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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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WILDLIFE WITHOUT BORDERS

Cover photograph: Tourists watching hatchlings enter the ocean. Velas beach, Ratnagiri district, Maharashtra, India. Photo Courtesy: Aniket Sayam.

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EDITORIAL

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Many thanks for your messages about the focus of IOTN Issue 22 on sea turtle-fisher interactions. We hope to bring you more frequent special issues that explore topics on sea turtle biology and conservation in the future; if you would like to suggest a topic or facilitate a special issue yourself, please send us a message at iotn.editors@gmail.com.

Issue 23 of IOTN explores community conservation initiatives in the form of ecotourism in western India and beach clean-ups in Tanzania; plastic pollution of sea turtle habitats is also considered in a study on the prevalence of microplastics on beaches around the Indian Ocean. There are also reports on the first recorded nesting of leatherback turtles on Great Nicobar Island since the 2014 Indian Ocean tsunami, sea turtle workshops in Malaysia and the Maldives, and outcomes of the recent Red List assessments for loggerhead turtles in the region.

We look forward to seeing IOTN readers again at the 36th Annual Symposium on Sea Turtle Biology and Conservation. Safe travels to Lima, Peru!

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 24 of IOTN, please email material to iotn.editors@gmail.com before 1st April 2016. Guidelines for submission can be found on the last page of this newsletter or at http://www.iotn.org/submission.php.

ARTICLES

THE OLIVE CURRENCY: A COMPARATIVE ACCOUNT OF COMMUNITY BASED ECOTOURISM VENTURES IN WESTERN INDIA

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INTRODUCTION

One of the fastest growing divisions of the tourism industry (Tisdell, 2003), ecotourism is touted for demonstrating both conservation and economic benefits. The main objectives of ecotourism are ostensibly to provide financial aid for conservation of natural areas and ensuring employment and economic profits for those living in the area. This is expected, in turn, to result in the involvement of local communities in conservation and management activities (Garrod, 2003). Consequently, local involvement could ensure the sustainability and longevity of such initiatives. However, very few of these initiatives have had great success (Sakata & Prideaux, 2013).

Several countries have sea turtle ecotourism initiatives, including those at Heron Island (Tisdell & Wilson, 2001a) and Mon Repos (Tisdell & Wilson, 2001b) in Australia, Rekawa in Sri Lanka (Tisdell & Wilson, 2005), Tortuguero in Costa Rica (Jacobson & Lopez, 1994) and Bahía in Brazil (Marcovaldi & Marcovaldi, 1999). While initiatives at Tortuguero, Rekawa and Bahía are managed by local communities, Mon Repos is managed by the Department of National Parks, Sports and Racing of Australia. Similarly in India, a few community run ecotourism ventures were started in Maharashtra (in collaboration with a local NGO and forest department), while Goa and Karnataka states' initiatives were supported by the local forest department.

Historically, ecotourism in India has mainly focussed on safaris in pursuit of tigers, leopards or elephants. However, in the last decade, there has been a rise in sea turtle ecotourism ventures on the Indian west coast, namely in the states of Maharashtra and Goa. In Maharashtra, in order to involve the local communities in conservation activities, the *kasav mahotsav* or turtle festival was initiated in 2006 by a local NGO called Sahyadri Nisarga Mitra (SNM). At the same time, there were several attempts in Goa by local villagers, shack owners and resorts to introduce sea turtle based tourism programmes. While the Maharashtra venture involved community-run hatchling release, the Goa efforts were relatively unplanned viewings of hatchling emergence and seaward crawl for tourists.

This paper provides an account of attempts at turtle based ecotourism at these locations in Western India; each initiated using different approaches depending on stakeholders' roles. It examines the factors that determined the success or failure of these initiatives and explores current and future challenges for these initiatives.

METHODS

The study was conducted on the west coast of India, in the states of Maharashtra and Goa which have a 720 and 160km long coastline respectively. Olive ridley (*Lepidochelys olivacea*) turtles are the only species that regularly nest on this section of the coast (Giri & Chaturvedi, 2006), with a few rare reports of green turtles (Gole, 1997) and hawksbills. The western coast of India has lower density nesting than the east coast, with Velas beach (3km), Maharashtra, receiving a maximum of around 30-80 nests/year.

We used qualitative, semi-structured interviews to survey a cross-section of stakeholders i.e. the founding NGO, tour operators, home-stay owners and experts. The key informants were the members of the founding NGO and experts who provided detailed backgrounds to the ecotourism ventures along with potential threats to the continuity of these programmes. Inputs from villagers and tour operators were crucial in understanding the management and composition of such ventures. They also reported their views on the success or failures of these initiatives and ways to improve them. Before each interview, potential participants were given information about the project and its objectives and permission to

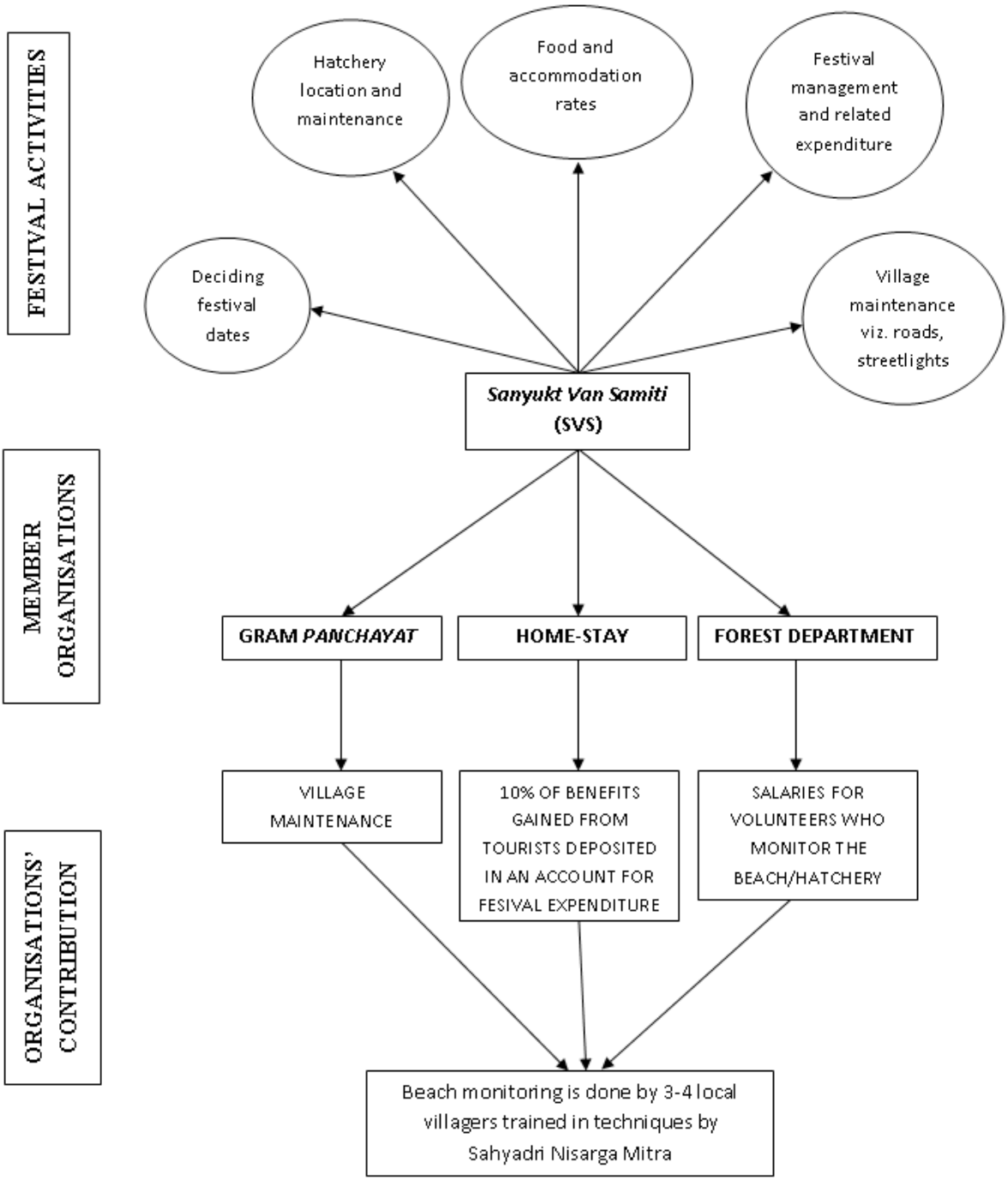

Figure 1. Contributions of stakeholders in the festival organisation.

record and use interviewees' responses was acquired.

RESULTS AND DISCUSSION

Stakeholders

The stakeholders involved in ecotourism in the two states varied depending on the socio-economic conditions, willingness to participate and resource availability. The participating groups mainly comprised of local villagers, Government departments and conservation NGOs.

In Maharashtra, consumption of turtle eggs was rampant

prior to the involvement of SNM (Darge pers. comm., 2015). After SNM's conservation efforts in the area, a ban was imposed on this consumption. To guarantee its proper enforcement, the local villagers of Velas were asked to join the monitoring and conservation programme and eventually, this was converted into a community run programme. Eventually, a turtle festival was initiated by SNM, which was over a period of time handed over completely to the local villagers and Forest Department (FD). The village governing council or *Gram Panchayat*, villagers and FD together formed a committee called the *Sanyukt Van Samiti* (SVS) to ensure proper management of the festival (Figure 1).

In Goa, there were several attempts to initiate sea turtle conservation and tourism at different locations. In Morjim, north Goa, conservation efforts were initiated by a local retired army officer, Captain Fernandes who involved local communities such as fishermen and beach shack (wooden huts that serve as restaurants and places for tourists to lounge on the beach) owners (Shanker & Kutty, 2005). This evolved into a sea turtle ecotourism project to involve youth as guides who were in charge of protecting the nests *in situ*. Shack owners were encouraged to join the initiative because it attracted more tourists to their business. In other locations like Agonda, the Forest Department protected sea turtle nests by erecting fences around them, with the shack owners catering to tourists.

Currently, 18km south of Morjim, on a beach called Mandrem, a resort called *Elsewhere* and its staff are involved in turtle ecotourism (http://www.aseascape.com/story.html). However, this is not open to all and is restricted only to the guests of the resort. Eventually, except for the Mandrem resort, most other ecotourism attempts failed to develop into substantial projects but have continued their conservation activities.

Tourism

The category of tourist has played a crucial role in determining the fate of ecotourism at each of these sites. The hatchling festival in Velas mostly receives tourists from cities in Maharashtra such as Mumbai, Pune and Kolhapur with few from other Indian cities such as Delhi and Kolkata. On an average, Velas receives only around 30 foreign tourists per year for tourism or community development activities. As the festival is advertised mostly in local newspapers, it mainly reaches out to local tour operators and people in Maharashtra.

As the popularity of the festival has increased, the number of tour operators offering Velas trip packages increased with most companies providing a two-day stay deal giving the tourists multiple opportunities to attend the hatchling release. During the day, the tourists also use the opportunity to visit other neighbouring tourist attractions and beaches like Bankot Fort and Shrivardhan or Harihareshwar beaches.

Goa, a popular global holiday destination, attracts tourists from around the world. The nature of clientele has been very important in determining the success of sea turtle conservation and ecotourism. According to Kulkarni (pers. comm., 2015), some years, interests of the tourist in sea turtles was very low while in other years, tourists would wait patiently to watch nesting or hatchling emergence regardless of the amount of time involved. The presence of tourists interested in sea turtles resulted in local shack owners keeping records of nesting so that they could inform them and in turn, ensure clients for their shack business. This resulted in an interest in turtle conservation and tourism for a brief period.

Successes and failures

The ecotourism ventures in both these regions have had positive and negative influences depending on various factors. The most successful venture has, so far, been the hatchling festival in Velas which has persisted despite a change in the managing organization and a limited market of tourists.

The Velas festival continues as a successful community-run initiative after the local villagers appreciated the monetary benefits from the activity and developed an innate interest in it. Due to transportation constraints, SNM included locals to facilitate daily monitoring since it was not feasible for their members to do so. Velas, being a remote village, is devoid of resorts or hotels and the closest hotel is 30-40km away. To ensure accommodation for tourists visiting the location, home-stays were initiated in local houses. The idea of home-stays was kept simple and required basic food, lodging and sanitation facilities. The rates for these facilities are uniform in all homes and are decided at the beginning of each festival by the SVS committee. Most villagers agreed that having home-stays boosted their household income considerably. With the majority of the population being agriculturists, home-stays provided them an alternate source of income as nesting occurs during the lull in the agricultural season.

Other form of local involvement included sale of local produce such as mango and jackfruit products, sale of coconut water, butter, etc. Formation of self-help groups for women with insufficient space for home-stays assured them an opportunity to earn by helping out in houses that provide accommodation.

In Goa, several lines of conflict arose between local

groups where one supported economic gains and the other conservation, which led to the closure of ecotourism initiatives. The programme slowly began to decline in the 2000s due to lack of support and conflict within the community. Also, a clientele more interested in late night parties had resulted in increased sound and light pollution which deterred sea turtles from nesting at those beaches. The tourism initiative ended but the locals agreed to help the Forest Department in patrolling and protection of the beach (Shanker, 2015). Currently, some local shack owners protect (*in situ*) nests close to their shacks for their patrons to see hatchlings and sometimes even sea turtle nesting (Kulkarni pers. comm., 2015). Without regular monitoring in Goa, nests that are found by chance are protected by erecting a fence around it. In some locations like the resort in Mandrem, tourists are allowed to release hatchlings.

The success in Velas can primarily be credited to the respect that local participants have for Mr. Vishwas (*Bhau*) Katdare, who initiated the sea turtle conservation activities in the region. Their participation in this initiative is credited mostly to the effort put in by Mr. Katdare for the festival in its nascent stage. His explanation to the villagers that it was turtles that attracted tourists and tourists brought benefits to the community led to their active involvement in not only the home-stay initiative but also turtle monitoring and conservation.

SNM also involved one local community member as a manager to handle most of the festival related activities such as monitoring, accounting, regulating tourist influx etc. On the other hand, the lack of community cohesion and an authority figure in the Goa initiatives resulted in the failure of ecotourism.

For monitoring in Velas, a few local individuals have been hired and trained in beach monitoring and hatchery management. Their work mainly involves deciding the hatchery location, construction, nest relocation and hatchling release. Tourists are not allowed to handle the hatchlings and these are released only by the appointed individuals. Stringent rules are in place to avoid any harm to the hatchlings. To ensure continuous funds for the turtle monitoring and festival, 10% of profits made by each home-stay owner are collected and used towards development of the village or other necessities for the festival. The success of the hatchling festival and its benefits has also encouraged the locals to host tourists year round for other eco-friendly initiatives. These include bird-watching, mango picking festival and garden tours to ensure tourist influx after the conclusion of hatchling festival for the year. This enthusiasm in hosting tourists should help ensure the continuity of the hatchling festival for years to come.

The equal and effective participation by all the stakeholders has resulted in a smooth running of the Velas festival. Each stakeholder has specific duties which they follow each year while making improvements in the process. Other motivating factors from the Government departments in the form of salaries, certification of quality from the state tourism department and awards such as *Sant Tukaram Gram Vangram* award (St. Tukaram award for forest friendly village) for conservation efforts in the district have also been beneficial (Upadhye pers. comm., 2015).

Potential future threats to ongoing efforts

At Velas, it is not clear whether all the nests found are relocated to the hatchery or just those that are under threat from predation. This raises questions about whether relocations are for conservation or the sole purpose of tourism. Although the tourists are warned before-hand about emergence being a natural phenomenon that cannot be guaranteed, most visit with the expectation of viewing hatchlings. Unruly tourists could be perceived as a threat to the culture of the village and lead to discontinuation of participation by the villagers (Joshi pers. comm., 2015). Some other threats that could endanger the festival are competition between the home-stay owners, poor waste management strategy, decline in nesting numbers, etc.

Currently, lack of development in the form of poor roads and electricity, and erratic phone connectivity is one of the major problems faced by the locals and tourists visiting Velas. According to the SVS, crowd management on the beach has also been a major challenge in conducting the festival. By rectifying shortcomings and avoiding pitfalls, Velas has the potential to build a successful ecotourism model. The adoption of approaches from the above case studies could help start similar initiatives elsewhere on the Indian coast and other developing countries.

CONCLUSION

From the described sea turtle ecotourism initiatives at Maharashtra and Goa, it appears that success requires involvement of locals, assistance from other stakeholders and assured sufficient compensation for their efforts. Handing over control to the locals, as in case of Velas, ensures they are able to make the necessary changes in its functioning in accordance with their needs and benefits. On the other hand, Goa showed that despite of favourable factors such as tourist influx and infrastructure, the efforts failed due to lack of enthusiasm at the community level and insufficient incentive to continue the projects. However, the success of community-based ecotourism activities has mainly

been credited to an effective partnership between local communities, government agencies and NGOs (Sproule, 1996), as has been the case in Velas. An increase in similar efforts would not only ensure income and employment for local communities, consequently enhancing livelihoods, but also boost the cause of conservation.

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FIRST NESTING RECORD OF LEATHERBACK SEA TURTLES ON THE WEST COAST OF GALATHEA BAY, GREAT NICOBAR ISLAND, AFTER THE 2004 INDIAN OCEAN TSUNAMI WITH NOTES ON NEST PREDATION

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INTRODUCTION

The leatherback sea turtle, *Dermochelys coriacea*, is rarely sighted in Indian waters and has few nesting records of on the mainland coast (Andrews *et al.,* 2002). However, nesting of leatherback turtles does occur in the Andaman and Nicobar islands (Andrews *et al.,* 2002), with Great Nicobar Island one of the three largest nesting grounds (Bhaskar, 1984; Andrews, 2000).

Galathea Bay in Great Nicobar Island (Figure 1) was an ideal nesting site for leatherback sea turtles prior to the 2004 Indian Ocean tsunami, with an increase in the number of nesting turtles every season. However, the nesting population was also under substantial pressure as a result of anthropogenic activities such as sand mining, bridge-port construction work, egg poaching and turtle meat consumption by indigenous peoples (Bhaskar, 1994; Namboothri *et al.*, 2012; Tiwari, 2012) and natural predation of nests by wild pigs, monitor lizards, and stray and feral dogs (Bhaskar, 1994; Choudhary, 2006; Namboothri *et al.*, 2012).

Galathea Bay bore the maximum impact of the 2004 tsunami, which destroyed all the nesting beaches (Andrews *et al.,* 2006; Hamann *et al.*, 2006). The last published leatherback nesting record is from November 2004, at which time 84 nesting leatherback turtles were observed in Galathea Bay (Andrews *et al.*, 2006). Post tsunami surveys indicated that the beaches were reforming (Andrews *et al.*, 2006) and it is now completely abandoned and free of any anthropological influence (Jadeja, pers.obs.). The present study looked for post-tsunami nesting on the west coast of Galathea Bay and potential threats to sea turtles and their nests.

METHODS

Galathea Bay (06° 49′ 05.99" N, 93° 51′ 16.65" E) on Great Nicobar Island is only accessible via a forest camp on the east coast. The Forest Department monitors sea turtle nesting on the east coast regularly and maintains a hatchery. The west coast is comparatively less or negligibly monitored as one has to cross the Galathea River, populated by saltwater crocodiles (*Crocodylus porosus*). Our study site was the uninhabited west coast, which has an expanse of 3.8km and the area characterized by sandy beach and dense beach vegetation.

The beach was surveyed each night from 18th to 20th February 2015 by two groups every half an hour during the incoming tide. After nesting activity was completed, sand samples (approximately 500g) were collected at a depth of around 10cm from the nest sites, packed in tight sealed polythene bags and transported for analysis. Samples were air-dried then sieved using five different mesh sieves (0.125mm, 0.25mm, 0.5mm, 1mm, 2mm). The sand temperature for each nest was recorded during the nesting activity using a PROBE thermometer at a depth of 25cm. Nest predation was described after direct and indirect sightings of predation during the survey period.

RESULTS

Four leatherback turtle tracks, probably 7-10 days old, indicating successful nesting were counted on the first day of the survey period. Three nesting leatherback turtles were observed on 20th February 2015. We also recorded three tracks for olive ridley turtles, including one false crawl, on the east coast of Galathea Bay. The sand grain size analysis and nest substrate temperature

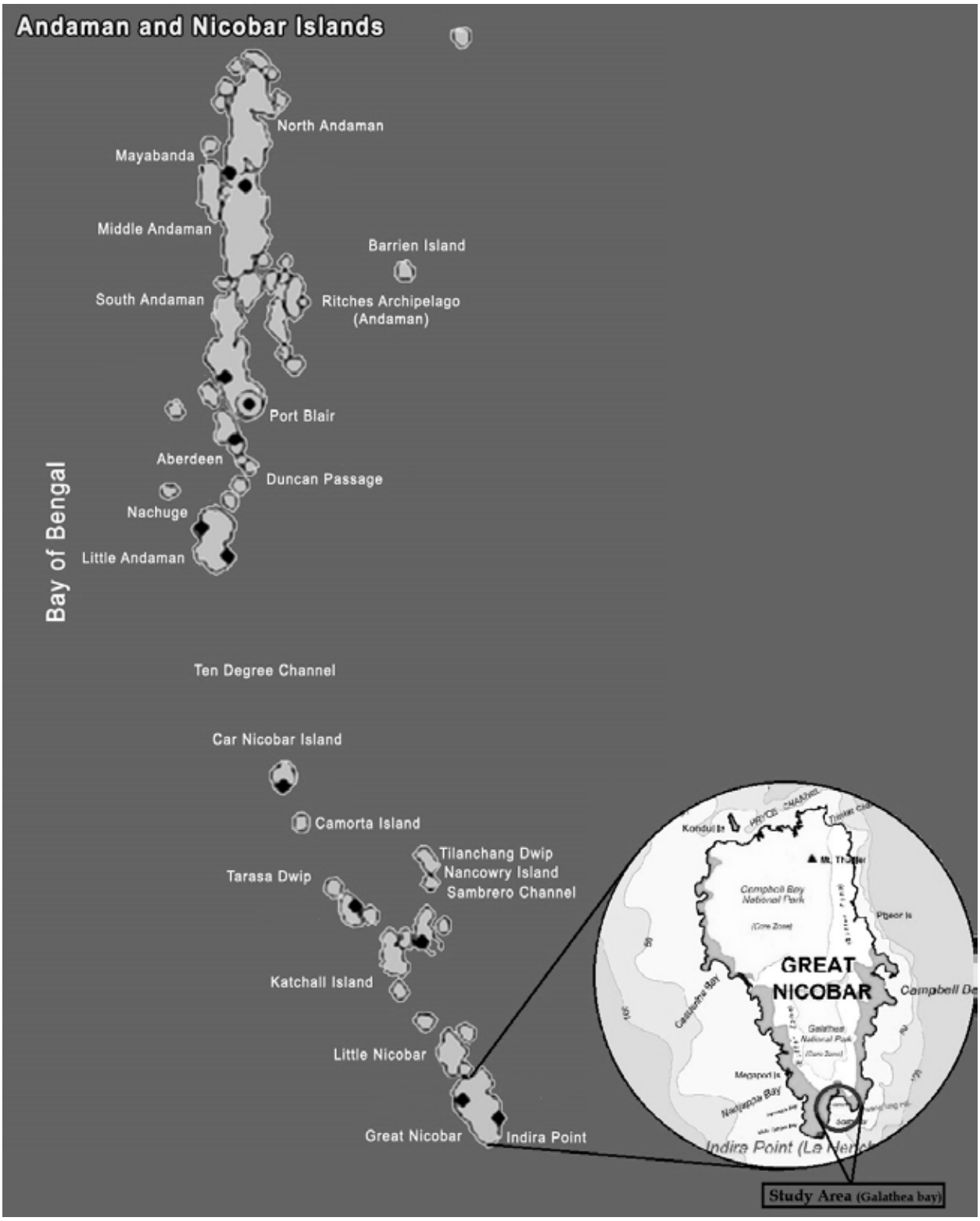

Figure 1. Galathea Bay at Great Nicobar Island in the Andaman and Nicobar Island Chain

Table 1: Physical properties of leatherback sea turtle nest substrates at Galathea Bay, Great Nicobar Island, 20th February 2015

Observation		Nest 1	Nest 2	Nest 3
Perpendicular distance from high tide line to nest site		~8.5m	~11.5m	~18.0m
Nest site temperature at 25cm		30.2°C	30.1°C	29.6°C
Sand grain size (sample weight 500gms)	2.0mm	0.11%	0.09%	0.04%
	1.0mm	0.18%	0.15%	0.13%
	0.5mm	0.09%	0.07%	0.11%
	0.25mm	0.41%	0.38%	0.36%
	0.12mm	0.13%	0.19%	0.17%
	Remainder	0.08%	0.12%	0.19%

(Table 1) show general consistency among nests. We suggest two potential predators for turtle eggs from the Galathea Bay based on our observations and published literature. The most aggressive forager is likely the Nicobari pig (*Sus scrofa nicobaricus*), observed actively searching the beach and digging out turtle nests to eat the eggs as the female turtle returned to the water after nesting (pers.obs.). We also observed hermit crabs feeding on exposed eggs after pig depredation of nests.

DISCUSSION AND RECOMMENDATIONS

The west coast of Galathea Bay, Great Nicobar Island, was previously a significant nesting site for leatherback turtles despite pressure from anthropogenic activities and natural predators. The nesting population has the potential to recover from disturbance resulting from the 2004 Indian Ocean tsunami, as human all settlements have gone and the region is, therefore, free of anthropogenic predation and light pollution which might affect nesting turtles. However, there is still predation of turtle nests by Nicobari pigs. Bhaskar (1994) also concluded that wild pigs were the chief predator of sea turtle eggs and hatchlings in this area, followed by the water monitor lizard (*Varanus salvator*), which was not sighted during the current survey. Predation by pigs may have increased since the tsunami, as human settlements may have deterred individual animals or controlled population numbers. A program to control pig numbers or protect turtle nests from pigs could help re-establish sea turtle populations at this site. There is no pre-tsunami substrate analysis from Galathea Bay with which to compare our results, but future substrate analysis may indicate changes as beaches re-stabilise.

ACKNOWLEDGEMENTS

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A STORY FROM THE FIELD: REMOVING MARINE DEBRIS TO RESTORE NESTING BEACH HABITAT IN KIPUMBWI VILLAGE, TANZANIA

LINDSEY WEST, BONIVENTURE MCHOMVU & TEMU PASTORY

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The pristine sandy beaches of Pangani District in northern Tanzania (Figure 1) are used by nesting green sea turtles *(Chelonia mydas*), while hawksbill turtles *(Eretmochelys imbricata)* are regularly observed foraging on inshore reefs. In 2008, Sea Sense NGO established a community-based sea turtle nest monitoring and protection programme. Since then, 713 green turtle nests have been recorded by a team of community 'Conservation Officers' who conduct daily foot patrols of six nesting beaches in Pangani District.

One of the beaches is close to Kipumbwi, a small fishing village situated in central Pangani District. However, nesting activity is rare at Kipumbwi due to high levels of human disturbance. There are 235 resident fishers in the village and an influx of as many as 800 migrant fishers during the main fishing season. Kipumbwi has the busiest fish landing site in Pangani District and it is an entry and exit point for goods (legal and illegal) from/to Pemba and Unguja (Zanzibar Archipelago).

With such high levels of human activity in Kipumbwi, a two-kilometre stretch of beach adjacent to the village had become severely degraded. The beach was used as a dumping ground for household rubbish and waste from fish processing (Figure 2). Many villagers were also using the beach as a public latrine. Rotting

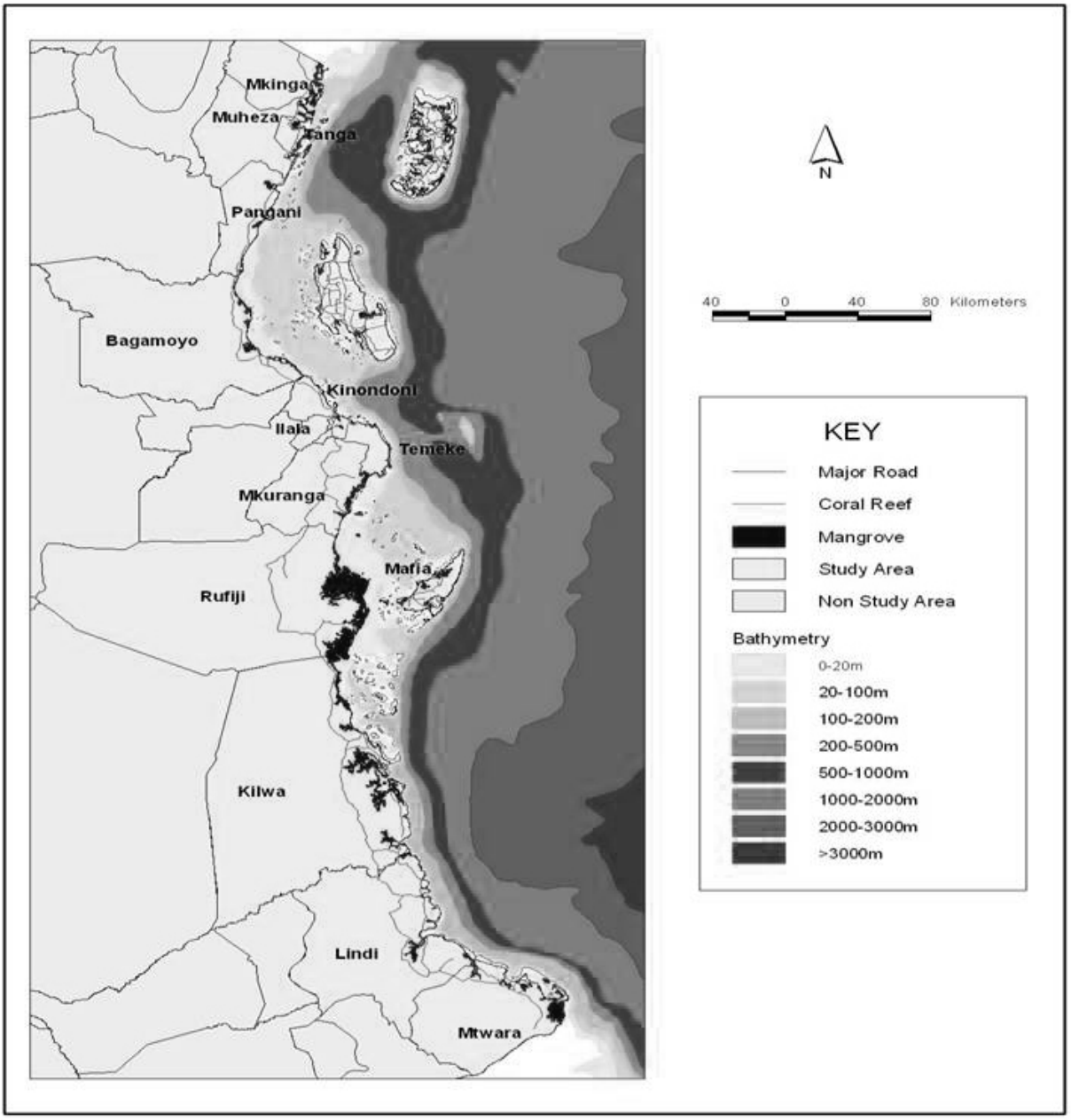

Figure 1. Pangani District in northern Tanzania

waste, fish carcasses and human excrement covered the beach, in close proximity to a sardine drying area. Therefore, the potential for growth and spread of infectious diseases represented a serious health concern. In 2011, in response to continued degradation of the beach, Sea Sense embarked on a waste management awareness campaign using community theatre as a form of educational entertainment. Fifteen members of Kipumbwi village were trained as 'artists' and worked with Sea Sense to design a series of storylines based around the issue of poor waste management and its impact on marine wildlife, human health and local livelihoods. The theatre performance was designed to include specific moments when members of the community-audience could ask questions, exchange ideas and experiences and suggest solutions to the waste management problem. In this context, community theatre has proven to be an extremely effective way of stimulating discussions about specific issues because it provides an opportunity for citizens and their leaders to communicate as a large group, in a participatory way. Citizens often become extremely vocal during the debates indicating a certain desire to challenge and demand accountability which is often suppressed without the presence of external support.

Figure 2. Rubbish on Kipumbwi beach in central Pangani District, Tanzania

Figure 3. Beach clean-up at Kipumbwi, Pangani District, Tanzania

Hundreds of villagers attended the theatre performance, which provoked extensive discussion and debate about the impacts of poor waste management as well as demands for community leaders to take action. As a direct result of the theatre project, a weekly village clean-up was implemented and enforced by Kipumbwi village council. In recognition of the positive step taken by Kipumbwi village leaders, Sea Sense donated wheelbarrows, rakes and gloves to assist with clean-up activities. An area of the village was set aside as a rubbish dump and citizens were fined by the village council for non-compliance.

Sea Sense continued with environmental awareness campaigns, and in 2013 an event to celebrate World Environment Day (June 5th) was held in Pangani Town. In the lead up to the event, Sea Sense elicited support from the District Commissioner and the District Executive Director, who led more than 50 district staff and local residents on a 'Clean-up Pangani' campaign. The following week, an event to celebrate World Oceans Day (June 8th) was held and Sea Sense once again joined forces with the Kipumbwi community to remove waste from local beaches and raise awareness on the importance of good waste management practices, including reusing and recycling.

To this day, the Kipumbwi village council continues to lead weekly beach and village clean-ups and local community groups have taken up the issue. A community fishers association successfully lobbied their local MP to join in a beach clean-up activity to support their efforts (Figure 3), and a youth group has shown interest in becoming ambassadors for improved waste management in Kipumbwi. To engage the youth group in International Coastal Clean-up Day activities, Sea Sense organised a waste management education and awareness session for the group. Twenty youths participated together with six members of the fisher association, a District Fisheries Officer and a District Environment Officer. The awareness session covered a range of topics including differences between degradable and non-degradable waste, types of plastic, links between waste and human health, and environmental legislation related to waste management. On International Coastal Clean-up Day the group led their own clean-up initiative in Kipumbwi and cleaned 2.5km of beach and collected 66kg of waste. The group separated, categorised and weighed the waste and their data were shared with the Ocean Conservancy who leads a global initiative to reduce marine pollution. Plastic bottles were separated for recycling although access to recycling facilities remains a challenge.

Towards the end of 2015, Sea Sense provided support to the community to formalise their waste management efforts by assisting with the drafting of village level waste management bylaws. These bylaws, authorised by the District Legal Officer, provide the Kipumbwi village council with a legal mandate to support and enforce effective waste management strategies in the community. Waste management has become high on the district agenda and this kind of institutional support is critical for the sustainability of community level actions.

In 2015, four years after the initial engagement on the issue of waste management, Kipumbwi beach is one of the cleanest in Pangani District and is used by villagers as a place for socialising and relaxation. Perhaps the beach will soon be used by nesting turtles again.

PRELIMINARY OBSERVATIONS OF MICROPLASTICS FROM BEACHES IN THE INDIAN OCEAN

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INTRODUCTION

Plastic is abundant and widely distributed throughout terrestrial and aquatic environments, and is now the main constituent of marine pollution. Sea turtles may be threatened by plastic pollution through ingestion, entanglement, degradation of key habitats including nesting beaches, and wider ecosystem effects (see Nelms *et al*. (2015) for a comprehensive review). Nelms *et al*. (2015) also recommend research priorities for each of these threats, among which are baseline surveys to establish the occurrence of plastic debris on nesting beaches and sand sampling to investigate plastic distribution and densities.

Plastic items of various types and sizes may accumulate on coastlines, including sea turtle nesting beaches (Ivar do Sul et al., 2011; Turra et al., 2014). Large plastic items may act as a barrier to nesting turtles or hatchlings and pose a risk of entanglement, but may be removed with continued, dedicated effort (as an example, see West *et al*. on pages 10-12 in this issue of IOTN). However, microplastics cannot be easily removed once in the environment (Cole *et al*., 2011) and may alter heat transfer and water movement in beaches. Changes in the thermal and hydric properties of a turtle nest have the potential to alter nest humidity and the likelihood of egg desiccation, incubation period, and hatchling sex ratio (reviewed by Carson *et al*., 2011). In addition, the nest substrate may become contaminated with persistent organic pollutants (POPs) absorbed by plastic articles or leached plasticisers (see Nelms *et al*. (2015)).

To investigate the potential for accumulation of microplastics on nesting beaches around the Indian Ocean to pose a threat to sea turtle nests in the region, we conducted a 'snapshot study' that would allow a rudimentary quantification of the density of microplastics and comparison among sites and previously published studies. It was anticipated that results of the study could then be used to inform design of a more detailed project, if warranted.

METHODS

Beach sand samples were collected from nine countries located around the Indian Ocean: Australia, Bangladesh, India, Indonesia, Maldives, Myanmar, Pakistan, Sri Lanka and Tanzania (Figure 1). In the absence of a recognised international protocol for sample collection, sand was collected from 1m seaward of the high tide line at 0-1cm depth within a 20x20cm sq. Replicate samples were not collected due to the problem of transporting large volumes of sand between countries. The method for separating microplastics from the sand samples was modified from that of Thompson *et al*. (2004) and Claessens *et al*. (2011); 100g of sand from each sample was dried in an oven at 100°C overnight, and three 25g sub-samples were used for further analysis. A concentrated saline solution (density of 1.2g/ml) was prepared by dissolving 357g NaCl in 1000ml of water at 25°C. The NaCl was visually checked before use, and showed no evidence of contamination with microplastics. 100ml of concentrated saline solution was added to each 25g dry sand sample before stirring using a magnetic stirrer for 2min. The slurry was allowed to settle for 1hr before vacuum filtration through GF/C Whatman filter paper with a pore size 1.2µm. The filter paper was then dried at 20°C for 1hr before microplastics, considered to be fragments less than <1mm in this study, were identified and counted using a dissecting microscope. The mean number of microplastics in a 25g sample was calculated from the three replicates to obtain the density of microplastics.

RESULTS

Microfibers, but not plastic beads or granules, were found in samples from all countries (Table 1). The average number of fibers was lowest (3.3) in Australia and Myanmar and highest (13.0) in India. The weight of the microfibers per sample was negligible and could not be accurately established.

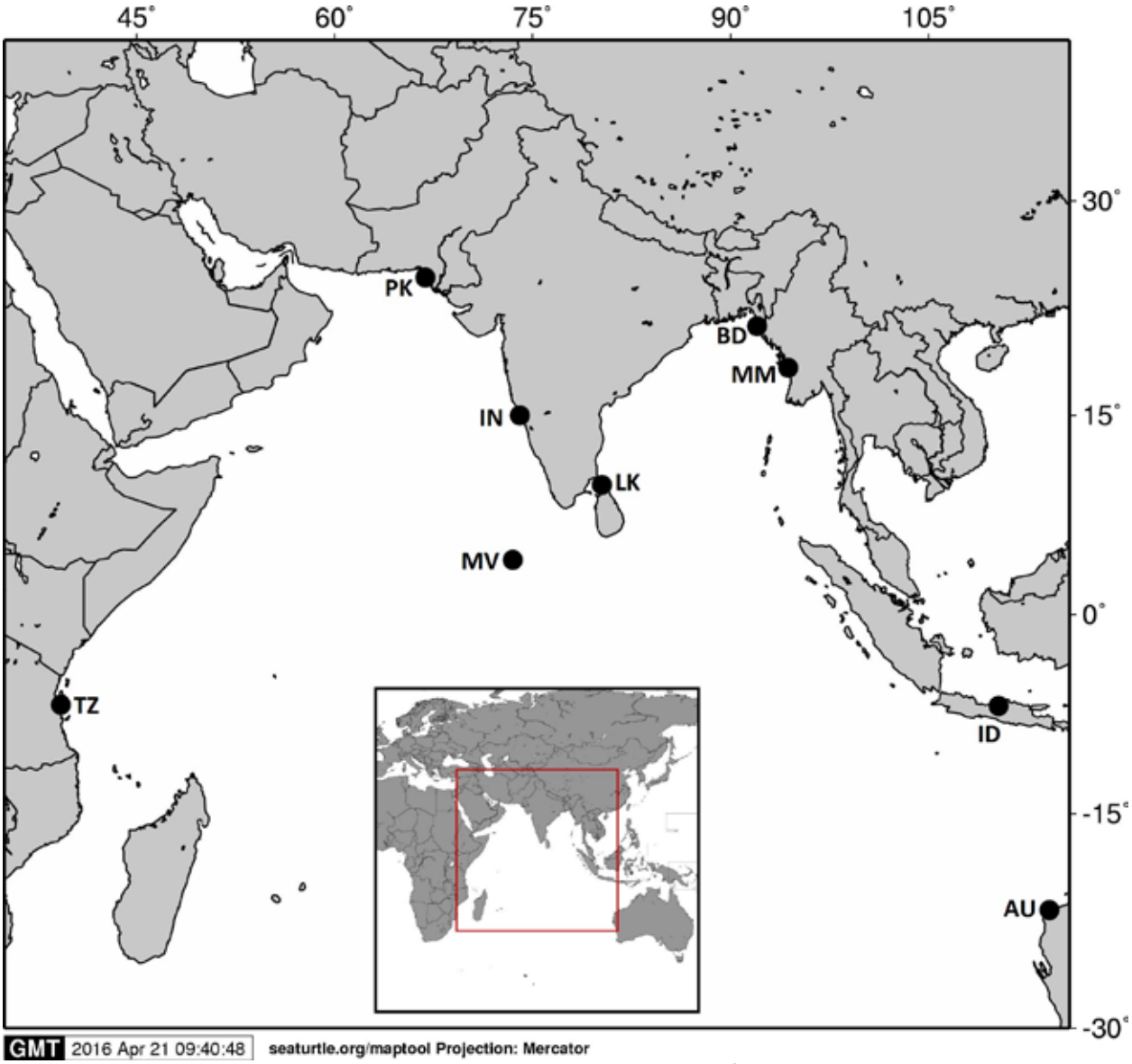

Figure 1. Location of sand samples collected from around the Indian Ocean. AU-Australia; BD-Bangladesh; ID-Indonesia; IN-India; LK-Sri Lanka; MM-Myanmar; MV-Maldives; PK-Pakistan; TZ-Tanzania

DISCUSSION

Microfibers, but not microplastics granules or fragments, were isolated from sand samples around the Indian Ocean. Woodall *et al.* (2014) also found a higher prevalence of microfibers than other microplastics in deep sediments and waters of the Indian Ocean, and concluded that particulates, mostly particles with larger volumes, may be transported from shallow coastal water to deeper seas by dense shelf water cascading (Canals *et al.*, 2006; Ivanov *et al.*, 2004), severe coastal storms (Sanchez-Vidal *et al.*, 2012), offshore convection (Durrieu de Madron *et al.*, 2013; Stabholz *et al.*, 2013), and saline subduction (Talley, 2002). Hence, the reason for not finding microplastic granules or fragments could be that the deposition and suspension cycle of particles may transport microfibers to the coastal areas and other microplastics to deep sediments and oceans.

Microfibers are secondary microplastics, plastic particles derived from the breakdown of larger plastics due to physical, chemical, and biological processes (Cole *et al.*, 2011; Stolte, 2014), and are most likely to have originated from treated or untreated domestic wastewater as more than 1,900 fibers can be released from clothes during a single wash (Browne, 2011). Fibers may also have originated from carpets and discarded and weathered polypropylene materials used in air filters, diapers and

Table 1. Number of microplastic fibers isolated from 25g sand samples collected from beaches around the Indian Ocean.

Country, Location	Mean (Range)
Australia, Exmouth	3.3 (4-5)
Bangladesh, Coxs' Bazar	12.3 (11-13)
Indonesia, Ngebum Beach	4.3 (4-5)
India, Palolem Beach	13.0 (8-17)
Maldives, Dhuni Kolhu	4.3 (4-5)
Myanmar, Napoli Beach	3.3 (3-4)
Pakistan, Hawkesbay Beach	12.0 (11-13)
Sri Lanka, Thumpalai Beach	9.6 (7-14)
Tanzania, Tebeke	4.6 (3-7)

fishing materials (Naidoo *et al*., 2015). In the current study, the highest numbers of microfibers were isolated from samples collected in Bangladesh, India, Pakistan and Sri Lanka (Table 1); however, our snapshot study examined only one sample per location, so comparisons among countries should not be made prior to more extensive sampling. It is interesting to note that number of microfibers isolated from beaches around the Indian Ocean exceeded those of many studies worldwide (Table 2), and is likely to be an underestimation as microplasic density varies with depth and surface sediments do not hold the greatest number of plastics (Turra *et al*., 2014). High numbers of microplastics may influence hatch success and hatchling sex (Carson *et al*., 2011) but the potential effect of microplastics at the density recorded in this study, and other, has yet to be determined.

ACKNOWLEDGEMENTS

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Table 2. Number of microfibers reported in studies worldwide. Numbers per sample weight were adjusted to the equivalent of 25g sand used in the current study.

Location	Site	Source	Fibers per 25g
Belgium, North Sea	High Water Mark Low Water Mark	Cauwenberghe *et al*. (2013)	0.41 0.09
Belgium, North Sea	High Water Mark	Claessens *et al*. (2011)	2.1-3.3
East Frisian Islands, North Sea	Beach High Tide Line Low Tide Line	Liebezeit & Dubaish (2012) Dekiff *et al*. (2014)	2.5-35 3.25 0.85
Germany, Baltic Coast	Drift Line	Stolte *et al*. (2015)	1.05-13.3
Halifax Harbour, Nova Scotia	High, Mid & Low Tide Lines	Mathalon & Hill (2014)	50-200
Romania, Black Sea	Seashore	Popa *et al*. (2014)	4.83-90.17
Singapore, Java Sea	Low Tide Line	Nor & Obbard (2014)	0.33-1.07
Slovenia, Adriatic Sea	Between High & Low Tide Lines	Laglbauer *et al*. (2014)	5.33

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REPORT ON THE MARINE TURTLE CONSERVATION SEMINAR AND WORKSHOP IN MALAYSIA, 1ST - 3RD SEPTEMBER 2015

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A report based on Watts and Migraine (2015).

BACKGROUND

Green (~2,400 nesting turtles annually), hawksbill (~500 nesting turtles annually), leatherback (<10 nests per year), and olive ridley (<10 nests per year) sea turtles nest in Malaysia. Some nesting populations of green and hawksbill turtles are believed to be stable, but severe declines in leatherback (99%) and olive ridley turtle (95%) populations have been observed since the 1960's. The size and status of foraging populations are largely unknown, although feeding green and hawksbill turtles have been observed in Malaysian waters (Liew, 2002).

Threats to sea turtles in Malaysia include: unintentional fishing bycatch; illegal, targeted poaching of turtles at sea; trade and consumption of eggs by humans; habitat degradation, disturbance and increased coastal development; and, natural predation of eggs such as through lizards, crabs and birds (WWF-Malaysia, 2016). The IUCN Red List of Threatened Species categorises global leatherback (Wallace *et al*., 2013) and olive ridley (Abreu-Grobois & Plotkin, 2008) turtle as 'Vulnerable', green turtles as 'Endangered' (Seminoff, 2004), and hawksbill turtles as 'Critically Endangered' (Mortimer & Donnelly, 2008). However, the West Pacific Ocean subpopulation of leatherback turtles is regarded as Critically Endangered (Tiwari *et al*., 2013); this is the only species of sea turtle found in Malaysian waters for which a subpopulation assessment has been completed and the Red List category for other species in this region may also differ from that of global populations.

Concerns about declining sea turtle population numbers and inadequate legislation to protect sea turtles were underlying factors for holding the seminar and workshop. Legislation to protect sea turtles in Malaysia is inconsistent among states. (Malaysia is a federal state comprising 13 states and three territories divided into two regions, Peninsular Malaysia (11 states and two territories) and Borneo (two states)). Under the Malaysian Federal Constitution, legislation may be enacted either by the Federal Government through the Parliament or by State Governments through State Legislative Assemblies. The Federal Constitution specifies which topics fall within federal (Article 74(1)), state (Article 74(2)) or joint authority (Federal, State and Concurrent Lists). Article 75 provides overriding power to laws made by Federal Parliament in the event of inconsistency between federal and state laws. Under the Federal Constitution, sea turtles are included in Item 12 on the States' list of mandates, so legislation, therefore, falls under the mandate of state governments. However, the Fisheries Act 1985 makes the federal government responsible for the conservation and management of sea turtles in waters within the Federal Territory of Kuala Lumpur and Labuan, as well as in areas outside the jurisdiction of any state in Malaysia (nine nautical miles from the shore).

Malaysian States can, therefore, enact legislation either through the States' Legislative Assemblies (with reference to the States' list of mandates), or with reference to section 1 of the Fisheries Act 1985, where relevant. In Borneo, both Sabah and Sarawak have listed marine turtles as totally protected under the Sabah Wildlife Conservation Enactment 1997 and the Sarawak Wildlife Protection Ordinance 1998, respectively. Two states on Peninsular Malaysia have enacted legislation on turtles: Terengganu and Perak. The Terengganu Turtle Enactment 1951 (amended 1987) prohibits the killing and taking of turtles and regulates the collection of turtle eggs via a licensing and tender system; however, there is no mention of the conservation of turtle habitats and the Enactment uses local Malay names with no definition at species level. The Perak River Rights Enactment 1915 only applies specifically to the Perak River within this State. The Enactment prohibits the

killing of turtles, but does not describe conservation of turtle habitats. The Sultan is given an exclusive right to collect turtle eggs laid within a specifically defined area.

Five states (Melaka, Penang, Johor, Negeri Sembilan, and Kelantan) have enacted Rules pursuant to the Fisheries Act 1985. Both the Melaka Fisheries (Turtles and Turtle Eggs) Rules 1989 and the Penang Fisheries (Turtles and Turtle Eggs) Rules 1999, which use the term "marine turtles" only with no definition of species, allow for state authorities to create marine turtle conservation reserves and provide for a licensed egg collection system. The Johor Fisheries (Turtles and Turtle Eggs) Rules 1984, Negeri Sembilan (Turtles and Turtle Eggs) Rules 1976, and Kelantan (Turtles and Turtle Eggs) Rules 1978 all use order *Chelonia* and local names with no definition of species, and allow licensed egg collection and tourism at turtle nesting areas, as well as the killing of turtles with the payment of a RM100 (USD23) fee.

MARINE TURTLE CONSERVATION SEMINAR AND WORKSHOP

The IOSEA initiated the sea turtle conservation seminar and workshop in Malaysia, 1st-3rd September 2015, which was organised by the Office of the Scientific Adviser to the Prime Minister of Malaysia and held at the University of Malaysia Terengganu. Three preparatory Stakeholder sessions, involving government representatives, marine scientists and conservationists, occurred prior to the seminar to develop the programme.

During the three-day program 85 representatives from government, scientific institutions and NGOs discussed the most important policy and legal interventions to enhance sea turtle conservation in Malaysia. Prof. Zakri, Scientific Adviser to the Prime Minister, emphasised that the discussion on sea turtle conservation in Malaysia had been occurring for more than two decades and that urgent action was needed and should result from this seminar. Presentations by the Executive Secretary of the Convention on Migratory Species (CMS) and the Coordinator of the Indian Ocean South-East Asia Marine Turtle Memorandum of Understanding (IOSEA MoU) explained the objectives, functioning and benefits for Malaysia to be a party and Signatory to the relative agreements, as Malaysia is currently a Signatory to the IOSEA MoU but not a party to CMS.

A detailed account of current laws and policies relate to marine turtles in Malaysia was followed by a number of presentations by government officials from different Malaysian States and NGOs. The presentations indicated that a number of strong conservation efforts are currently occurring, but that overall legislation was too disparate and weak to stop the decline in sea turtle populations. This was reconfirmed during the break-out sessions when participants reviewed Malaysia's National Plan of Action for Marine Turtles. Meeting participants were also given the opportunity to visit the Pulau Redang Turtle Sanctuary in Chagar Hutang, Kuala Lumpur.

KEY RECOMMENDATIONS

Participants at the seminar and workshop recommend that the Government of Malaysia:

- Review Malaysia's current National Plan of Action (NPOA) on Marine Turtles and update the document for the years 2016-2020. The document should incorporate a clear policy direction and priority issues identified with a monitoring mechanism and timelines stipulated for the achievement of each action to be undertaken. This task is to be completed by December 2015;
- Reactivate the Malaysian Sea Turtle Working Group (MSTWG) by November 2015 with multi-stakeholder membership and its Terms of Reference spelt out;
- Introduce a nation-wide ban on the selling of marine turtle eggs, as well as marine turtles and other derivatives by December 2016;
- Establish a dedicated multi stakeholder task force to re-examine the legal framework on turtles, and propose amending current legislations or create a new legislation to strengthen the governance of marine turtle conservation in Malaysia. This task force should complete its work by June 2016; and
- Take immediate actions for Malaysia to accede to the Convention on Migratory Species, subject to reservation if need be, by April 2016.

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REPORT ON THE SUB-REGIONAL WORKSHOP TO ESTABLISH THE NORTHERN INDIAN OCEAN MARINE TURTLE TASK FORCE (NIO MTTF), 11-12TH OCTOBER 2015, MALÉ, MALDIVES

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A report based on documents and statements arising from the sub-regional workshop to establish the NIO MTTF available at the IOSEA website (http://www.ioseaturtles.org/content.php?page=NIO-MTTF_Reports).

BACKGROUND

Five species of sea turtle nest in the Northern Indian Ocean (NIO): green, hawksbill, leatherback, loggerhead, and olive ridley. The IUCN Red List of Threatened Species categorises global olive ridley (Abreu-Grobois & Plotkin, 2008) turtle populations as 'Vulnerable', green turtles as 'Endangered' (Seminoff, 2004), and hawksbill turtles as 'Critically Endangered' (Mortimer & Donnelly, 2008). The global population (Casale & Tucker, 2015) and East Indian Ocean subpopulation (Casale, 2015) of loggerhead turtles are both regarded as 'Critically Endangered'. Global populations of leatherback turtles are categorised as 'Vulnerable' (Wallace *et al.*, 2013); however, the Northeast Indian Ocean subpopulation of leatherbacks is categorised as 'Data Deficient'. Subpopulation assessments have not been completed for all species in the NIO, so Red List categories for olive ridley, green and hawksbill sea turtles in this region may differ from that of global populations.

Discussions during the seventh meeting of signatory States to the Indian Ocean and South-East Asia (IOSEA) Memorandum of Understanding (MoU) in 2014 identified the need to establish a dynamic Task Force for implementation of the IOSEA MoU in the NIO region. Hence, a two-day regional workshop was held from the 11-12th October 2015 in Malé, Maldives. The workshop was hosted by the Government of the Maldives and organised by the Marine Research Centre. Participants included governmental and non-governmental representatives from Bangladesh, India, Maldives, Pakistan and Sri Lanka, regional experts and resources persons, and the IOSEA Secretariat.

Presentations by a representative from each country highlighted the greatest threats to sea turtles in the NIO, which were described as bycatch, habitat destruction, beach illumination, poaching of sea turtles and eggs, nest predation, and potential impacts of climate change. The forthcoming expiration (early 2016) of the moratorium to kill sea turtles in the Maldives was also noted. Current conservation actions to address these concerns range from bycatch monitoring, seasonal fishing bans, predator control, awareness and education programs, and law enforcement. A presentation about ghost gear in the Indian Ocean, a threat which effects sea turtles

throughout the region but which is most observable in waters around the Maldives due to its location in relation to currents within the Indian Ocean gyre, highlighted the need for regional cooperation in addressing such issues.

IMPORTANCE OF REGIONAL MARINE TURTLE TASK FORCES

Using the Western Indian Ocean Marine Turtle Task Force as an example, it was determined that a Northern Indian Ocean Marine Turtle Task Force (NIO MTTF) would play an important role in facilitating the sharing of:

- scientific data and information on threats to sea turtles and their habitats as well as conservation successes;
- standardised protocols and guidelines to address pressures and threats to sea turtles and their habitats;
- best practices for the conservation and management of sea turtles and their habitats;
- regional awareness and education campaigns related to the protection of sea turtles and their habitats; and
- cooperative efforts among governmental and non-governmental organisations, academic institutions civil society in conserving, protecting, replenishing and sea turtles and their habitats.

ESTABLISHING THE NIO MTTF

It was determined that the NIO MTTF would comprise two representatives from each member country, one from government and one from an NGO or academic institution, both to be selected by the Government based on the expertise currently required by the Task Force (governmental representative) and technical expertise (non-governmental representative). Task Force members might serve for three years and be eligible for re-nomination and reappointment pending Government approval. Observers contributing to or affecting marine turtle conservation in the NIO could attend Task Force meetings if proposed by the Chair of the Task Force in consultation with the Task Force members or the IOSEA Secretariat. For the complete Terms of Reference for the NIO MTTF see http://www.ioseaturtles.org/UserFiles/File/NIO-MTTF_Terms_of_Reference-Oct2015.pdf.

Muralidharan Manoharakrishnan (Dakshin Foundation, India) and Khadeeja Ali (Ministry of Fisheries and Agriculture, Maldives) were elected as Chair and Vice-Chair respectively. The NIO MTTF will meet annually, in conjunction with the Meeting of IOSEA Signatory States or with meetings of other international and regional bodies where possible. Broader regional issues to be addressed by the regional work programme include:

- fisheries/bycatch
- ghost nets
- standardised monitoring protocols
- sustainable ecotourism
- headstarting practices
- coastal development and anthropogenic light pollution
- socioeconomic issues
- climate change
- marine pollution
- citizen science
- sustainable use.

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RESEARCH SUMMARIES

FISHERIES AND TURTLES

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Issue 21 of IOTN focused on sea turtle-fisher interactions and presented new and important information on turtle by-catch in the Indian Ocean-South East Asian region. Collectively, these locally-based studies all reinforce the absolute need to involve local fishing industries in both the quantification of bycatch and developing solutions to the problem. Clearly, studies like these are valuable for local scale conservation of marine turtles.

Sea turtles, however, are international travellers and turtle populations can be exposed to fisheries in the waters of multiple nations or by many fisheries. At larger, national, or multi-national scales there are challenges to understanding and mitigating bycatch of marine turtles in commercial fisheries. Among them are: (1) the difficulty of assessing the impact of bycatch when both the rate of capture and the size of the affected marine turtle populations are not well known; and, (2) the challenges of cumulative fisheries impacts– i.e. that a particular turtle species or management unit is likely affected by more than one fishery.

These challenges have been addressed in part by research published in 2016. Casale and Heppell (2016) addressed the problem of not knowing the size of the species or populations impacted and thus not being able to quantify the severity of the bycatch problem. They did two key things. First they estimated the population size of two species in the Mediterranean by developing a theoretical demographic structure and abundance estimate that was as similar as possible to the Mediterranean populations. They then used Potential Biological Removal, a technique commonly applied to marine mammals, to examine whether the estimated loss of Mediterranean green and loggerhead turtles to bycatch was sustainable. The answer– it is likely unsustainable.

Another challenge to understanding and mitigating bycatch on large geographic scales is the lack of knowledge of the spatial and temporal degree to which a species/population is exposed to the threat. Lucchetti *et al.* (2016) used a combination of GPS tracking of turtles, GPS tracking of commercial fishing boats, and GIS analysis to quantify the extent to which turtles would be exposed to fishing activities. They calculated the probability of turtle occurrence in the northern and central Adriatic Sea and from this they estimated exposure of turtles to trawl fishing. These types of data combinations and analyses are becoming easier with advances in GIS based software and will be critical for designing spatial-based protection of sea turtles to fishing.

Sea turtle species or populations are generally spread over large geographic ranges. Thus, it is unlikely that a species or population of marine turtle is going to impacted by a single fishery. Understanding the cumulative impact of fisheries is challenging because bycatch data are often collected by different agencies or even the agencies in different nations. A PhD student at James Cook University in Australia, Kimmie Riskas, approached this problem by compiling all available bycatch data from multiple Australian fisheries to establish an estimate of total fisheries combined impacts (Riskas *et al.*, 2016). Her work stopped short of adding in international catch, but it would be an obvious next step if data were available. Kimmie's work also highlights the need to improve species identification so as to enable improved population based management.

Another key gap in managing fisheries bycatch programs is that the link between turtle captures and mortality to genetically distinct populations (see FitzSimmons & Limpus 2014) is mostly unknown. This gap is important to fill because a small population can withstand less mortality than a large one. While there are some challenges (e.g. CITES) to collecting skin samples from turtles caught by fisheries in international waters for genetic analyses, presumably international collaborations could overcome these. Plus national level projects could be attainable and would have considerable value.

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SUMMARY OF THE LOGGERHEAD TURTLE RED LIST ASSESSMENTS IN THE INDIAN OCEAN

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A summary based on:

Casale, P. 2015a. *Caretta caretta* (North East Indian Ocean subpopulation). The IUCN Red List of Threatened Species 2015: e.T84126444A84126520. http://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T84126444A84126520.en.

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Following decades of scientific debate over the appropriateness of using a global listing for sea turtles (Groombridge & Luxmoore, 1989; Mrosovsky, 2003; Godfrey and Godley, 2008), the IUCN Red List of Threatened Species now includes assessments for species at both the global and subpopulation levels. This enables systematic regional evaluation of each management unit, as threats, conservation efforts and recovery levels can vary significantly between regions.

A recent assessment of the loggerhead sea turtle (*Caretta caretta*) now lists the global population as 'Vulnerable', with the following listings assigned to each of its ten subpopulations (Casale & Tucker, 2015):

Critically Endangered: North East Indian, North West Indian, South Pacific
Endangered: North East Atlantic
Near Threatened: South East Indian, South West Indian
Least Concern: Mediterranean, North West Atlantic, South West Atlantic, North Pacific

The greatest threat to loggerheads worldwide is mortality associated with fisheries bycatch, followed by coastal development and direct harvest of eggs, meat and other products (Wallace *et al.,* 2011). Many of these threats also place loggerhead turtle populations in the Indian Ocean at risk (Casale & Tucker, 2015).

Loggerhead subpopulations in the northern Indian Ocean are among those facing the highest risk of extinction, and are listed as 'Critically Endangered'. Track counts at Oman's Masirah Island—the nexus of nesting for the North West Indian Ocean subpopulation—have declined by 70% over a thirty-year period (Casale, 2015b). Unfortunately, estimates of total abundance for this subpopulation are not available, with Oman's nesting data coming solely from a single index site. For the small and largely understudied North East Indian Ocean subpopulation, nesting is believed to be limited to the beaches of Sri Lanka, with a mere 25 nests estimated annually (Casale, 2015a). Unfortunately, there is a lack of robust population abundance data for Sri Lanka's loggerheads. Habitat management for loggerhead turtles in the northern Indian Ocean is also a concern, as protection in Oman is limited to Masirah Island, and does not currently exist for nesting or foraging areas in Sri Lanka (Hamann *et al*., 2013).

Both the North West and North East Indian Ocean subpopulations are threatened by fisheries bycatch, direct harvest and habitat degradation, but there is a need for additional research to evaluate the relative impacts of each of these threats (Hamann *et al*, 2013; Casale 2015a,b).

In contrast, subpopulations in the southern Indian Ocean are listed as 'Near Threatened', and have benefited from the implementation of conservation measures at key nesting and foraging areas. The South West Indian Ocean loggerhead subpopulation nests primarily in South Africa and Mozambique, with only small nesting grounds in Madagascar (Nel & Casale, 2015). Long-term population monitoring data indicate that nest counts have increased over the past generation, probably due to the establishment and ongoing maintenance of protected areas and nesting beach monitoring programs. All known loggerhead nesting for the South East Indian Ocean subpopulation, believed to be one of the largest in the world, occurs in Western Australia (Baldwin *et al*, 2003). While these nesting beaches are often located within marine parks and are, therefore, relatively protected, the lack of consistent monitoring has resulted in limited knowledge on population trends, sex ratios, or migration patterns of this genetic stock.

Threats to loggerhead turtles in the South West Indian Ocean include fisheries bycatch and direct harvest (Bourjea *et al*., 2008; Petersen *et al*. 2009; Humber *et al*., 2011; Brazier *et al*., 2012; De Wet 2013), while feral predators, vehicular beach traffic, industrial development and associated light pollution are the major threats affecting loggerhead turtles in the South East Indian Ocean (Casale *et al*, 2015).

The key knowledge gaps for loggerhead turtles in the Indian Ocean include:

1. Recent nesting data for rookeries in Madagascar which form part of the South West Indian Ocean subpopulation (Nel & Casale, 2015).
2. Unquantified nesting of the South East Indian Ocean subpopulation on some areas of the Western Australia coastline (Casale *et al*., 2015).
3. Long term monitoring to establish census data (e.g. annual number of nesting females and nests) and understand key demographic parameters (e.g. adult sex ratio, remigration interval, number of clutches per female) of the North East (Casale, 2015a) and South East Indian Ocean (Casale *et al*., 2015) subpopulations.
4. Unquantified nesting outside of the single index site (Masirah Island) in the North West Indian Ocean subpopulations.
5. Unquantified effects of threats to all subpopulations.

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ANNOUNCEMENT

BARNACLE SAMPLES FROM THE INDIAN OCEAN REQUESTED TO UNDERSTAND THE ROUTE OF THEIR ATLANTIC INVASION

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Dear IOTN readers,

We have been conducting research on the sea turtle specific barnacle, Stephanolepas muricata. Sea turtles are known to host diverse communities of epibiota by providing the substratum needed for their attachment. S. muricata is an embedding barnacle specific to cheloniid sea turtles and was previously believed to be restricted to the Indo-Pacific. However, the species was discovered relatively recently in the Atlantic Ocean (Frick et al., 2011). Individuals are relatively difficult to detect in the field and little is known about the dispersal behaviour of S. muricata, making it difficult to establish whether its newfound presence in the Atlantic is the result of a recent invasion or perhaps simply a lack of historical documentation.

To address these questions, we have begun a global genetic study that aims to determine possible routes of invasion into the Atlantic, as well as if the barnacle exhibits host species specificity. We also hope to better understand the transmission and potential gene flow in these barnacles between populations and across host taxa. By comparing the population genetic structure of this species and its host, it may be possible to infer non-reproductive connectivity between turtle populations (e.g. on feeding grounds) and, potentially, pathways of infection between turtle species with non-overlapping niches.

Unfortunately, we are lacking any samples from the Indian Ocean- which is a key component of addressing these questions. If anyone encounters these in the field, we would be very grateful if you could let us know via email. We have put together a fact sheet about the barnacle, and how to store any specimens you might collect. You can access the fact sheet at this web address: http://tinyurl.com/hfsoecv. Please email Mark A. Roberts (robertm2@email.sc.edu) or Nadège Zaghdoudi-Allan (nadegeallan@gmail.com) for further information.

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Frick MG , Zardus JD, Ross A , Senko J , Montano-Valde D, Bucio-Pacheco M, Sosa-Cornejo I. 2011. Novel records and observations of the barnacle *S. muricata* (*Cirripedia: Balanomorpha: Coronuloidea*); including a case for chemical mediation in turtle and whale barnacles. *Journal of Natural History* 45: 629-640

RESOURCE OF INTEREST

LOW-COST LABORATORY METHODS FOR FINDING MICROPLASTICS IN ENVIRONMENTAL SAMPLES

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Studies on microplastics usually require the contaminant to first be isolated from the sample substrate by density separation and removal of organic matter (reviewed by Cole *et al*. (2014) and Tagg *et al*. (2015)) before sorting from other materials in the filtrate, counting the number of microplastics, and identifying the type of plastic if possible. While the easiest and cheapest method of separating microplastics is by visual sorting using light microscopy, small plastic fragments or fibers can be difficult to see. The most accurate methods involve Fourier transform infrared spectroscopy (FT-IR, specifically reflectance micro-FT-IR or 'molecular mapping'), pyrolysis gas chromatography coupled to mass spectrometry (pyrolysis GC/MS), Raman spectroscopy, and fluorescence microscopy (see Hidalgo-Ruz *et al*. (2012) and Tagg *et al*. (2015)). However, these processes are time consuming and the equipment is expensive to purchase. During our studies on microplastics (see Balasubramanian and Phillott on pages 13-16 in this issue of IOTN), we identified some cheaper alternatives.

Fluorescence microscopy (the simplest and cheapest of the methods described above) reduces the risk of underestimating the number of plastic fragments present in samples. A cheaper alternative to a fluorescent microscope is a NIGHTSEA Stereomicroscope Fluorescence Adapter (~US$1,100), which can add *fluorescence* illumination to dissecting microscopes. Six different wavelength sets plus bright light are available; Royal Blue (440-460nm) is being used to identify microplatics (P. Dustan pers.comm., 2016). NIGHTSEA products are distributed by Electron Microscopy Sciences (EMS), and their distributors in the Indian Ocean region and Southeast Asia can be found at http://www.emsdiasum.com/microscopy/company/agents.aspx.

Fluorescence illumination can also be obtained by retrofitting an old light microscope with a brightfield vertical illuminator and very bright low-voltage light emitting diode (LED), although this option relies on the availability of a suitable microscope, vertical illuminator and LED flashlight. Steps to disassemble the vertical illuminator, attach the flashlight and assemble the internal optics are described in Babbitt *et al*. (2013).

Nile Red is a fluorescent dye that is usually used with cell and tissue samples, but is also reported to stain polyethylene, polypropylene and expanded polystyrene (Song, 2014) and may improve isolation of microplastics from samples (Cole et al., 2011) The dye may be added to the sample before filtration (3µg/mL; Desforges *et al*., 2014; 50mg/L, Song *et al*., 2014).

Researchers working in labs without a camera mounted on the microscope may also be interested in the simple cell (mobile) phone camera mount, built using inexpensive and common materials, described by Martin and Shin (2016). The mount ensures the phone camera is positioned correctly with relation to the ocular lens and the beam of light to improve the image quality.

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Galathea Bay at Great Nicobar Island, known to be the largest leatherback nesting beach inthe region, was severely affected by the earthquake and tsunami of 2004. Recent surveys reveal that the beaches have reformed and nesting of leatherback, green, hawksbill and olive ridley turtles have returned to numbers previously reported by Satish Bhaskar.

Photo Credit: Adhith Swaminathan

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.

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Tables and figures: Figures should not be embedded in the text file, they may be sent separately as JPEG, TIFF, BMP or PNG files. All figures and tables should carry a caption. Figures and illustrations must be accompanied by the appropriate credit/source. High resolution figures may be requested after acceptance of the article.

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.

Multiple references to be separated by a semi colon and in chronological order (Zade, 1995; Mathew, 1996a, b, 1998; Sharma, *et al.* 2004; Forman & Gordon, 2005, 2007)

Page numbers are essential when quoting or referring to some aspect or information from a report (Sharma 1960: 22 or Sharma *et al.* 1960: 22).

References that are long and/or have acronyms: Only acronym in text, e.g., INRA 2008

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

Unpublished/Undated references: In press, Forthcoming, In review, etc.

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

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).

Reference that are long and/or have acronyms: Full name followed by acronyms in parenthesis in reference list, e.g.,
Instituto Nacional de Reforma Agraria (INRA). 2008.

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