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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Photo Courtesy: Nicolas J. Pilcher

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EDITORIAL

EDITOR'S NOTE

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Despite another wave of COVID and lockdowns around the Indian Ocean and Southeast Asia, the IOTN team hopes that everyone was able to enjoy World Sea Turtle Day on 16th June. A special mention to IOSEA, who celebrated the 20th Anniversary of the Memorandum of Understanding with an online programme of talks that can still be viewed at http://bit.ly/seaturtle_livestream. If the 18 hours of 'Turtle TV' are not enough online entertainment for you, the 'Arribaba' exhibition, a collaboration between Aradhana Seth, Dakshin Foundation and WWF-India, has also been shared online (https://arribada.in/) after its showing was interrupted by India's response to the pandemic.

Issue 34 of IOTN brings to you the findings from stable isotope analyses in Oman, beach monitoring in Kenya, and observations of smuggling activities on nesting beaches in Pakistan. The issue also reports a range of outcomes from fisher-turtle interactions in Malaysia and India.

In addition, I draw your attention to the National Marine Turtle Action Plan (2021-2026) and Marine Megafauna Stranding Management Guidelines, both released by the Ministry of Environment, Forest & Climate Change in India in January 2021. These are the first documents of their kind for the country, and there has been limited discussion about them to date. IOTN will be interested to present the perspectives of different stakeholders as the action plan and stranding guidelines are implemented. The documents are available at the URLs below:

National Marine Turtle Action Plan (2021-2026):
http://www.indiaenvironmentportal.org.in/content/469691/national-marine-turtle-action-plan-2021-2026/

Marine Megafauna Stranding Management Guidelines:
http://www.indiaenvironmentportal.org.in/content/469754/marine-mega-fauna-stranding-management-guidelines/

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 35 of IOTN, please email material to iotn.editors@gmail.com before 1st November 2021. Guidelines for submission can be found on the last page of this newsletter or at http://www.iotn.org/submission.php.

ARTICLES

STABLE ISOTOPE ($\delta^{13}C$ AND $\delta^{15}N$) ANALYSIS OF OLIVE RIDLEY TURTLES FROM MASIRAH ISLAND, OMAN: A PRELIMINARY INVESTIGATION

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INTRODUCTION

There is a unique nesting population of olive ridley turtles (*Lepidochelys olivacea*) on Masirah Island, estimated to have around 150 turtles nesting annually in the 1970s (Ross & Barwani 1982). The population has subsequently received relatively little study (Rees & Baker 2006) and no trend in nest numbers is available to date; thus, the current status of this unique population is unknown. The only knowledge about movements of this population comes from a tracking study by Rees *et al*. (2012; n = 9), revealing five distinct inter-seasonal foraging areas (Figure 1). The turtle that is depicted in the most southern location in Figure 1 employed a vagrant strategy, constantly moving through oceanic and coastal waters in eastern and southern Oman, whereas the others resided in more spatially restricted locations. When northern and southern turtles were assessed as separate groupings, results from this study suggested that carapace size was related to foraging region (Rees *et al*., 2012). We are interested to see how representative of the population these results were. However, given the high cost and typically low sample size of satellite tracking studies, we sought the use of less costly alternative or complementary method to identify patterns of spatial distribution of olive ridley turtles in this region of the Indian Ocean.

Stable isotope analysis (SIA) has become a powerful and widely utilised tool in ecological studies and has been used to study marine turtle spatial, foraging, and reproductive ecology. The full potential of SIA was recently reviewed (Figgener *et al*., 2019; Haywood *et al*., 2019), and this includes the ability of SIA to assign individual turtles to specific foraging regions, given clear regional variation in stable isotope values (e.g., Ceriani *et al*., 2012; Bradshaw *et al*., 2017). This spatial variation is derived from food web isotopic signatures being reflected in the tissues of organisms and these signatures vary spatially based on a variety of biogeochemical processes (Hobson, 1999). For example, inshore food webs, linked to benthos, generally have higher $\delta^{13}C$ values than those from offshore pelagic food webs (Hobson, 1999).

Carbon and nitrogen isotopes analysed from epidermis

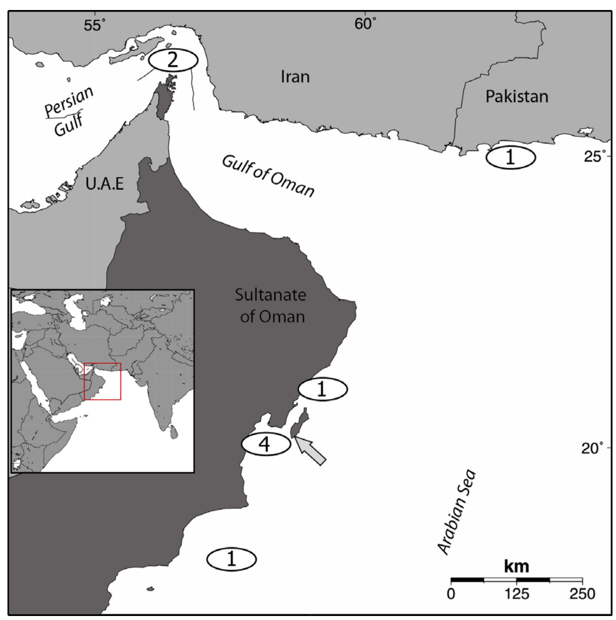

Figure 1. End locations of the only nine olive ridley turtles tracked after nesting on Masirah Island. Arrow indicates tagging site at the south of Masirah Island. Numbers indicate how many turtles used the location as a foraging area. Base map made in MapTool, a free map creation tool from seaturtle.org.

samples have been used to characterise loggerhead turtles (*Caretta caretta*) according to foraging area which identified a phenotypic difference between the underlying grouping, where body size was related to $\delta^{15}N$ (e.g., Zbinden *et al*., 2011; Ceriani *et al*., 2015), possibly suggesting phenotypic influences based on trophic foraging level. Here we use SIA of $\delta^{15}N$ and $\delta^{13}C$ to obtain isotope signatures of olive ridleys nesting on Masirah Island in an attempt to identify correlation between turtle size and stable isotope ratios to gain some further insight into their spatial ecology; with both the Indian Ocean and the species being underrepresented in global SIA studies (Pearson *et al*., 2017; Haywood *et al*., 2019).

METHODS

Sample acquisition

Small epidermis samples (approximately 5mm by 5mm) were collected by researchers from the Environment Society of Oman (ESO) from 14 olive ridley turtles that were encountered while nesting on Masirah Island, Oman (nine in 2013 and five in 2015). Samples were stored in 100% ethanol, initially at -5°C and subsequently at room temperature until analysis. In addition to tissue sample collection, two of the turtles were flipper-tagged (one each year) and Curved Carapace Length (CCL) and Curved Carapace Width (CCW) measurements were recorded to the nearest half centimetre for all turtles.

Sample preparation and analysis

Samples were prepared at the University of Exeter's Centre for Ecology and Conservation. Epidermis samples were separated from the dermis using a scalpel, then rinsed with deionised water, soaked for 24 hours, and dried in an oven at 60°C for 48 hours. Samples were then weighed to ~0.7mg (± 0.01mg) and folded into standard tin capsules prior to analysis. We were interested in the consistency in values for tissue samples from the same individuals and prepared replicate samples from four turtles.

Samples were sent to Elemtex Stable Isotope facility (www.elemtex.com) and combusted to analyse carbon and nitrogen isotope ratios, along with standard reference materials, Pee Dee Belemnite (PDB) and atmospheric nitrogen (AIR), for calibration. SI results of carbon and nitrogen ratios were given as parts per thousand (‰) using the equation: $\delta X = [(Rsample/Rstandard) - 1] \times 1000$ (where X is $\delta^{15}N$ or $\delta^{13}C$ and R is the corresponding ratio of 15N/14N or 13C/12C) and compiled for analysis.

The $\delta^{15}N$ and $\delta^{13}C$ were plotted, against each other and against CCL to identify evidence of clustering that might support previous findings identifying a tentative north - south dichotomy in body size (Rees *et al*., 2012). We manually divided the turtles into three size classes (CCL < 74cm, CCL 74cm-77cm and CCL >77cm) to simply investigate any relationship between isotopes and body size.

RESULTS

We obtained $\delta^{15}N$ or $\delta^{13}C$ values for all 14 sampled olive ridley turtles (Table 1). The results for four replicated samples were in close accordance with the original

Table 1. CCL and SIA data for 14 olive ridleys sampled from Masirah Island. * denotes values with inconsistent CCL and CCW combinations.

			Original Result		Replicate	
Individual	CCL (cm)	CCW (cm)	$\delta^{13}C$	$\delta^{15}N$	$\delta^{13}C$	$\delta^{15}N$
1	72.0*	85.0	-11.58	17.95		
2	72.0	74.0	-13.67	15.48		
3	73.0	73.0	-12.38	16.77	-12.44	16.48
4	74.0	75.0	-13.61	15.07		
5	74.5	71.5	-12.16	16.47	-12.36	16.33
6	75.0	73.0	-12.48	16.33	-12.60	16.35
7	75.0	75.0	-13.13	17.36		
8	76.0	77.0	-12.96	15.89		
9	77.0	77.0	-12.94	17.58		
10	77.0	74.0	-13.29	15.77	-13.31	15.54
11	77.5	76.0	-13.18	14.99		
12	78.0	74.0	-12.23	16.99		
13	79.0*	72.0	-14.20	19.22		
14	80.0	78.0	-13.42	13.52		

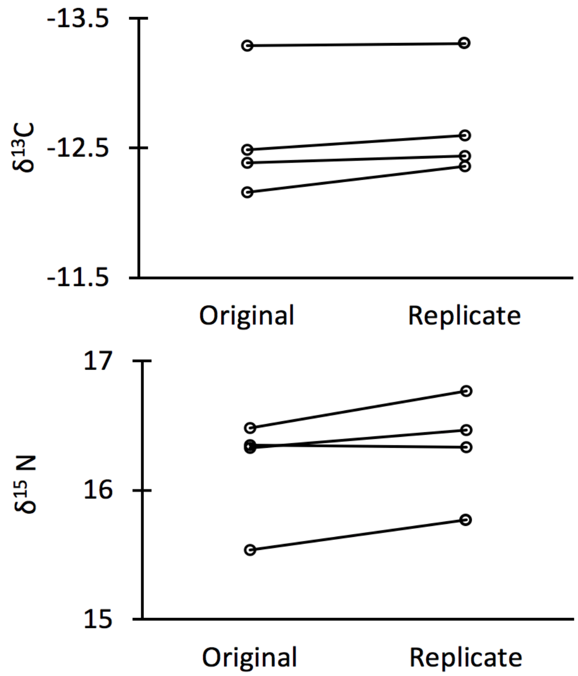

Figure 2. Difference in $\delta^{13}C$ and $\delta^{15}N$ values for replicate epidermis samples from four olive ridley turtles.

result (Figure 2), so all original data were kept. The CCL and CCW value combinations for two turtles were inconsistent (i.e., greater than 5cm difference between the two measurements; Rees, pers.obs.) and cast doubt as to accuracy of the CCL measurements (Table 1).

Mean CCL for all data was 75.7cm (75.8cm after removal of 2 suspect data points), range 72.0 to 80.0cm. Corresponding data for $\delta^{13}C$ were mean -12.95‰, range -11.58 to -14.20‰ and for $\delta^{15}N$, mean 16.38‰, range

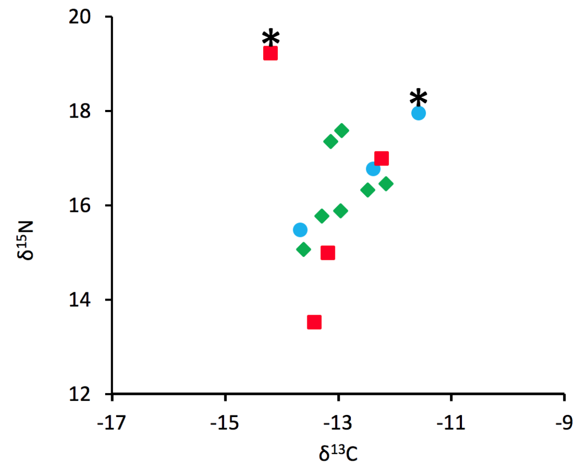

Figure 3. $\delta^{13}C$ and $\delta^{15}N$ values for the 14 olive ridley turtles, identified by size class (CCL). Blue circles = <74 cm, green diamonds = 74-77 cm, red squares = >77 cm. Data points with suspect CCL assignation are identified with an asterisk.

13.52 to 19.22‰. No clear pattern of size partitioning based on CCL was discernible plotting $\delta^{13}C$ against $\delta^{15}N$ signatures (Figure 3). One sample was a visual outlier, exhibiting both lowest $\delta^{13}C$ and highest $\delta^{15}N$ values.

There was no significant correlation between $\delta^{13}C$ and CCL (Spearman Rank Correlation, r_s = -0.295, p = 0.31; Figure 4a). Likewise, there was no significant correlation between $\delta^{15}N$ and CCL even after removal of the two suspect data points (Spearman Rank Correlation, r_s = -0.116, p = 0.72; Figure 4b).

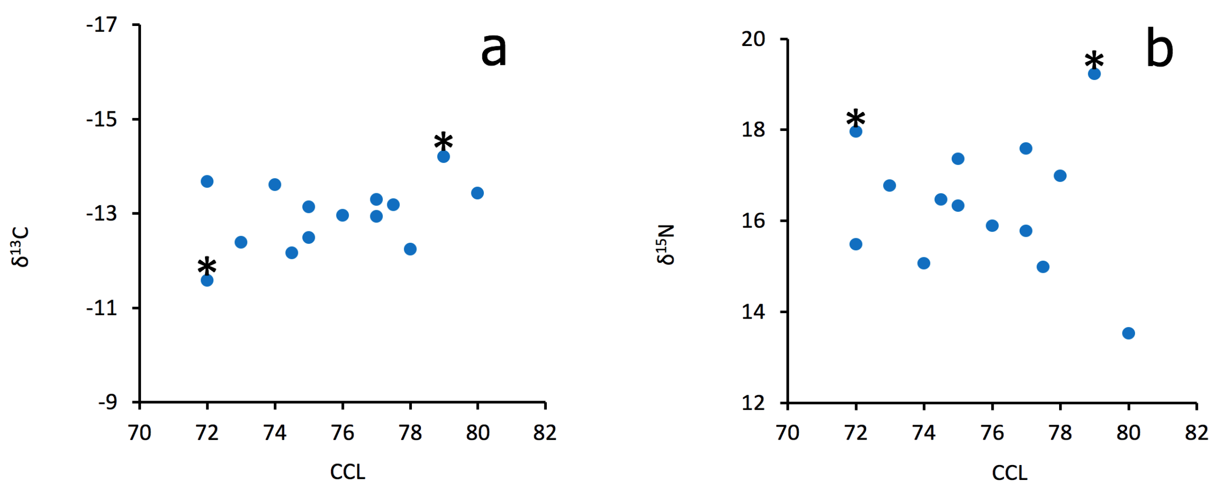

Figure 4. $\delta^{13}C$ (a), $\delta^{15}N$ (b) and CCL values for the 14 sampled olive ridley turtles. Data points with suspect CCL assignation are identified with an asterisk. No significant trends were observed.

DISCUSSION AND CONCLUSION

The close similarity in values between replicate samples from individuals suggests sampling and analysis were carried out in a manner sufficient to produce robust results and that inferences made from the absolute and range of values for both isotopes are reliable.

Values for $\delta^{13}C$ from Oman were notably higher than those for conspecifics from the eastern Pacific and southwest Atlantic (Table 2). Satellite tracking shows olive ridleys in Oman forage in coastal regions (Rees *et al*., 2012) where food webs are likely supported by algae or sea grasses as primary producers, whilst those from eastern Pacific and southwest Atlantic forage in oceanic waters (e.g., Plotkin, 2010) where food webs are likely supported by phytoplankton. Likewise, $\delta^{15}N$ values from Oman were higher than conspecifics from the eastern Pacific and southwest Atlantic (Table 2). In addition to potential oceanic baseline differences in isotope values, turtles with a coastal foraging strategy like those in Oman may be foraging at higher trophic levels than oceanic foragers. The almost 6‰ range for $\delta^{15}N$ is nevertheless highly suggestive of spatial influence on values, exceeding what may be expected from variation in food web isotopic signature alone. To better understand these oceanic differences, further research must be carried out.

No meaningful correlation between stable isotope values and body size was observed when considering the carbon and nitrogen stable isotope ratios singularly or in tandem. As the sampled individuals were not tracked and no isotope-body size effect was observed, no inferences can be made regarding foraging site and body size. Lack of differentiation can be due to a number of factors, including low sample size, potential heterogenous prey consumption at each foraging habitat that obfuscates dietary specific isotope signatures, or no difference in the baseline isotope ratios in these geographically separated foraging grounds (see Haywood *et al*., 2019).

Despite lack of characterisation found with the present samples, it is worthy to replicate and expand the study to incorporate a larger number of sampled individuals (suggested N≥50) and include contemporaneous tracking of a subset of the individuals (suggested N=15-20). Results from the tracking aspect alone would further highlight the relative importance of differing foraging locations and corroborate or refute the north-south body size dichotomy and incorporation of SIA may reveal further insights into foraging site and body-size trade-off, where productive foraging sites lead to increased body size.

Furthermore, due to the area's regional importance for sea turtle nesting (Ross, 1981; Ross & Barwani, 1982, Willson et al., 2020), it would be useful from a management perspective to also determine stable isotope values for the other three species of turtle found on Masirah (loggerhead turtle, green turtle *Chelonia mydas*, and hawksbill turtle *Eretmochelys imbricata*) together with their potential prey types. Determining potential prey (including vegetation) isotopic signatures from across the region can contribute to the foraging isoscape in which the turtles are located, which in turn can assist assignation of turtles to specific geographic regions and key habitats. Pearson *et al.* (2017) highlighted the need to align stable isotope study effort with conservation targets, showing few studies have been carried out in the Indian Ocean region or on Critically Endangered species such as hawksbill turtles that are of relevance to this area of study.

Finally, it may also be worth expanding the SIA to incorporate a third element, such as $\delta^{34}S$, which may better discriminate spatial structuring of foraging location, as was used to good effect in a study of green

Table 2. Mean and range in epidermis stable isotope values among olive ridleys sampled from Masirah Island (present study), Brazil (Petit & Bugoni, 2017) and the eastern Pacific Ocean (Peavey *et al*., 2017).

		$\delta^{13}C$			$\delta^{15}N$		
Location	**n**	**Mean (SD)**	**Min**	**Max**	**Mean (SD)**	**Min**	**Max**
Masirah Island, Oman	14	-12.9 (0.7)	-14.2	-11.6	16.4 (1.4)	13.5	19.2
Sergipe State, Brazil	43	-16.6 (0.7)	-17.9	-14.9	10.8 (1.3)	6.4	13.7
Gulf of California	29	-16.2 (0.5)	-17.8	-15.2	14.4 (0.7)	12.9	15.6
N. Equatorial Current	36	-15.7 (0.4)	-16.9	-15.1	13.6 (0.6)	11.5	14.5
E. Pacific Warm Pool	192	-15.4 (0.3)	-16.2	-14.5	13.3 (0.5)	11.9	15.0
Costa Rica Dome	63	-15.4 (0.3)	-16.1	-14.8	13.0 (0.6)	11.4	14.0
Peru Current	22	-15.9 (1.0)	-16.7	-14.6	11.7 (1.7)	8.8	15.2

turtles in the Mediterranean Sea (Bradshaw *et al*., 2018) and loggerheads in the southeast United States (Tucker *et al*., 2014).

Acknowledgements

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FUEL SMUGGLING: AN EMERGING THREAT FOR GREEN TURTLES AT DARAN BEACH, PAKISTAN

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INTRODUCTION

Green turtles (*Chelonia mydas*) nest on beaches along the coast of Pakistan throughout the year, with the peak nesting season between September and October (Firdous, 2001; Khanum *et al.*, 2014). Daran, which is located in the Jiwani area on the western most coast of Pakistan, supports the highest number of nesting sea turtles (Shockley, 1949; Waqas *et al.,* 2011; Moazzam *et al.,* 2020). Since Daran is a relatively remote area, turtle nesting and nests are usually not disturbed except by predators such as feral dogs, jackals, and foxes which dig up eggs, and gulls which prey on hatchlings as they cross the beach to the water (Waqas *et al.*, 2011). A major portion of Daran beach was extensively eroded by Cyclone Kyarr in late October of 2019, and the beach has not yet been re-established. No turtle nesting was reported from November 2019 to August 2020 (Moazzam & Hamera, 2020).

Daran is close to the border between Pakistan and Iran. Because of the porous nature of the border, a number of commodities are smuggled between the two countries. Fish is the usual product smuggled from Pakistan to Iran, whereas petroleum products (mainly diesel, petrol, grease, and bitumen) are smuggled from Iran to Pakistan. Iran produces 4.38 million barrels of oil per day and ranks 7th in the world for oil production. Pakistan produces only 0.08 million barrels per day of oil and ranks 53rd in the world (https://www.worldometers.info/oil/iran-oil/). Being an oil producing nation, the prices of petroleum products are low in Iran whereas the prices of fuel (diesel and petrol) are comparatively high in Pakistan. Because of the major disparity in the price of fuel between the two countries, smuggling of petroleum products occurs on a regular basis, with an estimated 1.2 million litres of petrol and diesel smuggled into Pakistan on a daily basis (Shahid, 2020). In the Jiwani area, this smuggling usually occurs in the creek system north of Daran (Figures 1-2).

The Iranian oil is often moved illegally into Pakistan in tankers and jerry cans mounted on pickup trucks and motorcycles in full view of the border security forces, customs authorities, and provincial administration. Border security agencies and customs authorities, at times, take action against fuel smugglers which results in temporary stoppage of the illegal trade. However, those involved in the smuggling then look for alternate routes for continuation of their illicit trade. In October 2020, after authorities had taken action against the smuggling of fuel from Iran into Jiwani via the usual route, those involved in the trade brought oil into the country via a sea route to Daran Beach for a period of 35 days. The beach had not been previously used for such activities. There is no landing facility at Daran, and the oil was carried in jerry cans from Iran and offloaded on to the beach at high tides (Figures 3-4). Hundreds of people

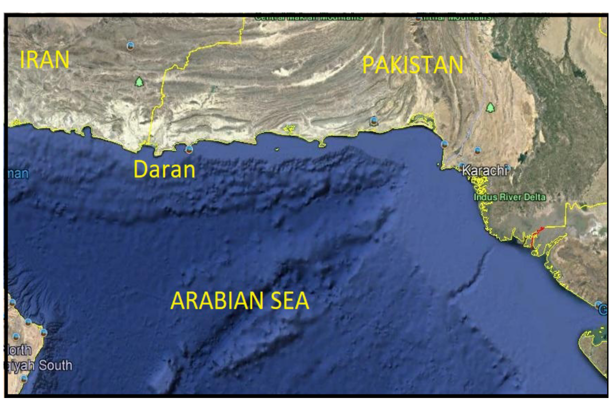

Figure 1. Coast of Pakistan showing Daran Beach.

Figure 2. Daran Turtle Beach in Jiwani area, Pakistan.

and ~50 pickup trucks were involved (Figure 5). This activity was mainly conducted during the daytime while low-level turtle nesting (~3 turtles per night at this time of year; Waqas *et al.*, 2011) continued at night.

Interactions with the smugglers were avoided, so it was not possible to take many photographs and collect detailed data on the impacts of oil smuggling on sea turtles at Daran Beach. However, the following have been observed:

a) Compaction of sand: Frequent human movement on the beach to transfer heavy loads of fuel from boats to pickup trucks leads to compaction of sand. Compacted sand decreases nesting success, alters nest-chamber shape and size, and hinders nest concealment (Crain *et al.*, 1995; Brinn, 2008).

b) Trampling of turtle nests: Frequent movement of people carrying heavy jerry cans resulted in the caving in or collapse of some nests, killing all eggs and hatchlings. This was observed in December 2020, when smuggling activities had shifted to other locations.

c) Spillage of fuel: During transfer of fuel from fishing boats to pickup trucks, fuel could be seen spilling from jerry cans due to loose, improper, or damaged caps. Patches of fuel were also seen on sand during the period the beach was used for smuggling. A major part of the beach was contaminated with fuel, as evident from the stench of oil in the area. Turtles are vulnerable to oil on the nesting sites as females may refuse to nest on the beaches that are contaminated with fuel (Camacho *et al.*, 2013). In addition, crossing of beaches contaminated with fuel could cause external oiling of the skin and carapace of nesting turtles.

d) Impact of fuel on embryos and hatchlings: Eggs exposed to oil or its products during the last half to last quarter of the incubation period have a significantly reduced hatching success and hatchling survival may also be affected. If hatchlings do survive to emerge from the nest, they tend to have developmental abnormalities (Wallace *et al.*, 2020). Two green turtle hatchlings, that emerged from a nest in the area frequented by fuel smugglers in December 2020 and were found after depredation, show anomalous scute counts (Figures 6-7). Prior studies at nesting beaches in Pakistan examined hatching success but not hatchling scale counts (Firdous, 2001; *Waqas et al.*, 2011) and future monitoring at nesting

Figure 3. Jerry cans filled with fuel being offloaded from small boats on Daran Beach in October 2020. (Photo credit: Anonymous)

Figure 4. Jerry cans filled with fuel oil offloaded from small boats kept for shifting to pickup trucks in October 2020. Compaction of sand can be seen due to human traffic on Daran Turtle Beach (Photo credit: Anonymous)

Figure 5. Jerry cans filled with fuel oil being loaded on pickup trucks at Daran Beach in October 2020. (Photo credit: Anonymous)

beaches could focus on this parameter as well to assess the potential impact of exposure to fuel.

e) The smuggling activity described here stopped in mid-November 2020 when smugglers shifted the operation back to their original site. However, Daran Beach was again used as a landing site from February to March 2021. It ceased again because of intensive wave action on Daran Beach. There is no possibility of the resumption of fuel smuggling at Daran Beach until the end of September 2021 because of rough sea conditions at this time of year.

Coastal communities in the area have asked the Government to keep a vigil and prevent illicit fuel smuggling through Daran Beach as it will have serious impacts on turtle nesting and other biodiversity of the area. They are also concerned because of the disturbance from movement of people, pickup trucks, and boats to fishing operations in the area.

Figure 6. Green turtle hatchling from Daran Beach with anomalous scute pattern, December 2020. (Photo credit: Anonymous)

Figure 7. Green turtle hatchlings from Daran Beach with normal and anomalous scute patterns, December 2020. Sand can be seen contaminated with spilled fuel from jerry cans. Hatchling with normal scutes is on the right. (Photo credit: Anonymous)

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SLAUGHTERED GREEN TURTLES (*CHELONIA MYDAS*) STRANDED ON THE COAST OF TERENGGANU, MALAYSIA, HIGHLIGHTS THE NEED FOR GREATER EDUCATIONAL AWARENESS WITHIN LOCAL COMMUNITIES

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INTRODUCTION

Within the last year, two incidents of green turtle carcasses, one male and one female, believed to have been killed by the cutting of their throats, were reported off the coast of central Terengganu State, Malaysia. In both instances, the Sea Turtle Research Unit (SEATRU) of Universiti Malaysia Terengganu and the Terengganu State Department of Fisheries (DOF) were contacted to investigate and determine the cause of death and make a report regarding the stranded turtle carcasses.

OBSERVATIONS

On the 4th October 2020, residents from Kampung Tengah Mengabang Telipot, in Kuala Nerus, Terengganu, reported the discovery of a green turtle carcass washed ashore on their local beach. They contacted SEATRU and DOF staff who conducted an extensive investigation and necropsy of the turtle carcass (Figure 1). The DOF report cited several key findings briefly describe below.

1. The turtle's sex was confirmed to be male due to the size and shape of its curved claws (brace claws) on its fore flippers.
2. The curved carapace length (CCL) measured 87.2cm, the curved carapace width (CCW) measured 77.4cm, and the turtle weighed 58.8kg.
3. The throat of the turtle was cut deeply, as if sliced open with a sharp knife.
4. The hind flippers and tail were eaten by monitor lizards, as reported by the villagers.
5. There was no significant bloating; therefore, death was assumed to have occurred within the previous 48hrs.
6. No foreign objects were observed in the digestive tract.
7. No external injuries like propeller or boat strikes were identified on the carapace, head, or limbs.
8. Several local fishers were interviewed who assumed that the mature male turtle was purposely killed and did not die from natural causes.

On the 26th May 2021, the carcass of another green turtle was found by the Kapas Conservation Society (KCS) floating offshore near the southern part of Kapas Island, off the coast of Terengganu State. The carcass was brought ashore by KCS who sent photographs to and

Figure 1. Photos taken at Mengabang Telipot, in Kuala Nerus, Terengganu showing (A) author MUR and DOF officers measuring the carapace of the slaughtered green turtle during their investigatory necropsy, in which they determined (B) the turtle was male based on the large brace claws present on the fore flippers, and a deep slash wound across the turtle's throat. Photo credit: Syamsyahidah Samsol.

communicated with the authors to determine the sex and cause of death (Figure 2). Later DOF staff performed an extensive investigatory necropsy of the turtle carcass and reported several key findings briefly describe below.

1. The turtle's sex was determined to be female due to the size of the tail and lack of large brace claws on its fore flippers.

2. The CCL measured 73cm and the CCW measured 67cm.

3. The throat of the turtle was cute deeply as if sliced open with a sharp knife.

4. There was a long and clean laceration along the central scute boundaries of the plastron, again appearing to be made with a sharp knife.

5. The turtle's internal organs were still intact within the peritoneal cavity.

6. There was also a small cut made to the back left flipper near the pelvic region.

7. The turtle was determined to be recently killed as there was no sign of bloating or scute peeling, typical in decomposed turtle carcasses floating at sea for long periods.

8. Locals believed that the plastron was cut open to retrieve unlaid eggs from the deceased turtle's internal body cavity.

DISCUSSION

Although most Malaysians consider sea turtles as part of their natural heritage and sea turtles are protected under the Fisheries Act of 1985 and the Terengganu Turtle Enactment of 1951 (Rahman *et al.* 2018), all four species of sea turtle found within Malaysia are in population decline and potentially facing extinction (Chan, 2006) due to the continued pressure from anthropogenic activities. The motive behind the separate killings reported here is thought to have been due to the turtles becoming entangled within offshore fishing nets, and the person/s responsible having killed the turtles to prevent them from thrashing and causing greater damage to their fishing gear. Enforcement of coastal fishing practices is particularly challenging in the region because these nets are often left at sea unattended for long periods, and it can be difficult to determine who the owners are, whether local or foreign, or whether licensed fishers or not.

The incidents reported here demonstrate one of the risks to turtles within Malaysia's coastal waters. An analysis of marine turtle stranding data off Peninsular Malaysia determined that stranding reports were concentrated

Figure 2. Photos taken at Kapas Island, off the coast of Terengganu, depicting (A) the lacerations made to the throat and plastron of a slaughtered female green turtle, and (B) DOF officers measuring the carapace length during their investigatory necropsy of the turtle carcass. Photo credit: Rani Bin Awang.

along the coast of Terengganu and Pahang, where the majority of turtle deaths were determined to be caused by anthropogenic factors; most notably from entanglement in fishing equipment, followed by boat strikes and external lacerations indicative of anthropogenic trauma. Furthermore, the stranding reports shows an increase in the number of turtle mortalities found within Malaysia's coastal waters from 2011 to 2019 (Mok, 2020).

Local fishers believe that the female turtle's plastron was cut open opportunistically to look for and retrieve its eggs. However, it would be easier to access the ovaries and oviduct through an inguinal cut, hinting at the inexperienced and opportunistic nature of the perpetrator/s. Therefore, it is most likely the perpetrator/s were not seasoned hunters, but more likely a coastal fisher who took the opportunity of a turtle entangled in their fishing net to retrieve some economic gain as the collection and sale of turtle eggs in Terengganu is highly profitable due to their exclusivity and high demand at local markets. This illustrates the adverse implications of the Terengganu state government sanctioning the commercial sale of green turtle eggs that encourage such heinous acts (see Mohd Jani *et al.*, 2020; Rusli *et al.*, 2020).

The carapace measurements of the slain female turtle (CCL=73cm and CCW=67cm), suggest that it would be a subadult yet to reach sexual maturity and not carrying eggs, as a study of 30 nesting green turtles at Chagar Hutang Turtle Sanctuary on Redang Island, Terengganu, determined the average maternal CCL measured 96cm and ranged between 84-107cm (Azmi, 2020). However, this might not be common knowledge in coastal fishing communities and that the female turtle had its plastron cut for the sole reason of collecting eggs. That the perpetrator/s may have tried to extract eggs but not taken any of the meat suggests the perpetrator/s were local. In Terengganu, coastal and island communities are majority Muslim and show high religious compliance, and in doing so only consume turtle eggs as eating the turtle's flesh is forbidden by Islamic Law. Furthermore, if the perpetrator/s were foreign fishers, it is considered that they would not have left the remains behind as the green turtle's body parts- the meat and carapace- would have high commercial value outside of Malaysia.

CONCLUSION

There is a need for greater marine conservation educational outreach in coastal fishing communities to educate people about the basic biology of sea turtles, their role as keystone species in coral reef and seagrass ecosystems, and the threat of extinction they face if their exploitation by humans is left unchecked. We suggest that the Malaysian State Government's DOF become more active in educating local fishing communities on what to do when they encounter turtles entangled in their fishing gear and make their officers better available to respond to sea turtle emergencies, in order to help rescue turtles from such situations that caused the deaths of the turtles described in this report. Only through local community outreach, the engagement and education of the individuals who may encounter sea turtles within Terengganu's coastal waters during their daily lives- about why killing turtles or plundering their nests is detrimental to the future survival of endangered sea turtle populations- can we make strides towards preventing the extinction of one of Malaysia's most charismatic marine organisms and ensure their existence as a natural heritage icon for generations to come.

ACKNOWLEDGEMENTS

We would like to thank Mohd Farith Rezza Isa for his dedication to sea turtle conservation, and for supplying SEATRU with photos and information about the slaughtered female green turtle discovered at Kapas Island, which ultimately motivated the concept of this report. In addition, we would like to thank Syamsyahidah Samsol for her assistance with the investigatory necropsy, and photographic documentary of the male green turtle found washed ashore in Kuala Nerus. Lastly, we would like to thank the Terengganu DOF officers who reported to these strandings, performed necropsies, and buried the carcasses of the deceased green turtles.

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NOTES

OBSERVATIONS ON BYCATCH OF SEA TURTLES AND SECOND RECORD OF LEATHERBACK SEA TURTLE OFF THE COAST OF MAHARASHTRA, INDIA

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Five species of sea turtles have been recorded from coastal waters of Maharashtra in India: (Karve *et al.*, 2020): the olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and leatherback (*Dermochelys coriacea*) turtles. All are protected under Part II of Schedule I of the Indian Wildlife (Protection) Act, 1972 (WPA, 1972), which offers the highest degree of protection to wildlife in India but still face many natural and anthropogenic threats (Chhapgar, 2005), including interactions with fisheries.

In December 2018, the Mangrove Cell of the Maharashtra Forest Department and the Fisheries Department of Maharashtra initiated a compensation scheme, under which fishers who cut or otherwise damage their fishing gear to release a marine animal protected under WPA 1972 were given monetary compensation. Fishers have to submit an application and photograph of an entangled animal in the fishing net, a video of the live animal being released back to the sea, GPS location of the incident, details of the boat owner and crew members, and boat registration documents to the Fisheries Department. Upon successful verification of the documents by the Fisheries Department, the application is forwarded to the Mangrove Cell and the compensatory amount is released to the bank account of the beneficiary. To date, the owners of 178 vessels have been compensated and 146 sea turtles have been released back to the sea by fishers along the coast of Maharashtra. Bycatch turtles recorded in the scheme comprise 90 olive ridley, 51 green, three hawksbill, and two leatherback sea turtles (Figure 1).

The first documented case of a leatherback turtle was recorded through the scheme in May 2019 (Karve *et al.*, 2020). We now share a second photographic record of a leatherback sea turtle (Figure 2) off Palghar district (20.03° N, 71.15° E). This turtle was caught on 12th March 2021 in a gill net (133mm mesh size) set during the day, ~85 nautical miles from the shore in water 55-60m deep.

The leatherback turtle was released by the fishers, who estimated its carapace length as “3.5 feet” (~110cm). The tail cannot be seen extending beyond the edge of the carapace in the video submitted to the Mangrove Cell, but the estimated carapace length suggests the turtle is a large sub-adult (Eckert *et al.*, 2012) or small adult and using tail length to distinguish between males and females at this size and/or age-class may not be reliable.

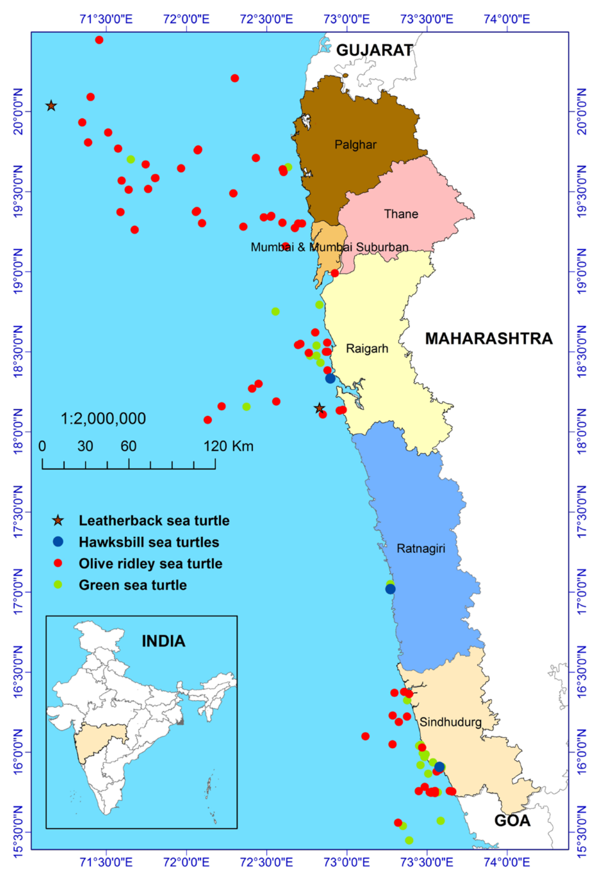

Figure 1. Locations of sea turtles caught in the fishing nets off Maharahstra and other states on the west coast of India from December 2018 to March 2021.

This information adds to the currently limited knowledge of occurrence and potential migratory pattern of leatherback sea turtles along the west coast of India. The earlier record of leatherback turtle off Bharadkhol (Karve *et al., 2020*) and recent record off Palghar district are from the months of May 2019 and March 2021 respectively, and may be related to the jellyfish blooms that occur in Maharashtra waters in the summer months (Saravanan, 2018).

Figure 2. Leatherback turtle entangled in gill net off Palghar district of Maharashtra on 12th March 2021 and released. (Photo credit: Prakash Tandel)

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RESCUE OF A GREEN SEA TURTLE CAUGHT IN A MIDWATER TRAWL ALONG PALK BAY, SOUTHEAST COAST OF INDIA

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An exploratory fish trawl survey was conducted on 4th March 2021 along the Mallipattinam coast of Palk Bay, Tamil Nadu, on the southeast coast of India. Midwater trawling was carried out between the coordinates of 10.25° N, 79.53° E and 10.28° N, 79.64° E, 5 nautical miles offshore and in waters 7m deep. When hauling the trawl net, we noticed that a single green turtle (*Chelonia mydas*) was accidentally caught in the trawl catch (Figure 1). The neck of the turtle was entangled in an abandoned gillnet. The turtle was removed carefully from the codend of the trawl net and cut free from the entangling gillnet without any further apparent stress and injury. The turtle was carefully examined but no sign of injury or malformation were found. Morphometric measurements were taken with a flexible tape measure (Figure 2) and the weight estimated by hand (Table 1). The tail did not extend beyond the carapace so, at this size, the turtle cannot be conclusively identified as male or female. The turtle was released back into the sea with the help of crew members (Figure 3).

Green turtles have a Type II developmental pattern, spending their early years in the oceanic zone and

Table 1: Morphometrics of bycatch green turtle.

Parameter	Measurements
Curved Carapace Length (CCL)	65cm
Curved Carapace Width (CCW)	62cm
Weight (estimated)	48kg

Figure 1. Bycatch green turtle -entangled in a gill net- in a trawl net. (Photo credit: Shanmugam Thirumalaiselvan)

Figure 2. Measuring the bycatch green turtle. (Photo credit: Muthusamy Rajkumar)

then moving into the neritic zone as young juvenile turtles (20-35cm CCL; see Bolten, 2003). Historically, seagrass meadows in the coastal waters of Tamil Nadu, including Palk Bay, supported foraging populations of green turtles (Agasitheesapillai & Thiagarajan, 1979) in such numbers as to support a commercial fishery (Jones & Fernando, 1973; Agasitheesapillai Mudaliar, 1996). The green sea turtle described in this study is likely part of the current foraging population in Palk Bay.

Figure 3. Release of bycatch green turtle into the sea. (Photo credit: Joseph Jegan)

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NEST LOCATIONS OF A GREEN TURTLE (*CHELONIA MYDAS*) AT WATAMU BEACH, KENYA

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Watamu Beach (3.367331° S, 40.00983° E) measures 5.7km in length and lies adjacent to the Watamu Marine Park on the north coast of Kenya (Figure 1). The park was established in 1968, making it Kenya's oldest marine park. Water temperature varies from 20°C (June to November) to 30°C (December to May). Watamu Beach is a nesting beach for mainly green and olive ridley turtles (Okemwa *et al.*, 2004), but one leatherback nesting has also been recorded (Van de Geer *et al.*, 2020). Daily monitoring (every night of the year) of sea turtle nesting on Watamu Beach is conducted by the NGO Local Ocean Conservation (LOC) in collaboration with local community members and other stakeholders.

Since 1997, LOC has been running a sea turtle nest monitoring and protection program which includes nightly beach monitoring for 2 hours before and after high tide, a period during which many turtles emerge to nest (Pinou *et al.*, 2009). The nest monitoring team at LOC observes nesting turtles to identify the precise nest location for monitoring purposes (SWOT Scientific Advisory Board, 2011). Turtles are tagged on both front flippers after nesting, following global tagging protocols (Heidemeyer *et al.*, 2018). The curved carapace length (CCL; cm) and curved carapace width (CCW; cm) are measured using a flexible tape measure in efforts

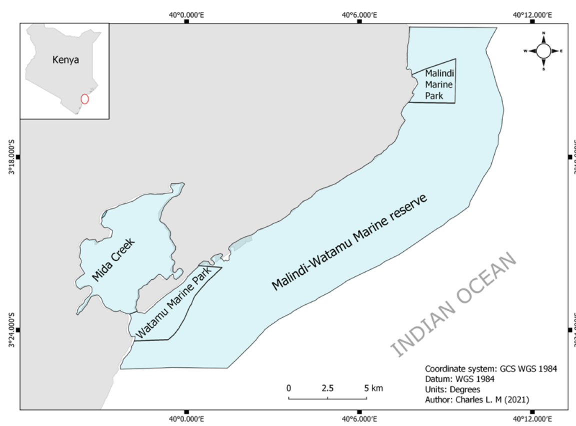

Figure 1. The location of Watamu Beach adjacent to the Watamu Marine Park on the north coast of Kenya.

to monitor growth rates of individual nesting turtles (Braun *et al.*, 2008). Eggs laid in vulnerable locations, for example below the high-water mark or at locations prone to depredation and disturbances from human factors like sunbeds and trade shades (known as beach shacks elsewhere in the region), are relocated to safer sites on the beach above the high-water mark (Tuttle *et al.*, 2010). The location of the original and relocated nest is recorded using a handheld GPS (GARMIN

Table 1. Nesting biology of the green turtle KE0628/KEL0363.

Nesting Season	CCL (cm)	CCW (cm)	Total # Clutches	Clutch Size (Mean±StDev)	Incubation Period (d) (Mean±StDev)	% Hatching Success (Mean±StDev)
2003	115.1	104.2	7	127.1 ±11.4	62.4±6.0	84.6±7.8
2008	115.0	104.0	8	122.1±9.7	72.1±5.1	89.0±9.1
2011	116.1	104.2	6	86.7±53.5	60.2±3.3	57.3±32.2
2014	116.7	103.5	7	79.1±47.8	65.3±3.8	59.5±40.5
2017	116.3	106.5	4	107.5±37.1	66.0±5.0	85.1±25.2
2020	115.3	110.1	3	119.0±34.6	64.4±3.6	89.4±7.6

eTrex 20x). Nests are monitored by frequent visits during night patrol until hatchling emergence, and nest contents are excavated and examined three days after the majority of hatchlings have left the nest to determine the clutch size and hatching success (Miller, 1999).

The continued long term monitoring activity by LOC confirmed repeated nesting of the green turtle tagged as KE0628/KEL0363 along Watamu Beach. This turtle was tagged in 2003 after laying its first recorded clutch, at which time it measured 115.1cm CCL and 104.2cm CCW. Since then, the turtle has been the longest recorded nesting history in Watamu, laying an average of six clutches per year, every three to five years, for a total of 35 nests from 2003-2020. Average clutch size, incubation period and hatching success over time are presented in Table 1.

However, the nest locations of green turtle KE0628/KEL0363 have shifted in an overall south direction during the five nesting seasons (2008, 2011, 2014, 2017, 2020; Figure 2), although one nest in 2020 was laid in the north of the marine park. A similar shift has been noted across the position of all nests over time (Makio, unpubl.). This geographic shift in nesting could be attributed to the shoreline changes resulting from temporary sea walls erected during the tourist season (August-March), which can affect the functionality of coastal beaches and can lead to sea turtle nesting shifts (Schooler *et al.,* 2017; Fujisaki *et al.,* 2018) and reduced sea turtle reproduction (Mazaris *et al.,* 2009). Additionally, the southwards shift in nesting could be due to different forms of coastal development, and/or lighting at the northern end of the marine park in comparison to the south.

These observations emphasise the importance of long-term and consistent monitoring of sea turtle nesting. This study recommends that similar long term and consistent monitoring be extended to other beaches along the Kenyan coast. Similarly, it recommends that the Integrated Coastal Zone Management (ICZM) Action Plan for Kenya 2010, which included strategic planning and management of coastal development, provision of infrastructure based on spatial planning, and coordination and communication mechanisms within and between governments, community and other stakeholders (Mwaguni & Munga, 2010), be implemented at Watamu Beach.

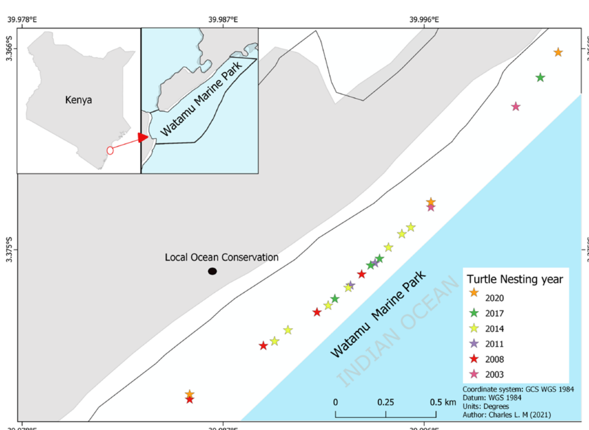

Figure 2. Nesting locations of the green turtle KE0628/KEL0363 over time along Watamu Beach.

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Photo of Interest

RELEASE OF REHABILITATED TURTLES

Image by Jeshurun Vineeth at Neelangkarai, Chennai, Tamil Nadu

Fishers turned conservation workers with the local NGO TREE Foundation rehabilitated three olive ridley turtles which had lost flippers after entanglement in fishing nets. After rescue and rehabilitation, the turtles were trained to swim in a backwater channel so their movements and buoyancy could be monitored for safety. Shown here just before release, the turtles are being kept cool and hydrated with seawater while they rest on a soft surface.

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