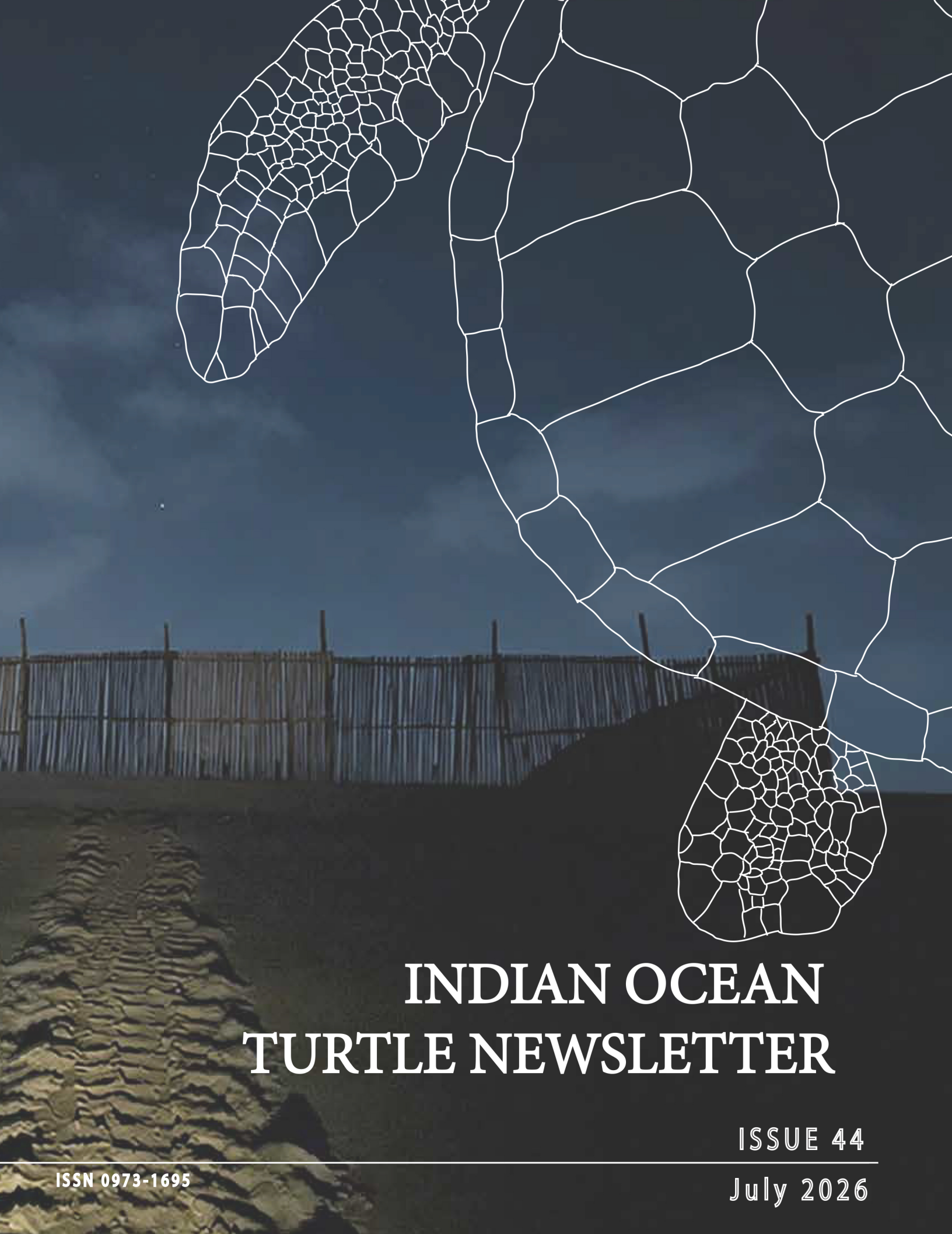




INDIAN OCEAN TURTLE NEWSLETTER

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The Indian Ocean Turtle Newsletter was initiated to provide a forum for exchange of information on sea turtle biology and conservation, management and education and awareness activities in the Indian subcontinent, Indian Ocean region, and south/southeast Asia. The newsletter also intends to cover related aspects such as coastal zone management, fisheries and marine biology.

The newsletter is distributed free of cost to a network of government and non-government organisations and individuals in the region. All articles are also freely available in PDF and HTML formats on the website. Readers can submit names and addresses of individuals, NGOs, research institutions, schools and colleges, etc. for inclusion in the mailing list.

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EDITOR'S NOTE

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Welcome to IOTN44, which includes articles on different threats to sea turtles. The first article reports on dead turtles from the southwest coast of India and the rescue of a live turtle found entangled in abandoned, lost, or discarded fishing gear associated with a fish aggregating device. This article also tests the use of DNA barcoding for species identification for species identification of decomposed turtles.

With microplastic pollution an emerging threat on nesting beaches, our second article compares the efficiency of different salt solutions in isolating particles from sand samples in India and presents preliminary data

on the abundance in surface sand. Next, The Students Sea Turtle Conservation Network (SSTCN) shares its annual turtle diary describing the highs and lows, which include high nest temperatures and many stranded turtles, during their 2026 nesting season.

In more optimistic news, IOTN44 also includes a note describing the sighting of a rare leatherback turtle in the Lakshadweep Archipelago. We report on the recent 44th International Sea Turtle Society Symposium in Hawai'i and announce the 45th symposium will be held in South Africa, which is closer to home for most IOTN readers.

CALL FOR SUBMISSIONS

The Indian Ocean Turtle Newsletter was initiated to provide a forum for the exchange of information on sea turtle biology and conservation, management and education and awareness activities in the Indian subcontinent, Indian Ocean region, and south/southeast Asia. If you would like to submit a research article, project profile, note or announcement for Issue 45 of IOTN, please email material to iotn.editors@gmail.com before 31st November 2026. Guidelines for submission can be found on the last page of this newsletter or at <http://www.iotn.org/submission/>.

ARTICLES



RESCUE AND POST-MORTEM IDENTIFICATION OF SEA TURTLES ON THE SOUTHWEST COAST OF INDIA

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INTRODUCTION

Sea turtles, as contemporary representatives of an ancient lineage of marine reptiles, offer unique insights into evolutionary history and adaptation. Their ecological roles as grazers, predators, and nutrient transporters make them keystone species vital to the structure and resilience of marine ecosystems (Hamann *et al.*, 2010). Globally, seven species of sea turtles are recognised, of which five occur in Indian waters: olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and leatherback (*Dermochelys coriacea*) turtles (Shanker & Pilcher, 2003). Only three species nest regularly in India. Olive ridley turtles demonstrate synchronised mass nesting events (“arribadas”) in Odisha (Shanker *et al.*, 2004) and the Andaman and Nicobar Islands (Namboothri *et al.*, 2015) and display solitary and sporadic nesting along the coastline of Andhra Pradesh and other states (Tripathy *et al.*, 2003). Green turtles predominantly nest in the state of Gujarat and on some offshore islands (Venkatesan *et al.*, 2004; Sunderraj *et al.*, 2006). Leatherback turtle nesting occurs in the Andaman and Nicobar Islands (Andrews & Shanker, 2002; Swaminathan *et al.*, 2011).

All sea turtles face severe anthropogenic pressures, including bycatch, entanglement in abandoned fishing gear, coastal development, light and other pollution, vessel strikes, and ingestion of marine debris (Fuentes *et al.*, 2023). Turtles that have been injured or killed by any of these threats are often found floating at sea or washed ashore, alive or dead. Accurate species identification of dead turtles is important for effective monitoring and management. Morphological traits such as carapace shape, number of carapace scutes, and number of prefrontal scales are typically used for identification (Wyneken, 2001). However, advanced decomposition and/or external damage can obscure these features. In such cases, molecular tools like mitochondrial

cytochrome c oxidase subunit I (COI) barcoding can provide robust species identification and strengthen stranding datasets (Naro-Maciel *et al.*, 2010).

In this study, we report on dead sea turtles from the southwest coast of India and the rescue of a live turtle found entangled in abandoned, lost, or discarded fishing gear (ALDFG) associated with a fish aggregating device (FAD). We employed an integrated approach combining detailed morphometric analyses with DNA barcoding for species identification and confirmation. Furthermore, we document the epibionts on a green turtle and interpret these observations within both biological and ecological contexts.

METHODS

Field surveys were conducted along the southwest coast of India from 2024 to 2025 as part of a marine mammal and sea turtle monitoring programme. During this period, three sea turtle encounters were recorded. On 15th October 2024, two olive ridley turtles were encountered: one dead individual (9° 13.9' N, 76° 17.8' E) and one live individual entangled in ALDFG (9° 13.9' N, 76° 17.9' E). Additionally, one dead green turtle was encountered off Kochi (09° 58.1' N, 75° 59.2' E) on 6th May 2025 (Figure 1). Morphological identification for all specimens was based on species-specific diagnostic traits following Pritchard & Mortimer (1999). Standard morphometric measurements were collected from all individuals following the protocols of Bolten (1999). Tissue samples were collected from the front flippers of the dead turtles using sterile scalpels and preserved in 95% ethanol for subsequent DNA extraction and molecular species confirmation.

Genomic DNA was extracted using the DNeasy Blood and Tissue Kit (Qiagen, Germany; Cat. No. 69504) according to the manufacturer's instructions. The mitochondrial COI gene, a standard marker for species

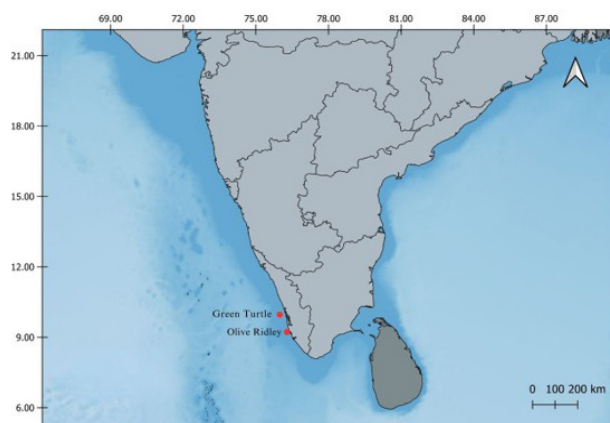


Figure 1. The Location of a Dead Green Turtle and Live and Dead Olive Ridley Turtles Examined in this Study.

identification, was amplified using primers: COI-F (5'-TCAACCAACCACAAAGACATTGGCAC-3') and COI-R (5'-TAGACTTCTGGGTGGCCAAAGAATCA-3') (Ward *et al.*, 2005). Each polymerase chain reaction (PCR) was performed in a 25 μ L Maxiamp PCR tube containing EmeraldAmp[®] GT PCR Master Mix (Takara Bio, Japan), molecular-grade water, the same primer pair, and template DNA. PCR amplification was performed on a SimpliAmp[™] thermal cycler (Applied Biosystems, USA) with standard barcoding cycling conditions. Amplified products were separated on a 1.5% agarose gel stained with ethidium bromide (EtBr) and visualised under ultraviolet illumination to verify amplicon size and integrity. Amplified products were purified and directly sequenced using the same primer pairs. The resulting sequences were compared against reference data in GenBank and the Barcode of Life Data Systems (BOLD) using BLASTn to confirm species identity. A maximum likelihood phylogenetic tree was constructed using the Tamura–Nei model with gamma-distributed rate variation (TN93+G). The freshwater turtle *Podocnemis unifilis* was included as an outgroup to validate tree topology.

RESULTS AND DISCUSSION

Morphological examination was used to identify the dead olive ridley and green turtles and the live olive ridley turtle found entangled in a FAD associated with ALDFG. The species of the dead turtle was also confirmed by molecular analysis. The dead green turtle exhibited external epibionts, notably *Chelonibia testudinaria*.

Morphological characteristics

The morphometric and morphological profiles of the three encountered sea turtles (Table 1) confirmed the species and indicated mature or immature life stages. The curved carapace length (CCL) and curved carapace width (CCW) for the olive ridley turtles fall within the documented sizes for adult populations along the Indian coast, where nesting and migratory adults typically exhibit a mean CCL of 60–70cm (Behera *et al.*, 2016). The size of the dead green turtle indicated a large sub-adult to emerging adult in the Indian Ocean where physiological maturity occurs between 85–90cm (Frazier, 1980; Wyneken, 2001).

Molecular species confirmation

DNA barcoding of the mitochondrial COI gene provided molecular confirmation of morphological species identification, with >99% similarity to reference sequences in GenBank and BOLD. The olive ridley and green turtle sequences were submitted to NCBI under accession numbers PV437215 and PX218923, respectively, and associated barnacle DNA sequences were also deposited (PX219660, PX226007). This congruence between morphology and genetics highlights the potential role for integrative approaches, particularly when decomposition or physical damage may obscure diagnostic traits (Naro-Maciel *et al.*, 2010).

Table 1. Morphometric data of live and dead sea turtles.

Curved Carapace Length (CCL), Curved Carapace Width (CCW), Total Body Length (TL), Head Length (HL), Curved Plastron Length (CPL), Curved Plastron Width (CPW), Right/Left (R/L). No data recorded (-)

Date	Turtle	Live/ Dead	CCL (cm)	CCW (cm)	CPL (cm)	CPW (cm)	TL (cm)	HL (cm)	Front	Back	# Vertebral Scutes	# Costal Scutes (R/L)	# Marginal Scutes
									Flipper Length (cm)	Flipper Length (cm)			
15 th Oct 2024	Olive Ridley	Dead	60.0	65.5	50.0	65.0	91.0	25.5	29.0	22.0	6	7/7	-
15 th Oct 2024	Olive Ridley	Live	64.0	62.0	-	-	-	28.0	34.0	-	8	-/7	-
6 th May 2025	Green	Dead	88.5	82.0	-	-	-	-	-	-	5	4/4	25–27

The maximum likelihood phylogenetic tree (Figure 2) constructed under Tamura–Nei model with gamma-distributed rate variation (TN93+G) resolved distinct, well-supported clades for each sea turtle species based on mitochondrial COI sequences. The sequences generated in this study (highlighted in blue) clustered within their respective species groups, confirming accurate molecular identification. *Chelonia mydas* samples grouped tightly with reference sequences (bootstrap=100), while *Lepidochelys olivacea* samples also aligned within their corresponding clades with strong support. The freshwater turtle *Podocnemis unifilis*, included as an outgroup, was clearly separated from marine turtle taxa, validating the tree topology.

Epibiont association and ecological insights

The dead green turtle exhibited a distinct macro-epibiotic settlement, characterised by the attachment of specialised turtle barnacles (*Chelonibia testudinaria*) across the carapace (Figure 4). *C. testudinaria* has been documented globally across all seven extant species of sea turtles, though its abundance patterns vary significantly by host species (Zardus & Hadfield, 2004). It is most heavily concentrated on loggerhead turtles (*Caretta caretta*), whose slower swimming speeds and rough carapaces provide an ideal settlement surface (Frick & Ross, 2001). Carapace colonisation by obligate commensals is widely documented in sea turtles, often serving as a biological indicator of prolonged pelagic residency or a decline in host health before mortality (Frick & Pfaller, 2013). While

C. testudinaria settlement is common among healthy foraging populations, excessive macro-epibiont loads can reflect a compromised physiological state. For instance, in loggerhead sea turtles, heavy barnacle infestations are highly prevalent in individuals afflicted by Debilitative Sea Turtle Syndrome (DSTS), where chronic lethargy reduces the host's natural swimming speed and grooming efficiency, thereby facilitating larval settlement (Baruffaldi *et al.*, 2023). In this study, the presence of these macroscopic bio-indicators on the green turtle carcass provides a critical ecological context. It suggests a period of reduced vitality or a prolonged, slow-moving trajectory, either actively migrating or passively drifting, within coastal or pelagic zones. This finding underscores how epibiotic profiling can enhance our understanding of sea turtle health baselines and mortality factors along the southwest coast of India.

Entanglement in ALDFG

The active entanglement event and subsequent rescue of the live olive ridley turtle documented in this study is an example of the threat posed by FADs and ALDFG to sea turtles in Indian coastal waters. Modern synthetic netting materials resist degradation and can persist as marine pollution for years to decades, resulting in prolonged "ghost fishing" dynamics that continually entrap non-target marine wildlife (Thomas *et al.*, 2023; Zainul *et al.*, 2025). Along the southwest coast of India, including states like Kerala, traditional artisanal fishers frequently deploy specialised, floating FADs to

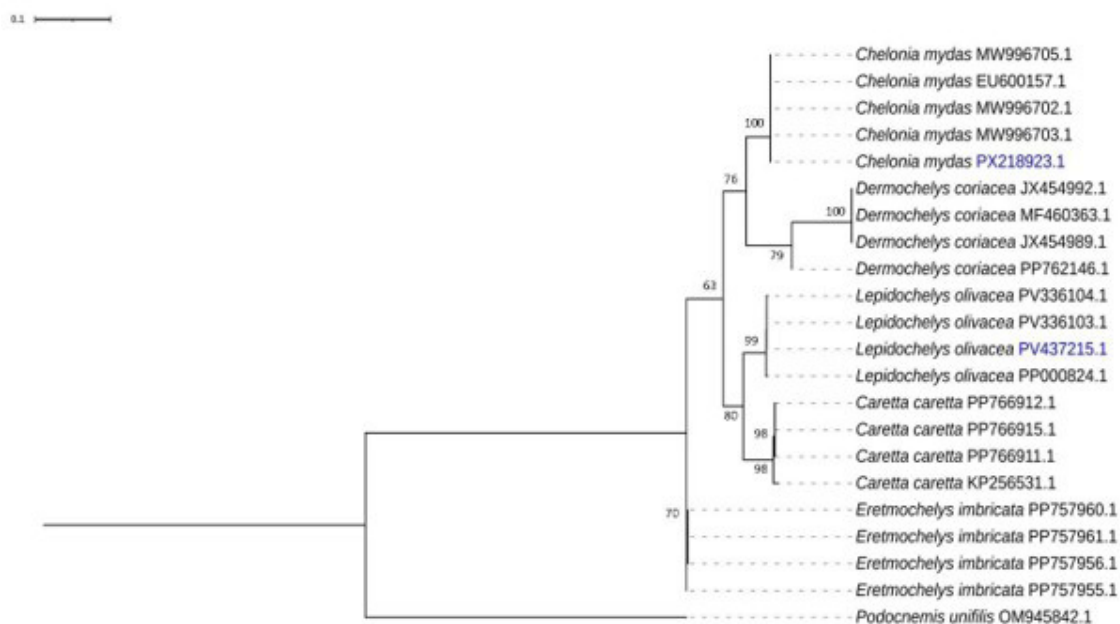


Figure 2. Maximum Likelihood Phylogenetic Tree of Study Sea Turtles Based on Mitochondrial COI Gene Sequences.

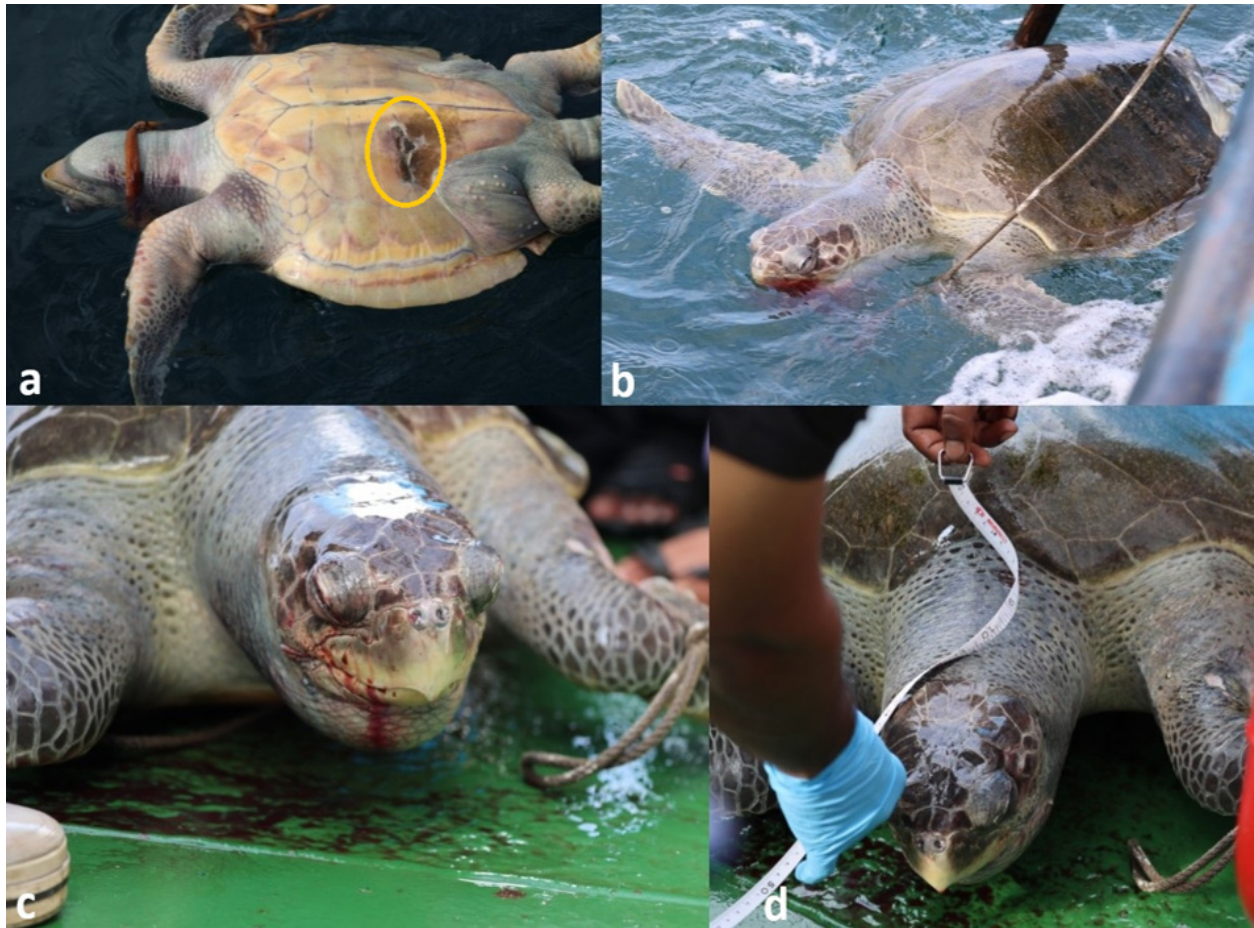


Figure 3. Dead Olive Ridley Turtle from the Southwestern Indian coast. a) Ventral View; Wound Outlined in Yellow. b) Floating Anterolateral View. c) Head, Dorsal Close-up. d) Measuring Turtle on Vessel Deck. (Photo credit: Vishnu C.B.)

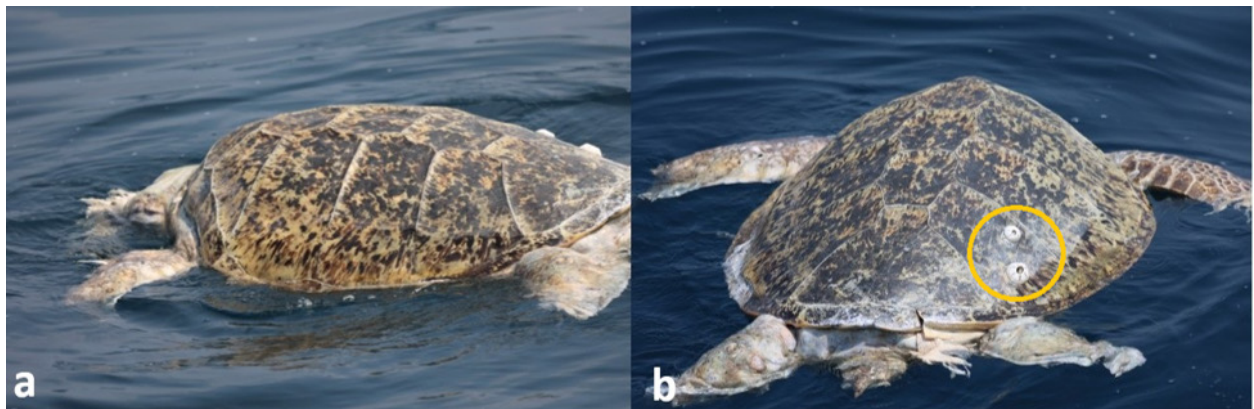


Figure 4. Dead Green Turtle from the Southwestern Indian coast. a) Lateral View of the Carapace. b) Posterolateral View with Two Macro-epibiotic Turtle Barnacles (*Chelonibia testudinaria*) Circled in Yellow. (Photo credit: Krishnapriya P.P.)

target cuttlefish. These configurations typically utilise inverted, biodegradable coconut spadices (fronds) to provide attractive, natural egg-laying substrates for cephalopods (Figure 5). However, to maximise efficiency, fishers often fix synthetic monofilament or gillnets directly around these organic structures. While

the core FAD components are biodegradable, these units can aggregate lost netting and synthetic marine debris over time. The combination of floating organic material and highly entangling synthetic mesh creates a cryptic, lethal hazard for marine megafauna; it is highly plausible that the live olive ridley rescued during this monitoring



Figure 5. Rescue of an Olive Ridley Turtle. a) Entangled in ALDFG Comprising Synthetic Netting, Structural Ropes, and Floating Plastic Bottles. b) Post-release Swimming Behaviour. c) FAD, the Coconut Spadices (Outlined in Yellow). (Photo credit: Zainul Abid P.M.)

period became entrapped within such a setup, a critical interaction that would have inevitably resulted in mortality without immediate human intervention. Managing ALDFG requires targeted, gear-specific conservation interventions and community-led ghost net mitigation frameworks.

CONCLUSION

This study documents dead olive ridley and green sea turtles along India's southwestern coast, using a reliable combination of morphometrics and morphological characteristics combined with DNA barcoding to confirm species identity. Incorporating these molecular methods makes regional wildlife monitoring more accurate when decomposition or physical injury makes it hard to identify a turtle species by its external features alone. Additionally, documenting entanglement in ALDFG highlights the human pressures these animals face in Indian waters. Our study demonstrates the information that could be collected by a long-term monitoring and stranding network on the Kerala coast.

ACKNOWLEDGMENTS

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EFFECT OF DENSITY SEPARATION SOLUTION ON ISOLATION OF MICROPLASTICS FROM SEA TURTLE NESTING BEACH SAND IN MAHARASHTRA AND GOA, INDIA

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INTRODUCTION

Microplastic pollution has emerged as a pervasive environmental issue affecting marine ecosystems worldwide (Thompson *et al.*, 2004). Defined as plastic particles smaller than 5mm, microplastics are commonly classified into two major categories based on their origin: primary and secondary microplastics. Primary microplastics are intentionally manufactured in microscopic sizes, for use in industrial and commercial applications (Cole *et al.*, 2011). These include industrial resin pellets or nurdles, cosmetic microbeads used in personal care products, synthetic textile fibres, and abrasive particles used in cleaning process (Andrady, 2011; Browne *et al.*, 2011). Secondary microplastics originate from the fragmentation and degradation of larger plastic debris already present in the environment. Common sources of secondary microplastics include discarded plastic bottles, fishing nets, packaging materials, plastic bags, and other consumer products that progressively breakdown into smaller fragments over time (Andrady, 2011) through physical, chemical, and biological weathering processes such as UV radiation, wave abrasion, mechanical friction, and thermal degradation (Thompson *et al.*, 2004; Wright *et al.*, 2013). Secondary microplastics are often irregular in shape and include fragments, films, foams, and degraded fibres, reflecting the characteristics of their source material (Cole *et al.*, 2011).

Both primary and secondary microplastics are persistent, light weight, buoyant, and small in size, enabling their extensive dispersal across coastal environments, particularly sandy beach sediments that function as important habitats for various marine organisms (Browne *et al.*, 2011; Wright *et al.*, 2013). These organisms include sea turtles, which use beach habitats for incubation of eggs to produce hatchlings. Microplastics in beach substrates may change physical, chemical, and/or thermal properties of the nest substrate (Estrella-Jordan *et al.*, 2023; Fuentes *et al.*, 2023) and, therefore, influence nest microclimate,

embryo development and survival, and hatchling sex ratios (given that the taxa demonstrate temperature-dependent sex determination). Hence, quantifying beach substrate microplastics and understanding the potential impacts is especially important, given ongoing concerns about the potential feminisation of sea turtle populations (Laloë *et al.*, 2024) and increased embryo (Santidrián Tomillo *et al.*, 2012; Hays *et al.*, 2017; Mollet Saint Benoit, 2019) and hatchling mortality (Laloë *et al.*, 2017; Hays *et al.*, 2021) with climate change. Understanding the likelihood and contribution of environmental pathways of microplastic accumulation in the sea turtle egg (Savoca *et al.*, 2018; Curl *et al.*, 2024) is required to assess the contribution of beach plastics to embryo exposure to particles and plastic-associated chemicals that may affect organ development, metabolism, immunity (Zhang *et al.*, 2021; 2024), sex determination, embryo development, and adult fertility, with potential long-term implications for population viability (Savoca *et al.*, 2018). Quantifying beach microplastics and understanding the impacts is also required to inform plans, policy, and legislation to manage current plastics loads and minimise the entry of additional plastics into the environment (e.g., Dijkstra *et al.*, 2021; Kumar *et al.*, 2021; Willis *et al.*, 2022).

Reliable detection and quantification of microplastics in beach sediments are, therefore, essential for understanding the extent of contamination and its ecological implications. Several methodologies have been developed for microplastic isolation from sediments, commonly involving sequential steps such as drying, sieving, density separation, organic matter digestion, filtration, and polymer identification (Hidalgo-Ruz *et al.*, 2012; Prata *et al.*, 2019). Density separation using a salt solution is one of the most widely applied techniques for isolating microplastics from sediments, as most plastic polymers possess lower densities than mineral particles in sediments, allowing plastics to float while heavier sediment grains

settle (Claessens *et al.*, 2011; Hidalgo-Ruz *et al.*, 2012; Masura *et al.*, 2015). Following density separation, the supernatant containing suspended microplastics typically undergoes vacuum filtration using fine filter membranes or glass fibre filters to retain the particles for further analysis. The filtered particles are visually inspected under a stereomicroscope or dissecting microscope, and suspected microplastics are identified and categorised based on their physical characteristics such as shape, colour, size, and texture (Nuelle *et al.*, 2014; Masura *et al.*, 2015). Visual inspection is an important preliminary step in microplastic analysis, as it enables synthetic particles to be distinguished from natural materials prior to polymer identification techniques such as Fourier Transform Infrared Spectroscopy (FTIR) or Raman spectroscopy (Hidalgo-Ruz *et al.*, 2012).

A variety of salt solutions have been used to separate microplastics from sediments, including sodium chloride (NaCl), zinc chloride (ZnCl_2), potassium carbonate (K_2CO_3), sodium iodide (NaI), sodium bromide (NaBr), and sodium hexametaphosphate (SHMP). Each solution differs in density, cost, and isolation efficiency (Imhof *et al.*, 2012; Claessens *et al.*, 2013; Patti *et al.*, 2020). Lower-density solutions such as NaCl ($\sim 1.2\text{g/cm}^3$) are inexpensive, non-toxic, and widely available, but may have less efficiency at isolating denser polymers such as polyethylene terephthalate (PET) and polyvinyl chloride (PVC) (Claessens *et al.*, 2011; Masura *et al.*, 2015). In contrast, high-density solutions such as ZnCl_2 , NaI, and NaBr can isolate a broader range of polymers more efficiently, although they are relatively more expensive and may involve greater handling, disposal, environmental, and safety concerns (Coppock *et al.*, 2017; Schütze *et al.*, 2022). Recently, K_2CO_3 has gained attention as a comparatively high-density and less hazardous alternative; however, its performance relative to other commonly used salts still requires further evaluation under field-relevant conditions (Gohla *et al.*, 2021).

As isolation efficiency is strongly influenced by the type and density of the salt solution used during extraction (Nuelle *et al.*, 2014; Coppock *et al.*, 2017), and different salt solutions can selectively recover different polymer types and particle sizes, recent studies comparing the efficiency of different salt solutions for microplastic isolation have highlighted the importance of selecting a solution based on sediment characteristics and target polymer types. Schütze *et al.* (2022) demonstrated that increasing solution density generally resulted in higher recovery rates of both conventional and biodegradable microplastics from solid matrices such as sand and soils.

Sodium bromide (NaBr; density $\sim 1.53\text{g/cm}^3$) showed particularly high recovery efficiencies for a wide range of polymers compared with lower-density solutions such as NaCl (density $\sim 1.20\text{g/cm}^3$) and water (density $\sim 1.0\text{g/cm}^3$) (Schütze *et al.*, 2022). Similarly, NaI (density $\sim 1.80\text{g/cm}^3$)-based density separation has achieved recovery efficiencies exceeding 95% for microplastics from complex sediment matrices (Karami *et al.*, 2017). These findings indicate that differences in isolation solution can substantially influence microplastic recovery, thereby affecting estimates of microplastic abundance, composition, and morphology as well as comparability among studies.

Other factors may also be a consideration when selecting a salt solution for microplastic isolation. For example, NaBr and NaI provide high recovery efficiencies for microplastic isolation but are not commonly used due to the cost, handling requirements, and greater environmental and laboratory safety concerns in comparison to other salt solutions (Karami *et al.*, 2017; Quinn *et al.*, 2017). SHMP is rarely used as standalone isolation solution because it acts mainly as a dispersing agent rather than as a density separation solution (Masura *et al.*, 2015).

In advance of work examining microplastics at sea turtle nesting sites in the states of Maharashtra and Goa, India, we compared the microplastic isolation efficiency of three density separation solutions – K_2CO_3 , ZnCl_2 , and NaCl – for isolating microplastics from surface sand collected from four sea turtle nesting beaches. K_2CO_3 , ZnCl_2 , and NaCl were selected for comparison as these solutions are among the most widely used in studies worldwide because of their density, cost, isolation efficiency, and low environmental toxicity (Claessens *et al.*, 2011; Imhof *et al.*, 2012; Coppock *et al.*, 2017; Patti *et al.*, 2020). By evaluating variations in microplastic recovery using different salt solutions, this study aims to determine the most efficient density separation solution for isolating microplastics from the beach sediments of the selected study sites and demonstrate good research practice in microplastics research.

METHODS

Study Sites

The study sites encompass four sea turtle nesting beaches (Figure 1). Velas and Wayangani beaches are located in the state of Maharashtra, and Morjim and Agonda beaches are in Goa, India.

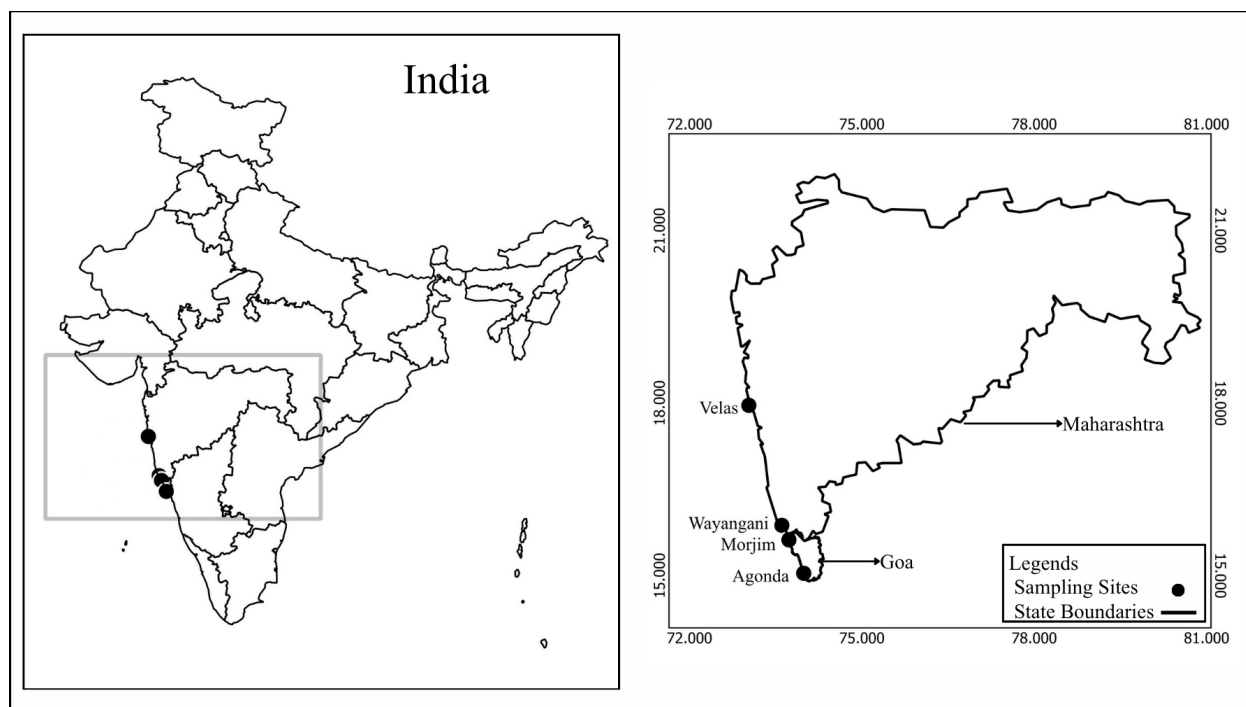


Figure 1. Sea Turtle Nesting Beaches from Which Sand Was Collected to Compare Microplastic Isolation Efficiency Using Different Salt Solutions.

Contamination Control

Several precautionary measures were implemented throughout field sampling and laboratory processing to minimise the risk of plastic contamination (Monteiro *et al.*, 2020; Patti *et al.*, 2020). During field sampling, sediments were collected using a metal trowel and transferred into pre-labelled paper bags to avoid contact with plastic materials. All clothing (including laboratory coats composed of 100% cotton) and accessories (e.g., hair ties) worn by researchers during field and laboratory work were plastic-free. Latex gloves were used while handling chemicals.

Non-plastic equipment and materials were used in the laboratory, including glass stirring rods, glass storage containers, and metal utensils. All equipment and laboratory utensils were rinsed three times with distilled water prior to use and dried using paper or cotton towels. Laboratory surfaces and instruments, including weighing balances and microscopes, were cleaned with ethanol before use, and ovens were thoroughly cleaned before drying procedures.

To monitor airborne contamination in the laboratory, three procedural control samples consisting of damp Whatman GF/B filter papers (1.2µm) placed in open petri dishes were exposed to laboratory air during sample

preparation and analysis. In addition, all salt solutions used for density separation (K_2CO_3 , NaCl, and $ZnCl_2$) were examined for microplastics by pre-filtering before use. Materials and equipment, including beakers, flasks, filters containing extracted material, and decanted solutions, were covered with aluminium foil throughout processing to minimise the risk of airborne particle contamination.

Sample Preparation

Sampling at each study site occurred in January 2026. Surface sand samples were collected to a maximum depth of 2cm using a metal garden trowel, and ~1kg of sediment at each location was collected into paper bags. Following collection, the samples were transported to FLAME University, Pune, Maharashtra, and stored at ambient temperature until processing.

For laboratory analysis, sand samples collected from each study site were homogenised separately in pre-cleaned glass trays using the coning and quartering method to ensure representative subsampling and to minimise sample heterogeneity (Campos & Campos, 2017). The sand was thoroughly mixed, then triplicate subsamples of 20g were placed in glass petri dish and oven dried at 50°C for 24hr to remove moisture prior to microplastic isolation.

Density Separation Protocol

Solutions for each salt were prepared using distilled water to concentrations in Figure 2 and stored in clean glass containers. The three subsamples of dried sand from each study sites were thoroughly mixed with each salt solution, by hand with a glass stirrer, in a 1L glass beaker then allowed to stand undisturbed at room temperature (Figure 2). Methods followed those outlined for previous studies on microplastic separation from sand using a solution of K_2CO_3 (Patti *et al.*, 2020; Gohla *et al.*, 2021), $ZnCl_2$ (Imhof *et al.*, 2012), and $NaCl$ (Thompson *et al.*, 2004; Claessens *et al.*, 2011; Balasubramaniam & Phillott, 2016).

Microplastic Isolation

The floating fraction (supernatant) from each beaker containing the sand–salt suspension was carefully decanted into a glass Büchner funnel fitted with Whatman glass fibre filter paper (pore size 1.2 μ m). Vacuum filtration was subsequently carried out using a glass Büchner funnel assembly connected to a side-arm vacuum flask and an oil-free diaphragm vacuum pump under controlled vacuum pressure (≤ 700 mm Hg) for the recovery of microplastics from sediment samples (Hidalgo-Ruz *et al.*, 2012; Masura *et al.*, 2015).

The filtration process typically required ~2–5 minutes per sample. Sides of the beaker were rinsed with distilled water into the filter to ensure complete transfer and recovery of any microplastic particles that may have adhered to the beaker surface (Masura *et al.*, 2015; Miller *et al.*, 2017). Filters were then rinsed with distilled water to remove residual salts and stored individually in glass petri dish to dry at room temperature prior to further analysis (Claessens *et al.*, 2013; Masura *et al.*, 2015).

Dried filter papers were examined for the presence of microplastics using a dissecting microscope at 10 $\times$ magnification. Filter papers were systematically scanned to ensure complete coverage, guided by grid paper attached to the underside of the petri dish. Microplastics were retrieved using clean forceps under microscopic observation; a hot needle test (Beckingham *et al.*, 2023) was performed on suspected particles that did not visually resemble microplastics for confirmation of their composition. Microplastics were transferred to a glass petri dish with labelled grid paper affixed beneath to aid spatial referencing. To maintain consistent orientation during observation and counting, the top and bottom of the grid paper were marked in different colours. Microplastics isolated

from each sample were counted and categorised by shape (fibre, pellet, fragment, foam, film) according to Duncan *et al.* (2019).

The distribution of microplastic counts isolated using each salt solution at each location was assessed using a Shapiro-Wilk normality test, which indicated that the data were not normally distributed ($p < 0.05$). Therefore, a permutational multivariate analysis of variance (PERMANOVA) was conducted to compare the number of microplastics isolated at each location using different salt solutions. The PERMANOVA (comprising 999 permutations) was conducted in PAST 4.03.

Sediment Characteristics

Sand samples from each location were also processed and analysed for grain size distribution, sorting, and skewness to characterise the sediment properties of each beach and assess their potential influence on microplastic isolation using different solutions. Approximately 200g of sediment from each study site was oven dried at 60°C and weighed at 24-hour intervals until the difference between consecutive weights was $< 0.1\%$, after which the sand was considered completely dry.

The dried sand was then sieved manually for 15–20min using stacked Endecott metal sieves (200mm diameter) with mesh sizes of 4mm, 2mm, 1mm, 0.5mm, 0.25mm, 0.125mm, and 0.063mm, following standard procedures (Carson *et al.*, 2011; Blott & Pye, 2012). After sieving, the sand retained in each sieve was transferred into separate glass containers. Residual sand grains adhering to the sieves were carefully removed using a sieve

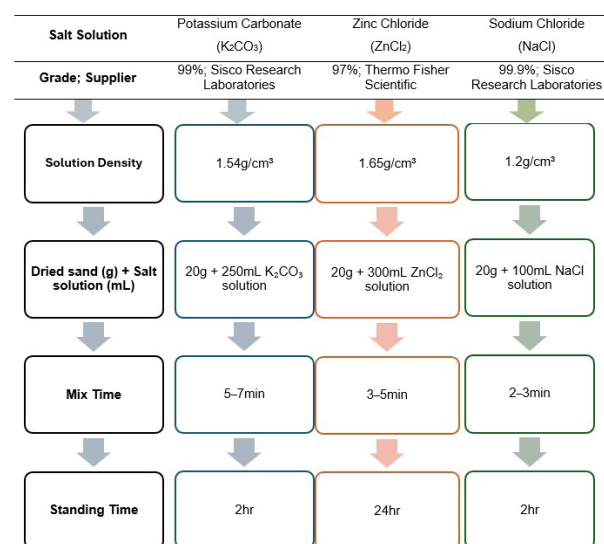


Figure 2. Density Separation Method for Microplastic Isolation Using Different Salt Solutions

brush and by gently tapping the underside of the sieves into the appropriate containers. Each sand fraction was subsequently weighed separately. Sand fractions were then classified into size fractions according to the Wentworth grain size scale (Carson *et al.*, 2011; Blott & Pye, 2012).

The percentage weight retained in each sieve fraction was used to calculate mean grain size and other sediment characteristics. Mean grain size, sorting, and skewness, were determined using the graphical method proposed by Folk & Ward (1957), based on phi (ϕ) values, where grain size is expressed on a logarithmic scale ($\phi = -\log_2 d$), with d representing grain diameter in millimetres. Percentile values including ϕ_5 , ϕ_{16} , ϕ_{25} , ϕ_{50} , ϕ_{75} , ϕ_{84} , and ϕ_{95} were obtained from the grain size data and used to calculate these parameters. Mean grain size represents the average sediment particle size, sorting indicates the uniformity of sediment distribution, and skewness reflects the dominance of finer or coarser particles within the sediment sample.

Sorting was used to evaluate the uniformity of sediment grain sizes, where lower sorting values indicate more uniform sediments and higher values indicate greater variability in grain size distribution. Inclusive graphic standard deviation (sorting) was calculated using the following equation (Folk & Ward, 1957):

$$\sigma_I = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$$

where ϕ_{84} and ϕ_{16} represent the 84th and 16th percentiles, respectively, and ϕ_{95} and ϕ_5 represent the 95th and 5th percentiles. Lower sorting values indicate well sorted sediments with relatively uniform grain sizes, whereas higher values indicate poorly sorted sediments with greater variability in particle size distribution (Blott & Pye, 2001).

Skewness was calculated to determine whether sediments contained a greater proportion of finer or coarser particles relative to the average grain size. Inclusive graphic skewness was calculated using the following equation (Folk & Ward, 1957):

$$k_I = \frac{(\phi_{16} + \phi_{84} - 2\phi_{50})}{2(\phi_{84} - \phi_{16})} + \frac{(\phi_5 + \phi_{95} - 2\phi_{50})}{2(\phi_{95} - \phi_5)}$$

where ϕ_{50} represents the median grain size. Positive skewness values indicate dominance of finer particles, negative skewness values indicate dominance of coarser particles, and values close to zero indicate symmetrical grain size distribution (Folk & Ward, 1957).

RESULTS

Microplastic Isolation

The number of microplastics isolated at each location varied with separation solution. Isolation performed with K_2CO_3 resulted in the highest mean counts for all categories of microplastics at all locations. The lowest microplastic counts were recorded when microplastic isolation was done using $ZnCl_2$ (Table 1). However, a PERMANOVA found no significant variation ($F=1.006$, $R^2=0.60$, $p=0.455$) among the total number of microplastics isolated from each study site using different salt solutions. Fibres were the dominant microplastic category isolated from all beaches irrespective of the salt solution used. Microplastic fragments, pellets, foam, films, and other forms were comparatively few (Table 1). Control filter papers and salt solutions, visually inspected for airborne contamination, revealed no microplastics.

Sediment Characteristics

Sediment characteristics differed among the four study sites. Using the Wentworth grain size classification, sediments from Velas and Morjim predominantly consisted of very fine sand fractions, whereas Wayangani and Agonda were dominated by fine sand. Velas beach sediment exhibited the lowest sorting value (0.45), indicating well-sorted sediment with relatively uniform grain sizes. In comparison, sediments from Wayangani, Morjim, and Agonda were classified as moderately well sorted, with sorting values ranging from 0.56 to 0.66, suggesting greater variability in grain size distribution. Skewness values also varied among study sites, reflecting differences in sediment particle distribution. Velas (-1.1) and Morjim (-1.66) exhibited strongly negative skewness, indicating a higher proportion of coarser particles relative to the mean grain size. Wayangani (-0.16) showed near-symmetrical distribution, whereas Agonda (0.40) displayed positive skewness, suggesting a relatively greater proportion of finer sediment particles (Table 2).

DISCUSSION

This study compared the efficiency of three commonly used density separation salt solutions ($NaCl$, K_2CO_3 , and $ZnCl_2$) for isolating microplastics from sand collected from four sea turtle nesting beaches along the coasts of Maharashtra and Goa, India. A PERMANOVA revealed no statistical difference in microplastic isolation efficiency among the salt solutions across locations ($p=0.455$), despite differences in sand characteristics (grain size and classification, sorting value and category, and skewness).

Table 1: Microplastics (number $\pm$ standard deviation (range) in a 20g sample) isolated from surface beach sand at four study sites using K_2CO_3 , NaCl, and $ZnCl_2$ solutions.

Solution	Study Site	Microplastic Category						Total
		Fibre	Pellet	Fragment	Foam	Film	Other	
K_2CO_3	Velas	60.0 $\pm$ 2.0 (58-62)	0.0	0.0	0.0	0.0	0.0	60.0 $\pm$ 2.0 (58-62)
	Wayangani	38.7 $\pm$ 9.1 (32-49)	0.0	0.0	0.0	0.0	0.3 $\pm$ 0.6 (0-1)	39.0 $\pm$ 8.7 (33-49)
	Morjim	53.7 $\pm$ 11.6 (43-66)	0.0	1.0 $\pm$ 1.0 (0-2)	0.0	0.0	0.0	54.7 $\pm$ 11.0 (44-66)
	Agonda	51.7 $\pm$ 9.5 (41-59)	0.0	2.3 $\pm$ 2.1 (3-4)	0.0	0.0	0.7 $\pm$ 1.2 (0-2)	54.7 $\pm$ 10.5 (44-65)
NaCl	Velas	40.0 $\pm$ 11.5 (27-49)	0.0	1.3 $\pm$ 0.6 (1-2)	0.0	0.0	0.0	41.3 $\pm$ 11.0 (29-50)
	Wayangani	34.3 $\pm$ 10.8 (22-42)	0.0	0.7 $\pm$ 0.6 (0-1)	0.0	0.0	0.3 $\pm$ 0.6 (0-1)	35.3 $\pm$ 11.0 (23-44)
	Morjim	37.7 $\pm$ 4.7 (34-43)	0.0	0.3 $\pm$ 0.6 (0-1)	0.0	0.0	0.0	38.0 $\pm$ 4.4 (35-43)
	Agonda	42.3 $\pm$ 11.0 (31-53)	0.0	1.7 $\pm$ 0.6 (1-2)	0.0	0.0	0.0	44.0 $\pm$ 11.5 (32-55)
$ZnCl_2$	Velas	30.0 $\pm$ 2.6 (28-33)	0.0	1.0 $\pm$ 1.0 (0-2)	0.0	0.0	0.0	31.0 $\pm$ 3.6 (28-35)
	Wayangani	25.7 $\pm$ 5.8 (19-29)	0.3 $\pm$ 0.6 (0-1)	0.3 $\pm$ 0.6 (0-1)	0.0	0.0	0.0	26.3 $\pm$ 6.9 (20-30)
	Morjim	19.0 $\pm$ 2.6 (16-21)	0.0	0.0	0.0	0.0	0.0	24.7 $\pm$ 7.5 (17-32)
	Agonda	24.0 $\pm$ 7.5 (17-32)	0.0	0.7 $\pm$ 1.2 (0-2)	0.0	0.0	0.0	19.0 $\pm$ 2.6 (16-21)

Among the tested salt solutions, K_2CO_3 consistently isolated higher mean microplastic counts across all sampling sites and across most microplastic categories, particularly fibres and fragments. The comparatively higher isolation efficiency of K_2CO_3 may be attributed to its density (1.54g/cm³). Previous studies have similarly identified K_2CO_3 as an effective and environmentally safer alternative for microplastic isolation when compared with other salts such as $ZnCl_2$ and NaI (Patti *et al.*, 2020; Gohla *et al.*, 2021). K_2CO_3 solution also exhibits lower viscosity and reduced particle aggregation during separation, which

improves sediment settling, facilitates decanting and vacuum filtration, and enhances overall microplastic isolation efficiency. Its ability to recover a broader range of polymer types while maintaining operational simplicity makes it particularly suitable for microplastic research (Coppock *et al.*, 2017; Rani *et al.*, 2020; Gohla *et al.*, 2021).

NaCl isolated intermediate numbers of microplastics across all beaches in this study. NaCl is widely used in microplastic studies because it is inexpensive, easily available, and non-toxic (Thompson *et al.*, 2004;

Table 2: Characteristics of beach sediments

Study Site	Mean Grain Size (ϕ)	Wentworth Classification	Sorting Value	Sorting Category	Skewness
Velas	3.73	Very fine	0.45	Well sorted	-1.21
Wayangani	2.07	Fine	0.57	Moderately well sorted	-0.16
Morjim	3.69	Very fine	0.56	Moderately well sorted	-1.66
Agonda	2.28	Fine	0.66	Moderately well sorted	0.40

Claessens *et al.*, 2011). However, the relatively low density of NaCl solution limits the isolation of heavier polymers such as polyethylene terephthalate (PET) and polyvinyl chloride (PVC), which may remain within the sediment fraction during separation (Claessens *et al.*, 2013; Coppock *et al.*, 2017). Consequently, NaCl-based isolation methods may underestimate the total abundance of microplastics in beach sand, particularly where dense polymers are present (Imhof *et al.*, 2012; Prata *et al.*, 2019).

ZnCl₂ isolated the lowest number of microplastics in this study despite its high density (1.6g/cm³), which is generally considered suitable for isolating dense plastic polymers (Imhof *et al.*, 2012). The lower isolation observed in this study may be associated with interactions between the dense solution and sediment grain size characteristics. Fine-grained sediments, particularly very fine sand and silt fractions, tend to remain suspended for longer periods in ZnCl₂ solutions, resulting in increased turbidity and aggregation of sediment particles (Claessens *et al.*, 2013; Coppock *et al.*, 2017). These aggregates can entrap microplastics and reduce flotation efficiency during separation and filtration. Since beach sediment from this study sites were dominated by very fine to fine sand fractions (Carson *et al.*, 2011; Turra *et al.*, 2014), sediment texture may have contributed to the comparatively lower recovery at these locations observed with ZnCl₂. Therefore, the reduced microplastic counts observed with ZnCl₂ in this study may reflect limitations associated with sediment texture.

Despite differences in sediment characteristics among the study beaches, the isolation efficiency pattern of the salt solutions remained consistent across locations. K₂CO₃ consistently isolated the largest number of microplastics across all beaches and microplastic categories, while also providing advantages in terms of high density, operational simplicity, and cost-effectiveness. Therefore, K₂CO₃ was

determined to be the most suitable salt solution for the locations and will be used for the isolation and analysis of microplastics from all remaining sediment samples in the current study.

CONCLUSION

This study compared effectiveness of three salt solutions K₂CO₃, NaCl, and ZnCl₂ for isolating microplastics from beach sediments collected from sea turtle nesting beaches along the coasts for Maharashtra and Goa, India. Although no significant differences were detected among the number of microplastics isolated by each salt solution, K₂CO₃ consistently recovered higher numbers of microplastics compared with NaCl and ZnCl₂. NaCl showed moderate recovery efficiency whereas ZnCl₂ isolated the fewest microplastics, possibly due to interactions between dense salt solution and fine sediment fractions that reduce separation efficiency. Considering its comparatively high isolation efficiency, cost effectiveness, environmental safety, and ease of handling, K₂CO₃ will be used to isolate microplastics during more detailed examination of temporal and spatial variation in beach microplastics at the four study sites in future research.

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SSTCN TURTLE DIARY OF 2026

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Introduction

The 2025 nesting year was quite a landmark season in many ways. We registered the highest number of stranded dead turtles in SSTCN's and, therefore, Chennai's history. The Forest Department swung into action and reactivated the Nodal Task Force. The task

force met frequently and every potential department of the Government was pressed into action. The Fisheries Department came under close scrutiny to take action against trawlers breaking the law by fishing in illegal waters. The Coast Guard was pulled in to monitor the trawlers. The Forest Department acquired two boats of their own to monitor the coast. The Coastal Security

team was invited to be a part of ensuring safety for turtles. The Forest Department, along with the Fisheries Department, initiated awareness and education camps, known as *Sagar Mitra*, in all fishing villages, particularly engaging with the women-led groups. This programme continued through the season and after as well.

SSTCN Preparation for 2026

In all, there was a feeling of readiness for this year's turtle season. We started the season with the Nodal Task Force meeting to run through checklists and make sure that all departments were in readiness for the contingencies of the season. SSTCN started monitoring the beaches with night walks on 15th December 2025. We were able to walk only the Neelangarai -Basant Nagar stretch of the local coastline due to limited volunteers and not having police permissions at the start of the season. One of our most senior and committed volunteers, Nambirajan, began the night walks and straight away noted dead stranded turtles in high numbers. For instance, he recorded nine dead turtles on 17th December alone. Even before the first nest was found on 4th January 2026, we had recorded more than 125 strandings on these beaches. It was quite a shock to us, as we were expecting low mortality given the amount of work done in the previous season.

Due to finding nests early in the season and not having enough volunteers on call, we decided to start public walks early on 16th January 2026. However, we began to regret this decision with the number of strandings remaining steadily high. On 20th January, we recorded 20 dead turtles on the beaches and another 14 on the 21st January, with five more dead turtles floating in the water. A dwarf sperm whale also washed up dead, and was spotted by our volunteers on a weekday walk.

As we began to despair, we seemed to turn a corner on the 23rd January. The number of nests began to rise. The dead turtles kept stranding but with us getting busy with nest collection, the presence of dead turtles was not as daunting. We ended January with a count of 58 nests. Unfortunately, our dead turtle count exceeded 300.

Tagging Turtles

This year a decision was taken to satellite tag 10 turtles and flipper tag 100 turtles. This was initiated by Ms. Supriya Sahu, Environment Secretary of the Tamil Nadu Government, and carried out under the guidance of Dr. Suresh Kumar of the Wildlife Institute of India (WII). Mr. Mohit from WII was initially responsible for

the programme. He recruited local people to help him monitor the beaches and worked closely with us to locate nesting turtles to fix the satellite tags to (Figure 1).



Figure 1. Olive Ridley Turtle, with Satellite Transmitter and Flipper Tag Applied by WII, Returning to the Sea After Nesting. Photo credit: Shravan Krishnan.

After flipper tagging 16 turtles, Mr Mohit left to continue the work in other sites and Mr. Anoop Sabu took over. He and his team walked several kilometres every night, particularly near the estuary, to monitor and tag nesting turtles. This brought a new aspect to our walks. The week-day walkers had someone to look forward to meeting and had to keep their eyes keenly open, look for potential nesters, and give a heads-up to the WII team to flipper tag and/or satellite tag the turtle after it finished nesting. Those involved in the public walks had the assurance of a nest waiting for them somewhere, as Mr. Anoop or his team would have located the nest, perhaps tagged the turtle, and often left the nest for us to collect. It was really nice for us to walk with this assurance and also to have the company of others on the beach who felt and acted like us. Suddenly we didn't feel alone anymore.

Working in Collaboration with the Forest Department

After being together for so many years, we have a reasonably smooth working relationship with the Forest Department staff. Like in the earlier years, the DFO Mr. Manish Meena gave instructions to the staff to walk the beaches on the second part of the night, after we walked the first part of the night, to ensure that the whole night was covered between the two agencies.

The turtle conservation work is taken very seriously by senior personnel in the department. Higher level officers like Mr. Rakesh Kumar Dogra (PCCF and Chief Wildlife Warden) and Mr. Srinivas Reddy (HOFF) visit the hatchery regularly and Ms. Supriya Sahu Ma'am has always taken great interest and has been fully involved in the whole project.

Beach Cleaning Equipment

We ran into trouble for a while with new beach cleaning vehicles which were introduced to scour the local beaches and free the sand from plastic and other waste. These vehicles would completely erase all tracks of turtles and there was no way we were going to find a nest on sand which these vehicles had done the cleaning.

We brought it to the notice of the Corporation commissioner who readily understood the issue. But to make sure that all the staff became aware and to ensure that they did not use these vehicles up to 50 metres from the high tide line took some coordinated effort.

Working with Other NGOs

With the growth of social media, turtle walks have become immensely popular. From the very start of the season, we received far more requests than we were able to handle in the short season available to us. Overall, there were 10 weekends of walks, 20 nights in all, during the season. Taking more than 50 people during each walk makes the experience less than desirable for all concerned so we are able to cater to only around a thousand people per season. As an organisation committed to conservation and education, our primary targets for the walks are school and college students and other young people interested in nature.

However, there was a whole new group who was keen to walk and they are the corporate entities wanting to organise walks for their employees. We just didn't have the space for such engagements. In the last couple of seasons, another organisation has stepped in to fill this void: Save a Turtle (SaT). They conduct walks on the Marina beach stretch with the help of the Forest Department staff. So public walks were happening in unison on two stretches of coast on the same nights.

At the Hatchery

While conducting two walks simultaneously works pretty smoothly, there is only one hatchery and one hatchling release programme. A public release of hatchlings is only possible in the evenings and on days that hatchlings emerge from their nests in the late afternoon.

In the past season we had some crazy evenings with 500 to 600 people coming to the hatchery to witness the hatchlings being released. This year, we worked out a deal among ourselves, restricting or rather trying to restrict the number of visitors to 100 between two groups. This allowed for some level of control during the release. It was

definitely better managed than other years.

Ant Problem

Little red ants consistently invaded the hatchery in March and April of 2026. Volunteers sprinkled Neem cake powder and turmeric powder generously in the hatchery, but it was quite a struggle to keep the ants from biting emerging hatchlings. In spite of constant vigilance, we did lose a hatchling now and then to these ants. Fortunately, as the heat intensified after mid-April, the ants upped and left.

Total Nest Count, Unexpected Heavy Rains, and Loss of Eggs

We ended the season with 340 nests in all. We found 58 nests in January, 136 nests in February, 147 nests in March and one in April 2026. We had significant rains on 26th January, 18th March, and again on 6th April 2026, leading to inundation of water into many of the nests. Around 32% of the eggs that we collected did not hatch. When excavating the nests, our assessment was that approximately 15% of the eggs showed no signs of embryo development and 17% had embryos that did not survive to hatch. This means that of the total 38,358 eggs collected from 340 nests, 12,297 eggs showed no evidence of embryo development. Of the 26,061 remaining eggs, only 22,133 hatchlings emerged. More than 100 hatchlings also emerged from nests that we found during patrolling but did not move to the hatchery.

The daytime temperature (11am to 4pm) outside the hatchery between 11th March and 11th April 2026 averaged 39.5°C while the temperature inside the hatchery was at least one degree higher. We have shaded the hatchery with shade cloth or jute since 2005 to prevent direct exposure of nests to the sun and reduce overheating, but this prevents the sea breeze from cooling the inside of the hatchery. We need to reconsider this design next season.

The majority of turtle nesting is usually in February but this year the highest number was in March. This meant that the majority of the hatchlings emerged in April and May. As it got hotter and wetter in these months, embryo survival dropped dramatically. The initial survival rate at the start of the season for eggs collected in January and February was >75%. Average hatching success for the last 40 nests, collected in March, was <19%. The overall hatching success was just 56% this season, our lowest in the last 20 years.

The last public walk for 2026 was on 27th March 2026. The last big release of hatchlings was on 30th March, with

456 hatchlings being released. The last hatchling release was on 20th May 2026.

The Red Headed Centipede

Scolopendra morsitans, also known as the Tanzanian blue ringleg, was found in the hatchery this year, as it has been found in the past (Figure 2). The species grows to around 13cm. It is found across all continents and is highly invasive. The centipede is an opportunistic predator which hunts primarily at night and feeds on other arthropods and some small vertebrates, using its neurotoxic venom and its strong jaws. We have not seen the centipedes injure hatchlings.

Special Moments

A juvenile hawksbill turtle (Figure 3) was brought to the Forest Department in early January, and Besant Memorial Animal Dispensary (BMAD) took responsibility for its care. The turtle was in critical condition, suffering from floating syndrome. This usually happens when air is stuck in the gastrointestinal tract, often after swallowing a foreign body. It was thought to have been caught in a fishing net and then thrown back into the sea. The turtle was unable to dive due to the floating syndrome, and had to be treated for over three months. During this time, it defecated some fishing line (Figure 4). The turtle was

released into the Gulf of Mannar on 9th April 2026 with a lot of fanfare.

An adult olive ridley turtle was brought in with a hook in its jaw (Figure 5). The hook was surgically removed by a team of doctors from the Government veterinary college in BMAD and the turtle was safely released. A special thanks to Mr. Shravan Krishnan and his team for their commendable work in treating injured turtles and enabling their safe release back to the sea.

Mr. Anoop and our volunteers kept coming across a turtle which would come ashore but couldn't dig a nest. It seemed like her left hind flipper wasn't functioning properly, though there was no visible injury. After she had tried digging a pit unsuccessfully seven or eight times over a couple of weeks, she was taken to BMAD. They didn't find any injury, just general weakness. It was felt that holding her in the clinic would be detrimental as she was full with eggs and she was released into the sea. After 11 or so attempts she seemed to have stopped coming ashore. She might have released the eggs in the sea itself.

Press Lowkey

The print news press who had raised the issue of dead turtles quite strongly last year barely addressed the issue



Figure 2. Red-headed Centipede in the Hatchery. Photo credit: Adhith Swaminathan.



Figure 3. Juvenile Hawksbill Turtle with Floating Syndrome that was Treated at Besant Memorial Animal Dispensary. Photo credit: Adhith Swaminathan.



Figure 4. Fishing Line that had been Swallowed by the Floating Juvenile Hawksbill. Photo credit: Shravan Krishnan.



Figure 5. Adult Olive Ridley Turtle with a Hook in its Jaw that was Treated at Besant Memorial Animal Dispensary. Photo credit: Shravan Krishnan.

this year. They got quite caught up in the turtle tagging story and were content to cover it as positive news. The number of dead turtles this year was still very high, though a little lower than last year. We recorded more than 750 dead this year compared to 1,197 last year.

Woes of the Season

Being situated in Chennai, the hatchery receives a lot of attention from Government officials. This is a mixed blessing. It is good for creating awareness about the turtles. On the other hand, many of these officers came with their families and friends who the Forest Department staff felt compelled to allow inside the hatchery. This was a big problem as there was the issue of nest marking sticks being knocked down and a bigger danger of handling hatchlings. Also, the public were upset that they were asked to stay out of the hatchery, citing the safety of hatchlings, while family members of Government officials were being allowed to handle hatchlings. Most officers were understanding of the situation, but the Forest Department staff were reluctant to address the issue with their higher-ups. This left the SSTCN volunteers in the awkward situation of having to address this with the officers and their families.

Save a Turtle was very active on Instagram and were actively inviting people to come and witness the release of hatchlings. This became quite a catch phrase - "Baby turtle farewell". There were two issues with this. One was the handling of crowds, which we managed somewhat with constant negotiation with members of SaT. The bigger issue was that our volunteers felt that SSTCN was not recognised for the work as only SaT was visible on social media. While it was a conscious decision on SSTCN's part to maintain a low profile, the angst it caused our volunteers was quite draining.

Quite a few nesting turtles were attacked by feral dogs and this was extremely distressing. We need a mass sterilisation programme for stray dogs in the area, especially on the beaches. While we are able to sterilise the dogs near the hatchery area in Uroor Kuppam every year by befriending them, this process is very slow and we're unable to do it for the entire 14km stretch of coastline. Many of us walkers love animals, including dogs. Our walks are in the company of a number of friendly dogs. But we recognise the larger issue of the beach needing to be safe for turtles. The problem needs to be addressed on several levels. The food waste left behind by people is one of the key factors which causes a burgeoning rise in the stray dog population. The turtle

walks in Chennai are more than five decades old and have gained a cult status in many ways. Unfortunately, this has not resulted in bringing about a sense of civic consciousness in people to, at the very least, keep the beaches clean and safe for turtles. We rue this very much and recognise it as a failure on our part as the custodians of turtles.

One of upshots of the Instagram popularity is that groups of people were found roaming the beaches on self-appointed “turtle walks” looking for turtles to shoot videos of and gain Instagram fame. It was very amusing to sometimes come across groups of people walking in the opposite direction ‘looking for turtle nests’.

Conclusion

In all, the season was a very mixed one for SSTCN volunteers (Figure 6). Purely in terms of mortality of turtles, it was a season we would not want to remember. We hope for a better season next year. We are losing our resilience to face turtle deaths in such numbers. It has nearly broken our spirit to face such dire situations over two consecutive years. This despite the best efforts by the Government through the Forest Department and the Environment secretary. We intend to do as much outreach as possible to schools and colleges during the off season to address the larger issues of the beach and ocean ecosystem as a whole.



Figure 6. Some of the SSTCN Long-term Members and Newcomers. Photo credit: SSTCN

NOTES



REDISCOVERY OF THE LEATHERBACK SEA TURTLE AT KADMAT ISLAND, LAKSHADWEEP ARCHIPELAGO, INDIA

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The Lakshadweep Archipelago is a chain of low-lying atolls in the northern Indian Ocean, comprising 12 coral atolls enclosing 27 small islands. This geographical positioning makes it a potentially important habitat and migratory corridor for sea turtles (Tripathy *et al.*, 2002). The first documented sea turtle survey in this region was conducted in 1976 (Bhaskar, 1978, 1979). Subsequent investigations by the Central Marine Fisheries Research Institute (CMFRI) (Silas, 1984; Lal Mohan, 1989) and later by Tripathy *et al.* (2006) reported four out of the seven globally recorded sea turtle species in the region. Among these, three species — the green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), and hawksbill (*Eretmochelys imbricata*) turtles — are the most common and are known to forage or nest in the islands. In contrast, there is limited and inconclusive evidence regarding the occurrence of the leatherback sea turtle (*Dermochelys coriacea*) in Lakshadweep, and not much known about its nesting in the region.

The leatherback sea turtle is the largest extant marine turtle and is easily distinguishable by its large body size and leathery carapace. It is widely distributed across tropical and temperate oceans and exhibits extensive migratory behaviour. In India, its major nesting populations are primarily confined to the Andaman and Nicobar Islands, particularly Great and Little Nicobar Islands and Little Andaman Island (Andrews & Shankar, 2002; Andrews *et al.*, 2006). Recent systematic marine biodiversity assessments and turtle monitoring programmes in the Lakshadweep Archipelago (Shankar *et al.*, 2024) have not documented the presence of leatherback turtles, rendering it effectively absent from contemporary regional records. However, historical accounts and indigenous ecological knowledge indicate that the species, locally known as “lasar mulla,” was occasionally encountered by fishers and only rarely came ashore for nesting (Bhaskar, 1978). Earlier systematic surveys by Tripathy *et al.* (2002, 2006),

based on secondary data, reported that only a small proportion of fishers mentioned sightings or nesting events, but these accounts lacked verifiable scientific evidence. In this context, the present sighting of a leatherback sea turtle from the coastal waters of Kadmat Island represents a rare and scientifically significant record for the Lakshadweep Archipelago.

Kadmat island is 8km long and 550m wide, with a lagoon covering a total area of 20.9km². On 29th April 2026, at 13:30 h, crew members of the fishing craft *Amina Beebi* (IND-LD-KD-MO-452) sighted a single leatherback sea turtle ~0.44nm offshore on the southeastern (11.177° N, 72.768° E) side of the island (Figure 1). The individual was observed in a surface-basking state and had an estimated carapace length of ~1.5m (Figure 2).

The present sighting at Kadmat Island therefore represents a notable rediscovery. This occurrence may indicate previously undocumented migratory routes through the Arabian Sea, linked to oceanographic conditions such as prey (jellyfish) abundance, or broader ecological changes influencing species distribution. Given the species’ global conservation status as Vulnerable (Wallace *et al.*, 2013), such records carry significant implications for regional marine biodiversity assessments and conservation planning. This finding underscores the importance of integrating traditional ecological knowledge with modern scientific monitoring. This observation constitutes the first contemporary evidence of the species in Lakshadweep waters. It also highlights the need for systematic, long-term observation efforts in Lakshadweep to better understand the occurrence patterns of rare and migratory marine megafauna.

Acknowledgements

The authors sincerely thank the crew of the fishing

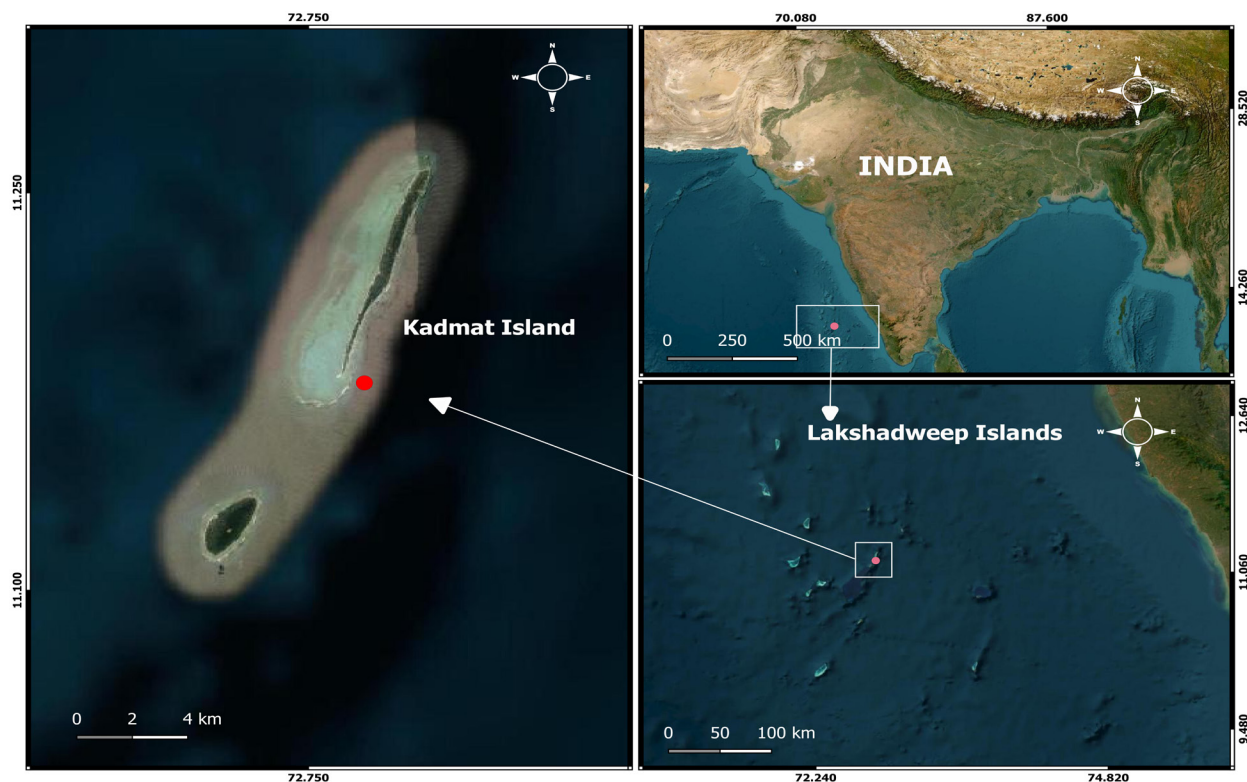


Figure 1. Map of Kadmat Island. The Red Circle Indicates the Location of the Leatherback Turtle Sighting.

craft *Amina Beebi* for their enthusiasm and responsible reporting of this important sighting. The authors also acknowledge Dr. Kartik Shanker for his valuable support and constructive feedback during the preparation of this manuscript.

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Figure 2. Dorsal View of the Leatherback Turtle Sighted at Kadmat Island. (Photo credit: Aboosayeed A.M.)

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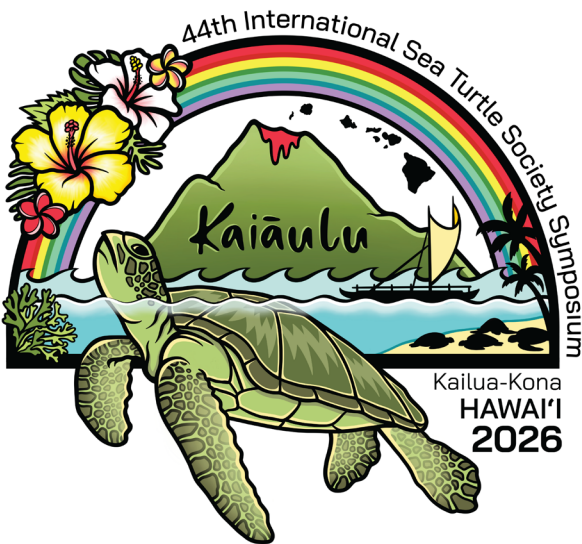


PRESIDENT'S SUMMARY REPORT: 44TH INTERNATIONAL SEA TURTLE SOCIETY SYMPOSIUM, 28TH FEBRUARY TO 6TH MARCH 2026, KAILUA-KONA, HAWAI'I, USA

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INTRODUCTION

The 44th International Sea Turtle Society (ISTS) Symposium was held from 28th February to 6th March 2026 in Kailua-Kona, Hawai'i. This meeting marked a historic milestone as the first symposium hosted in Hawai'i or anywhere in the Pacific Islands, bringing the global sea turtle conservation community into a region where sea turtles are deeply embedded in cultural, ecological, and spiritual systems.

Convened under the theme *Kaiāulu*, the symposium emphasised interconnected relationships between people, place, and environment. This framework shaped both the design and delivery of the meeting, guiding an approach that placed equal value on scientific exchange, cultural grounding, and community well-being. The result was a symposium that not only advanced scientific knowledge, but also intentionally created space for reflection, dialogue, and connection across diverse perspectives.

PLENARY PROGRAMME AND INTELLECTUAL IMPACT

A defining feature of the 44th ISTS Symposium was the structure and impact of its plenary programme, which, together with the Opening Ceremony, was intentionally designed as a cohesive intellectual and cultural foundation for the week.

The symposium opened with a traditional Hawaiian oli and blessing, grounding the meeting in place and establishing a tone of respect, connection, and shared responsibility. Invited speakers emphasised themes of stewardship, responsibility to place, and the deep relationships between people, place, sea turtles, and ocean. This opening was not simply ceremonial; it set the conceptual framework for the sessions that followed, reinforcing the symposium theme of *Kaiāulu* and positioning conservation within broader social, cultural, and ethical contexts.

Building on this foundation, three plenary sessions moved beyond traditional keynote formats to create space for dialogue around complex and, at times, contested issues in sea turtle conservation.

The first plenary, *Pacific Island Nations, Shared Seas: Indigenous Perspectives on Sea Turtle and Marine Conservation*, elevated Indigenous leadership and Pacific Island voices, centring customary stewardship, cultural relationships with sea turtles, and the integration of traditional knowledge into conservation practice. This session reframed conservation as a process grounded in place, culture, and community, rather than solely as a scientific or management exercise.

The second plenary, *Headstarting Revisited: Effectiveness, Ethics, and Evidence*, revisited a long-

standing and historically debated practice in sea turtle conservation, situating it within the broader question of how conservation strategies evolve over time. The session critically examined the biological effectiveness and ethical considerations of headstarting, while also addressing its appropriateness in a modern conservation context. Discussion reflected continued divergence within the field, with some practitioners supporting its use under certain conditions and others questioning its value relative to alternative strategies.

The third plenary, *Surviving to Thriving: Evolving the Ethos of Sea Turtle Conservation*, explored the transition from crisis-driven conservation toward long-term stewardship. As some populations recover while others remain imperilled, the session challenged the field to reassess its assumptions, adapt its strategies, and incorporate a broader range of perspectives into conservation decision-making.

Together, the Opening Ceremony and plenary sessions created a deliberate progression, from grounding in place and values, to critical examination of existing practices, to forward-looking reflection on the future of the field. This structure marked a clear shift in the role of the symposium, from a venue primarily for presenting results to one that more intentionally fostered dialogue, reflection, and direction-setting within the global sea turtle conservation community.

These themes were not confined to the plenary sessions but were further explored through complementary workshops and discussions during the symposium, including sessions addressing decolonisation in conservation practice and the role of sustainable use in contemporary management frameworks. Together, these elements reflected a broader engagement across the programme with evolving and, at times, challenging questions in the field.

INNOVATION, TECHNOLOGY, AND FIRSTS

The 44th ISTS Symposium introduced several first-of-their-kind advancements in symposium delivery, communication, and long-term accessibility, fundamentally expanding how the meeting is experienced and accessed.

The symposium marked the first comprehensive effort to record core components of the meeting, including oral presentations, poster sessions, plenaries, and the opening ceremony. A total of 342 (87.9%) of presenters opted in to recording, with only 47 opting out, reflecting strong community support for broader dissemination

of content. This effort extended beyond documentation to significantly expand access and extend the lifespan of the symposium. Recordings create opportunities for participants who were unable to attend specific sessions, as well as for the broader global community, particularly those facing financial, geographic, or logistical barriers to participation. They also establish the foundation for a lasting digital archive, enabling continued learning, reference, and engagement well beyond the meeting itself.

The symposium also marked the first time a dedicated mobile programme application was developed, with 640 installations, representing adoption by the vast majority of attendees. Used alongside the printed programme, the app significantly improved real-time communication, scheduling, and participant engagement, demonstrating the value of integrated digital tools for large international scientific meetings.

The scale of coordination required for the symposium was also substantial, with more than 21,000 system-generated communications supporting registration, scheduling, and participant coordination. Together, these advancements represent a meaningful step toward a more accessible, connected, and resilient model for future ISTS symposia.

PARTICIPATION AND GLOBAL REACH

The symposium attracted 693 participants, representing 53 nations. Participation reflected strong global engagement across regions and sectors.

Attendees included representatives of NGOs, government agencies, and academic institutions. Registration data also reflected the broad diversity of the symposium community, including 128 students, 54 participants from Pacific Island regions, 205 participants from low-income countries, 228 from high-income countries, 34 non-ISTS members, and 44 single-day registrants. These categories highlight important dimensions of participation, though they are not mutually exclusive. Extensive travel support also played an important role in enabling attendance from a diverse and globally distributed community.

A total of 363 participants had no prior recorded attendance since tracking began at the 40th ISTS Symposium, underscoring the meeting's success in expanding its reach to new and previously unrecorded members of the global sea turtle conservation community.

SCIENTIFIC PROGRAMME

The scientific programme was substantial, with 437 abstracts submitted and 1,177 completed reviews conducted by Session Chairs. Following withdrawals prior to the symposium, the final programme included 389 scientific contributions, consisting of 180 oral presentations and 209 poster presentations.

Sessions covered the full breadth of sea turtle science and conservation, including in-water ecology, nesting biology, population monitoring, fisheries interactions, conservation management, and socio-cultural dimensions of conservation. Delivery of the scientific programme was supported by three Programme Chairs, 41 Session Chairs and 118 volunteers, whose contributions were essential to coordinating reviews, managing sessions, and ensuring the smooth execution of the programme.

STUDENT PARTICIPATION AND ENGAGEMENT

Student participation continued to be a defining strength of the symposium, spanning both the scientific programme and a range of dedicated engagement activities. A total of 126 students applied for the Archie Carr Student Awards, reflecting strong interest in competitive recognition within the scientific programme. In parallel, 145 student presentations were evaluated through the symposium's student evaluation process, including 83 poster presentations and 62 oral presentations, supported by 129 volunteer evaluators. Because participation in both the awards and evaluation processes was optional, the total number of student contributions to the symposium was likely higher than these figures alone.

Engagement extended beyond the scientific programme through a well-attended suite of student-focused events. The student mixer brought together 69 participants, while 42 students and 5 experts participated in the student workshop. Speed chatting sessions included 19 students and 9 experts, contributing to a total of 14 experts engaged across student programming.

Together, these efforts facilitated meaningful interaction between students and established researchers, supported professional development, and reinforced the symposium's role in cultivating the next generation of sea turtle scientists and conservation practitioners.

WORKSHOPS, REGIONAL MEETINGS, AND CAPACITY BUILDING

Workshops and regional meetings held during the first three days of the symposium remained a central component of the programme, providing structured opportunities for training, collaboration, and regional coordination. Nineteen workshops engaged a total of 846 participants, providing opportunities for technical training, skill development, and collaboration. Individual workshops ranged from approximately a dozen to over 90 participants, reflecting both specialised and broadly attended topics. Several workshops also engaged directly with themes highlighted in the plenary programme, extending discussions on topics such as decolonisation in conservation practice and the role of sustainable use into more applied and participatory settings. In addition, six regional meetings brought together 243 participants to discuss region-specific conservation priorities, strengthen networks, and coordinate efforts across geographic areas. Together, these sessions played an important role in building capacity, fostering collaboration, and supporting coordination across the global sea turtle conservation community.

OUTREACH, COMMUNITY EVENTS, AND CULTURAL PROGRAMMING

A diverse suite of community, cultural, and special events complemented the scientific programme and were intentionally integrated into the symposium to reinforce the theme of *Kaiāulu*, fostering connection, place-based engagement, and shared experience.

The Welcome Social and Farewell Luau served as cornerstone events, each integrating cultural elements that grounded the symposium in its Hawai'i setting. The Welcome Social featured traditional Hawaiian music and performances, alongside hula, Tahitian dance, and fire knife dancing, and was attended by approximately 500 participants. The Farewell Luau similarly combined a traditional Hawaiian culinary experience with live local music, drawing more than 440 attendees and providing a meaningful and celebratory close to the symposium.

Additional events supported both community engagement and professional exchange. These included Video Night, which provided a public-facing platform for storytelling and outreach and featured 24 films representing a wide range of countries and perspectives. The Origin Stories session created space for personal narratives from individuals working in sea turtle conservation, highlighting diverse pathways into the

field and the experiences that have shaped practitioners' careers. The IUCN Marine Turtle Specialist Group (MTSG) meeting also served as an important forum for global coordination and collaboration.

The Makana Aloha programme offered a mechanism for participants to support the symposium while sharing locally inspired goods, reinforcing the event's connection to place and community. Together, these events extended the impact of the symposium beyond the formal scientific programme, reinforcing its role as both a professional gathering and a vibrant global community.

SPONSORSHIP, PARTNERSHIPS, AND FUNDRAISING

The 44th ISTS Symposium achieved the highest level of financial support and partnership engagement in its history, reflecting an unprecedented level of investment in both the scope and delivery of the meeting. In total, sponsorship and partnership contributions generated approximately \$290,000 in support of the symposium, representing the highest level of financial support in its history.

The symposium was anchored by Wild Earth Allies as Lead Partner, whose support was instrumental in shaping both the scope and ambition of the meeting, including the development of the plenary programme and other key initiatives. Additional major contributions were provided by three Platinum Sponsors, the Coastal Wildlife Club, Oceans and Wildlife Institute, and the National Oceanic and Atmospheric Administration. Further support was provided by the Pacific Cooperative Studies Unit at the University of Hawai'i at Mānoa as a Gold Sponsor, alongside a broader base of event-specific and general sponsors whose contributions supported student participation, programme delivery, and community events throughout the week.

The symposium's live and silent auctions were exceptionally successful, generating a combined total of \$39,185, including \$12,161 from the silent auction and \$27,024 from the live auction. This represents a record-breaking outcome for the symposium and reflects a high level of engagement and generosity from the global sea turtle conservation community.

Merchandise sales were also highly successful. Through an in-kind contribution from Free Fly Apparel, sun hoodies were made available for purchase, generating \$15,290 in gross revenue. With production costs of approximately \$5,000, net proceeds of roughly \$10,000 directly supported the symposium. The symposium

also included 18 exhibitors and vendors, including 6 commercial exhibitors and 12 non-profit exhibitors.

Travel grant support remained a major priority, with 180 applications received and 121 grants awarded (67.2% of applicants). Delivering this level of support in Hawai'i required substantial investment, with approximately \$149,000 allocated to support participant accommodations, reflecting both the success of fundraising efforts and the symposium's commitment to accessibility.

Together, these contributions enabled an expanded scope of programming, accessibility, and participant support beyond what has been achieved in previous symposia.

LEGACY AND FORWARD IMPACT

The 44th ISTS Symposium represents a clear inflection point in the evolution of the Society's flagship meeting.

By combining one of the largest scientific programmes to date with strong global representation, expanded accessibility, and a willingness to engage directly with complex and evolving conservation topics, the symposium broadened both the scope and purpose of the meeting.

Together, these elements reinforced the symposium's longstanding role as a platform for sharing research while elevating its function as a space for reflection, dialogue, and direction-setting within the global sea turtle conservation community. The conversations initiated in Hawai'i, particularly those centred on Indigenous leadership, contested conservation practices, and the evolving ethos of conservation, are likely to influence both discourse and practice in the years ahead.

In this way, the 44th ISTS Symposium not only reflected the current state of the field but also contributed to shaping its future trajectory.

ANNOUNCEMENTS



45TH INTERNATIONAL SEA TURTLE SOCIETY SYMPOSIUM, 2ND TO 8TH APRIL 2027, GQEBERHA (PORT ELIZABETH), NELSON MANDELA BAY, SOUTH AFRICA

RONEL NEL

President International Sea Turtle Society

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You are invited to join us to relish sea turtle-related conservation science, management debates and cutting-edge research together with people from around the world uniting in one country – South Africa. The symposium will celebrate conservation achievements while looking forward on how to address emerging challenges and opportunities. The theme for the symposium is *From ancient shores to ocean highways: Sea turtles at a crossroads*.

This theme reflects both the location and time in global history. Looking through this window into “deep time”, the theme acknowledges the evolutionary ritual of nesting, dispersal and migration that has unfolded through the eons. At the same time, it acknowledges the immensity of our rapidly changing world, where near-cataclysmic challenges await – climate tipping points, giga-scale coastal transformation and Artificial Intelligence capable of reshaping the status quo.

It is fitting to host this momentous meeting in South Africa. The country has one of the longest histories in conservation with some of the oldest formally recognised protected areas in the world, such as the Kruger National Park and Tsitsikamma Marine Protected Area. More

importantly, South Africa has been a pioneer in sea turtle conservation and monitoring.

Fossilised hatchling tracks from about 100,000 years ago have been discovered not far west of Nelson Mandela Bay, in a completely different marine bioregion from where sea turtles occur today. The oldest known record of sea turtle-human interactions comes from Sibudu Cave, in the Tongati River valley north of Durban in KwaZulu-Natal. These remains date from the late Middle Stone Age, about 50,000 years ago, indicating that early humans interacted with sea turtles.

The “modern history” of sea turtle conservation in South Africa began more than a century ago, when the first legislation protecting sea turtles was introduced in 1916. Five decades later, monitoring started in earnest, and the early conservation officers developed many of the techniques still used today. Now, we unite to celebrate the conservation successes and accomplishments of the past while grappling with the challenges of the future.

The 45th ISTS Symposium will be held in “Port Elizabeth,” on the southeastern edge of the African continent. Port Elizabeth is the colonial name of the town now known as Gqeberha. It is often called “The Friendly City” because of its smaller size, friendly people, exquisite beaches, laid-back attitude and relatively affordable lifestyle.

The Boardwalk Hotel and Convention Centre is a comfortable beachfront venue located just five minutes from the Chief Dawid Stuurman International Airport (PLZ is the airport code). There is plenty of nearby accommodation, along with restaurants, shops, and entertainment, all within walking distance. A short ride from the airport means you will not need a car to get around. Come prepared to join the locals in their early morning activities along the promenade, like beach walking, jogging, dog walking, and open-water

swimming from sunrise onwards, gradually giving way during the day to more social activities, sunbathing and evening dining.

In addition to the workshops, meetings, and symposium events, this is also your opportunity to explore the rest of South Africa. There are multiple day trips available within an hour of the city, ranging from visits to the Addo Elephant and Tsitsikamma National Parks, or a boat trip to St Croix Island to see African penguins. If you have more time, a leisurely journey westward along the spectacular Garden Route will take you to Cape Town and the winelands, while a flight north to Kruger National Park, iSimangaliso Wetland Park, or Hluhluwe Game Reserve provide the chance for a safari to see the Big Five.

Plan your journey and make the most of it!

The website will go live on 1st June 2026 at www.ists-symposium45.org, and abstract submissions and

registration will open on 1st October 2026. In addition to the traditional symposium themes, we would like to encourage submissions around sea turtle medicine, “omics,” and health-related topics, habitat management including ecosystem functioning and ecological roles, coastal zone management, and opportunities presented by AI-driven technologies.

The symposium will also trial a few innovations, such as electronic posters and thematic days with plenary speakers sharing wisdom at the start of the day and capturing lessons learned at the end. Favourite events, such as the silent and live auctions, will be done in local style, but, as always, they rely on you to bring gifts and items to be auctioned.

We cannot wait to host you in South Africa and share our local hospitality. Stay tuned for updates, put your thinking caps on, and start planning your presentations and travels. Make the most of your travels to the edge of the African continent.

INSTRUCTIONS FOR AUTHORS

Please refer to the style requirements listed below. Manuscripts should be submitted in MS Word or saved as text or rich text format. Appropriate files should be submitted by email to: iotn.editors@gmail.com. For further details please see www.iotn.org or consult a recent issue of IOTN.

Language and spelling: Please follow British spelling and grammar conventions.

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References in text: References should appear first in chronological then alphabetical order.

Two authors to be separated by ‘&’ symbol, e.g., as Rai & Sahu, 2001

More than 2 authors: first author *et al.* (*et al.* in italics) e.g., Roy *et al.*, 2004

Two publications of the same year for the same author(s), the reference in the text should be Sharma 1960a, b not 1960a, 1960b and the two publications should be dated accordingly in the references.

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References that are long and/or have acronyms: Only acronym in text,

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List personal communication references in text only. e.g. (Hariya pers. comm., 2011)

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For references with more than 7 authors: first 7 names, *et al.*

Use complete page ranges. e.g., 371-379 (not 371-9); 227-235 (not 227-35).

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Instituto Nacional de Reforma Agraria (INRA). 2008.

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Silas, E.G., M. Rajagopalan, A.B. Fernando & S.S. Dan. 1985. Marine turtle conservation and management: A survey of the situation in Orissa 1981/82 & 1982/83. *Marine Fisheries Information Service Technical & Extension Service* 50: 13-23.

Pandav, B. 2000. Conservation and management of olive ridley sea turtles on the Orissa coast. Ph.D. thesis. Utkal University, Bhubaneswar, India.

Kar, C.S. & S. Bhaskar. 1982. The status of sea turtles in the Eastern Indian Ocean. In: *The Biology and Conservation of Sea Turtles* (ed. Bjorndal, K.). Pp. 365-372. Washington, DC: Smithsonian Institution Press.

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CONTENTS

EDITORIAL

- 1 Editor's note
Andrea D. Phillott & Seh Ling Long

ARTICLES

- 2- 7 Rescue and post-mortem identification of sea turtles on the southwest coast of India
Zainul Abid P.M., Ratheesh Kumar R., Durga V., Adithya Chandra P.B., Utthamapandian U., Vishnu C.B., Balu Tharakan E.M., Krishnapriya P.P., Alvin Anto & Monolisha S.
- 8 - 16 Effect of density separation solution on isolation of microplastics from sea turtle nesting beach sand in Maharashtra and Goa, India
Aditi Renake & Andrea D. Phillott
- 16- 21 SSTCN Turtle diary of 2026
V. Arun & Akila B.

NOTES

- 22-23 Rediscovery of the leatherback sea turtle at Kadmat Island, Lakshadweep Archipelago, India
P.A. Habeebu Rahman, Aysha Suhaila P.K.P. & K.K. Idreesbabu

REPORTS

- 24 – 27 President's summary report: 44th International Sea Turtle Society Symposium, 28th February to 6th March 2026, Kailua-Kona, Hawai'i, USA
Alexander R. Gaos

ANNOUNCEMENTS

- 28 – 29 45th International Sea Turtle Society Symposium, 2nd to 8th April 2027, Gqeberha (Port Elizabeth), Nelson Mandela Bay, South Africa
Ronel Nel

