – For covering the turtle's head and cleaning the carapace.
12. Satellite Tracking Units – Ensure they are pre-tested and ready for deployment.
13. Knife – For any required cutting or adjustments.
14. Freshwater – For cleaning the turtle's carapace.
15. Anti-Fouling Paint and Brush – For the final coat after tag attachment.
16. Magnets – For assisting in the tag deployment process.
17. Scissors – For cutting materials as needed.
18. Scouring Pad – For cleaning surfaces before application.



STEP-BY-STEP DEPLOYMENT OF SATELLITE TRACKERS

Satellite tags are deployed on turtles according to standard operating procedures used internationally. The process involves several important steps to ensure the safety and comfort of the turtle while collecting accurate tracking data.

Preparation of the Turtle

1. Once located, move the turtle inside the plastic/wooden box in a natural prone position. Ensure the size of the box is appropriate for the size of the turtle.
2. Keep the turtle cool by providing shade. A wet cloth may be used to cover the turtle's head to keep it calm.
3. Team members should remain calm and work quietly to minimize disturbance to the turtle.



4. Check and record flipper tags, PIT tags, and any unique markings on the turtle. If it is new turtle, tag it as per Section 2.2.2.3.
5. Measure Carapace Length (CCLmin) and Width (CCW) as per Section 2.2.24.
6. Test the transmitter prior to deployment to ensure it is functioning correctly
7. Turn on the transmitter and record the date, time, and GPS location of the attachment.

Attachment of Tracker

Attachment methods depend on the species, with harness-based systems used for 'soft'-shelled species such as Leatherback Turtle, and adhesion methods used for hard-shelled species like Green, Hawksbill, Olive ridley, and Loggerhead turtles. Only the adhesion method, where the transmitter will be adhered directly to the carapace is discussed here.

The following procedure is based on the guidelines provided by the manufacturer for satellite trackers. While the process may be similar for other trackers, there may be slight variations specific to different models. It is essential to refer to the manufacturer's instructions for any unique requirements.

1. Prepare Fiberglass Cloth:

- Cut a rectangular or oval base 50% larger than the tag base.
- Cut two 1.5" wide strips, 50% longer than the tag's length.
- Cut two 1.5" wide strips, 50% wider than the tag's width.

2. Protect Sensors:

- Cover the wet/dry sensors on the tag with brightly colored tape.
- Remove the tape before releasing the turtle.

3. Calm the Turtle:

- Place a damp cloth over the turtle's eyes, ensuring the nares are not blocked.

4. Clean the Carapace:

- Use sea water and a scouring pad to clean the carapace.
- Dry thoroughly.



5. Select Tag Placement:

- Position the tag dorsally, centered near the head for optimal hydrodynamics.
- For smaller tags, consider a single-scut attachment on the second central dorsal scute.



Applying epoxy mix to attached Tag on carapace (Left), after drying the Epoxy applied antifoul paint on all tag and epoxy surface

6. Prepare Attachment Site:

- Sand paper the area where the tag will be placed (50% larger than the tag).
- Clean with acetone or IPA to maximize adhesion. Avoid touching after cleaning.
- Repeat sanding and cleaning twice.

7. Mix Epoxy:

- Mix the two part epoxy for 60 seconds.
- Apply a thin layer onto the carapace where the fiberglass base will be placed.

8. Apply Fiberglass Base:

- Lay the base fiberglass on the wet epoxy.
- Brush additional epoxy to thoroughly wet the fiberglass.
- Let it dry for 5-10 minutes.

9. Prepare Epoxy Putty:

- Knead the epoxy putty (three-quarters of the stick) for 2 minutes until uniform.
- Divide into two logs and apply to the bottom of the tag.



10. Position the Tag:

- Press the tag down firmly onto the carapace.
- Move it side-to-side to ensure even coverage and squeeze out excess putty.
- Add more putty to any gaps, smooth with a gloved finger.
- Let it set for 10 minutes.

11. Apply Epoxy Fiberglass Strips:

- Apply fiberglass strips over the epoxy putty across the back, sides, and front of the tag.
- Repeat until all sides of the tag are covered.

12. Paint with Anti-Fouling Paint:

- Once the epoxy is tacky, apply a coat of anti-fouling paint to the tag and surrounding epoxy.
- Do not paint over the sensors.

13. Final Steps:

- Remove tape from sensors and let the paint dry before releasing the turtle.

CASE STUDY: USING SATELLITE TELEMETRY TO UNDERSTAND MARINE TURTLE MOVEMENTS IN THE BAY OF BENGAL

As part of the project Updating Biodiversity Data of the Swatch-of-No-Ground (SoNG) Marine Protected Area for Knowledge-based Decision Making, IUCN Bangladesh deployed satellite transmitters on five marine turtles in 2025 to improve understanding of post-release movements and habitat use in the Bay of Bengal. Of these, four individuals provided sufficiently long and detailed tracking records to inform spatial ecology at regional scales.

Telemetry data revealed marked variation in movement strategies among turtles. Two individuals moved rapidly toward the eastern Bay of Bengal coastline, suggesting targeted use of coastal foraging habitats. In contrast, the remaining turtles followed broader, offshore movement paths, crossing large portions of the Bay of Bengal and spending extended periods within and around the SoNG region before continuing southward into deeper Indian Ocean waters. These contrasting dispersal patterns indicate that the SoNG Marine Protected Area functions as more than a static habitat. Instead, it appears to act as a dynamic ecological interface,



serving different roles for different individuals, ranging from a foraging area to a migratory waypoint linking coastal and oceanic habitats.

This case study highlights the value of satellite telemetry in revealing hidden connectivity between marine protected areas, coastal zones, and offshore ecosystems. Such information is critical for designing effective, scale-appropriate conservation measures for highly mobile marine species, particularly in regions where baseline movement data have historically been limited.

NEST EXCAVATION AND HATCHLING MEASUREMENTS



A hatchery guard collects sea turtle eggs from a nest

©GIZ BD/IUCN/CODEC/Md. Liakat Ali

To assess the reproductive success of sea turtles, determine the suitability of nesting beaches, and evaluate the health of nesting populations, several key metrics must be measured. These include the number of eggs laid, the size and weight of the eggs, incubation success, hatchling emergence, and the number of hatchlings that make it to the water. These data provide insights into clutch size, hatching success, and emergence rates. For these studies, nests are marked at the time of egg laying and then revisited for excavation to assess the fate of the nest a few weeks after the hatching season. This process provides data on how many of the laid eggs have hatched, been predated, or failed to hatch (based on what remains in the egg chamber during excavation).



SAMPLING EQUIPMENT

Each sampling kit includes the following items:

- Gloves
- Small calipers
- Brush or cloth
- Electronic balance (minimum accuracy of 0.5g)
- Plastic container
- Pen or pencil
- Ziplock bags
- Wipes for cleaning hands
- GPS unit
- Spare batteries
- Small shovel
- Flexible 2m measuring tape
- 25-100m flexible tape measure
- Bucket
- Rope

Note: All equipment should be routinely calibrated.

EGG MEASUREMENTS

This is done during egg laying or subsequently (within 2 hours of egg laying) if the nest can be safely excavated.

1. **Handling Eggs:** Always wear gloves and ensure your hands are free of chemicals (e.g., insect repellent). Choose ten eggs at random from each clutch. Avoid rotating the eggs, as this can lead to mortality. If egg handling is not completed within 2 hours of oviposition, the eggs should remain undisturbed for at least 25 days.
2. If not already recorded, document the female's tag number, and the date and time the nest was laid.
3. **Clean the Eggs:** Wipe off any sand from the eggs using a cloth or brush. This step ensures accurate measurement.
4. **Measure Egg Dimensions:** Hold the egg so that the shell is firm by gently pressing a finger against it to create a slight dimple. Use the calipers to measure the largest and smallest diameters. The smallest diameter is typically located 90 degrees to the axis of the largest diameter but may vary. Record both values and calculate the average diameter by adding the largest and smallest diameters, then dividing by two.
5. **Weigh the Eggs:** Use an electronic balance to weigh the egg with a minimum accuracy of 0.5g. Record the weight.



6. **Mark Eggs (if necessary):** If needed, mark the eggs with a soft, blunt pencil or ink-based marking pen.
7. Carefully return the eggs to the nest after measurement.
8. **Insert a Nest Tag:** If the nest will be excavated later, insert a nest tag. The label should contain the female's tag number, the nesting date, and be written in permanent ink. Attach the tag to a small rope or colored tape into the egg chamber so that it extends to the beach surface. This will help locate the clutch after the turtle finishes laying eggs.
9. Record the nest's GPS position, mark the location with poles.

NEST EXCAVATION

1. Nest excavation should ideally be conducted after the incubation period (approximately 60 days for Olive Ridley turtles), when there is a high likelihood that most hatchlings have either emerged from the nest or are in the process of emerging.
2. **Locate the Nest:** Use the recorded GPS coordinates and nest markers (e.g., poles) to locate the marked nest. Begin excavation once hatchlings have emerged from the nest.
3. Always wear rubber gloves during excavation. Be cautious not to disturb any adjacent clutches that are still incubating.
4. **Record Nest Depth:** Measure the depth from the sand surface to the top of the nest using a tape. Record this depth.
 - Examine and Categorize Nest Contents
 - E (Emerged): Hatchlings that have left the nest. Live hatchlings just below the surface (i.e., not trapped by debris) should be counted as successful in reaching the beach.
 - S (Shells): Count empty shells (those that make up more than 50% of the egg size). Do not count shell fragments.
 - L (Live in Nest): Live hatchlings still in the nest among the shells.
 - D (Dead in Nest): Hatchlings that have left their shells but are deceased.
 - UD (Undeveloped): Unhatched eggs with no visible embryo.
 - UH (Unhatched): Unhatched eggs with visible embryos.
 - UHT (Unhatched Term): Full-term embryos in the eggs that have not hatched, often showing pipping (with a small amount of yolk remaining).
 - P (Depredated Open): Nearly complete shells with egg residue, typically showing holes or small tears, indicating predation.



HATCHLING MEASUREMENTS

If hatchlings are still present in the nest or emerging, a sample may be taken for measurement.



Hatchlings emerging from eggs

©GIZ BD/IUCN/CODEC/Abdul Mojib

1. **Select Hatchlings for Measurement:** Choose ten hatchlings from the clutch that have emerged naturally from the nest. Do not select hatchlings that have been captured after entering the sea or those that remained in the nest.
2. **Measure Straight Carapace Length (SCL):** Use calipers to measure the straight carapace length from the nuchal scale (anterior midline) to the posterior notch between the supracaudal scales. Be careful not to distort the shape of the shell, as hatchling shells are very flexible. Record the lengths.
3. **Weigh the Hatchlings:** Weigh the same 10 hatchlings using an electronic balance with a minimum accuracy of 0.5g. Weighing should be performed out of the wind to ensure accuracy. Record the weights.
4. Release the hatchlings as soon as possible, ideally on the same day. They should not be held overnight.



NEST PROTECTION AND PREDATOR CONTROL

If nests at a given monitoring beach have been consistently disturbed by predators such as monitor lizards, jackal, mongoose etc. early in the nesting season, it is likely that this issue will persist throughout the season. Developing a method for protecting the nests or controlling the predators is essential for safeguarding the future of the monitoring beach and increasing the survival rate of hatchlings.

PLANNING AND SITE SELECTION

If predation has been observed at the nesting beach, it is crucial to develop a comprehensive plan to mitigate these impacts. You can choose to either protect individual nests or address the predator issue directly, but a combination of both strategies is often the most effective approach.

- Protecting as many nests as possible with meshing is ideal, but this may be constrained by available resources. Strategic planning is essential when selecting nests for protection. Focus on areas with higher predation risk and ensure meshing covers the egg chamber accurately.
- When selecting predator control methods, consider factors such as the beach layout, the types of predators causing the most damage, and the characteristics of the site. Predator control methods should be chosen based on the target species, predator density, local wildlife management laws, site size, and accessibility, among other factors. This topic is not discussed in this manual.

NEST PROTECTION TECHNIQUES

Nest protection is best achieved through the use of mesh to cover the egg chamber, securing the mesh with four PVC pegs at the corners. The following steps outline this method:

1. Mesh Selection:

- Use nylon-coated wire garden mesh with 10 cm² squares, which is effective against larger predators like jackals, dogs and pigs.
- Olive ridley turtles, which often lay shallow clutches, benefit particularly from meshing. The egg chamber's precise location should be identified to ensure the mesh is applied effectively.

2. Mesh Size:

- Mesh should cover an area of approximately 1.5 x 1.5 meters, depending on the nest size.



3. Mesh Application:

- Secure the mesh over the egg chamber by pegging the four corners to the ground, ensuring the mesh does not move and that predators cannot access the eggs.

4. Alternative Protection Method:

- In some cases, such as with monitor lizard predation, garden mesh may not be sufficient, as goannas can fit through the mesh squares. In these instances, specially designed aluminium cages with escape slots for hatchlings have been successful in preventing predation.

CODE OF CONDUCT

When interacting with nesting turtles, it's crucial to respect their behavior and environment to ensure minimal disruption. The following guidelines will help ensure the safety and well-being of the turtles while allowing for meaningful observation:

ADULT NESTING TURTLES

1. Arriving on the Beach

- Upon arrival, allow your eyes to adjust to the available moonlight.
- Stand quietly with minimal movement, as turtles have highly sensitive vision and are more responsive to movement than noise.

2. Searching for Turtles

- Walk along the beach just below the high tide mark near the water, where footprints will be washed away by the tide. Look for turtle tracks in the wet sand or observe turtles from a distance.

3. No Lights or Flash Photography

- Do not use any bright white lights, including torches, or flash photography as these can disturb the turtles. Red lights are the standard.
- If you encounter a turtle, remain calm, stop where you are, sit down, and stay still while waiting for the turtle to start digging. This is called the "Stop, drop, rock" method.



4. Minimize Noise and Movement

- Avoid making noise and sudden movements at all times, as these can startle the turtle and disrupt nesting.

5. Approaching a Nesting Turtle

- Always position yourself behind the turtle and remain low to the ground. Sitting, crouching, or lying on the sand will ensure you don't get too close. If you are getting covered in sand as the turtle digs, you are too close.

6. Patience is Key

- Be patient if the turtle abandons the nest to dig another one. Turtles may abandon a nest for reasons such as hitting an obstacle or if the sand is too dry.

7. Wait Until Egg Laying

- Wait until the turtle is actively laying her eggs before moving closer. A turtle is still in the process of nesting if she is using her flippers or spraying sand. She will be still while laying eggs.

8. Respect the Nesting Process

- Ensure that the turtle has enough space to camouflage the nest after laying eggs.
- Do not interfere with the turtle's ability to return to the ocean.

9. Allow the Turtle to Return Uninterrupted

- Let the turtle return to the ocean without obstruction. Never get between her and the water.

EMERGING HATCHLINGS

The emergence of hatchlings from the nest to the sea is a critical phase in their development. It is essential not to interfere with this process in any way to avoid disrupting their natural behavior and development. The following guidelines will help ensure the safe passage of hatchlings:

1. Stand Back from the Nest

- Avoid standing too close to the nest to prevent compacting the sand and hindering the hatchlings' movements.

2. No Lights or Flash Photography

- Refrain from using lights or flash photography, as this can disorient the hatchlings during their emergence.



3. Do Not Touch Hatchlings

- Never handle or touch the hatchlings (unless as a part of a measuring study), as this can cause harm and disrupt their natural development.

4. Avoid Blocking the Path to the Ocean

- Never stand between the hatchlings and the ocean. Allow them to follow their natural path to the water.

5. Let Hatchlings Move on Their Own

- Allow hatchlings to make their own way to the ocean. This journey helps them exercise their lungs and prepares them for survival in the wild.

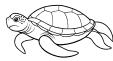
6. Avoid Crossing Hatchling Paths

- Hatchlings can become stuck in footprints. Stand to the side to allow them to move freely without obstruction.



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