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CURRENT STATUS AND DISTRIBUTION OF THREATENED LEATHERBACK TURTLES AND THEIR NESTING BEACHES IN THE NICOBAR GROUP OF ISLANDS

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INTRODUCTION

Nesting of leatherback turtles was first observed in the Andaman and Nicobar Islands by Satish Bhaskar while conducting surveys for the Madras Crocodile Bank Trust in 1979 (Bhaskar, 1979a, 1979b), with his first sighting on West Bay beach of Little Andaman Island on 31st December of that year (Bhaskar, 1979c). Since Bhaskar's reports, additional surveys and reports have confirmed that the beaches of the Andaman and Nicobar Islands are an important nesting ground for leatherback turtles in India (Andrews *et al*., 2001; Andrews *et al*., 2006a; Andrews *et al*., 2006b; Namboothri *et al*., 2011; Swaminathan *et al*., 2011; Swaminathan *et al*., 2016). There are earlier records of sporadic leatherback nesting from the Indian mainland (Kar & Bhaskar, 1982); however, the current nesting populations are restricted to the Andaman and Nicobar Islands.

Many nesting sites for sea turtles in the Andaman and Nicobar Islands were severely affected by the December 2004 Indian Ocean earthquake and the subsequent tsunami. The coastline and the shore topography were severely altered in many of these islands, with the Nicobar group of islands undergoing submergence (Ramachandran *et al*., 2005), while coastal plates in some of the Andaman Islands were uplifted (CORDIO/IUCN, 2005; Kulkarni, 2005). In 2008, a long-term monitoring programme was initiated at Little Andaman Island to monitor the post-tsunami recovery of nesting leatherback turtles. The observations made at South and West Bay of Little Andaman suggested that leatherback nesting had recovered substantially after the 2004 tsunami, and the population appeared stable with some fluctuations (Swaminathan *et al*., 2011; Swaminathan *et al*., 2016).

Poor infrastructure and challenging logistics have limited sea turtle monitoring and conservation efforts in the Nicobars since the 2004 tsunami. Barring a few reports and surveys that indicated some beaches have re-formed, there is little information on the recovery of these nesting beaches and populations (Namboothri *et al*., 2011; IOSEA, 2012; Jadeja *et al*., 2015). Here, we report on our rapid surveys of nesting beaches throughout the Nicobar group that are being used by the four sea turtles found in this region (leatherback, green, olive ridley and hawksbill turtles), with a primary focus on leatherback turtle nesting on Great and Little Nicobar Islands.

METHODS

Between 2nd March and 18th April 2016, the first three authors visited the entire Nicobar group of islands (Figure 1), to understand the recovery of previously described nesting beaches, identify new nesting beaches, and document nesting intensities on all visited beaches.

Local fishing boats were used to survey the coastline of islands, and the team carried out surveys by foot during daylight hours when a sandy beach was encountered. Upon encountering turtle tracks, the species was identified established based on track characteristics (Pritchard & Mortimer, 1999). While it is possible to misidentify olive ridley and hawksbill tracks, we classified each track to species using basic information such as the known seasonality of the different species and characteristics of the nesting habitat (Pritchard & Mortimer, 1999; Shenoy *et al*., 2011). Olive ridley turtles are known to nest from November to April and prefer wide-open beaches, similar to leatherback turtles; while hawksbill turtles are known to nest from July to December and prefer beaches with offshore reefs and typically nest near or in vegetation (Pritchard & Mortimer, 1999; Andrews *et al*., 2006a; Shenoy *et al*., 2011). After a thorough visual inspection of every nest mound, depth of body pits, abandoned body pits and nest chambers, we categorised each crawl as

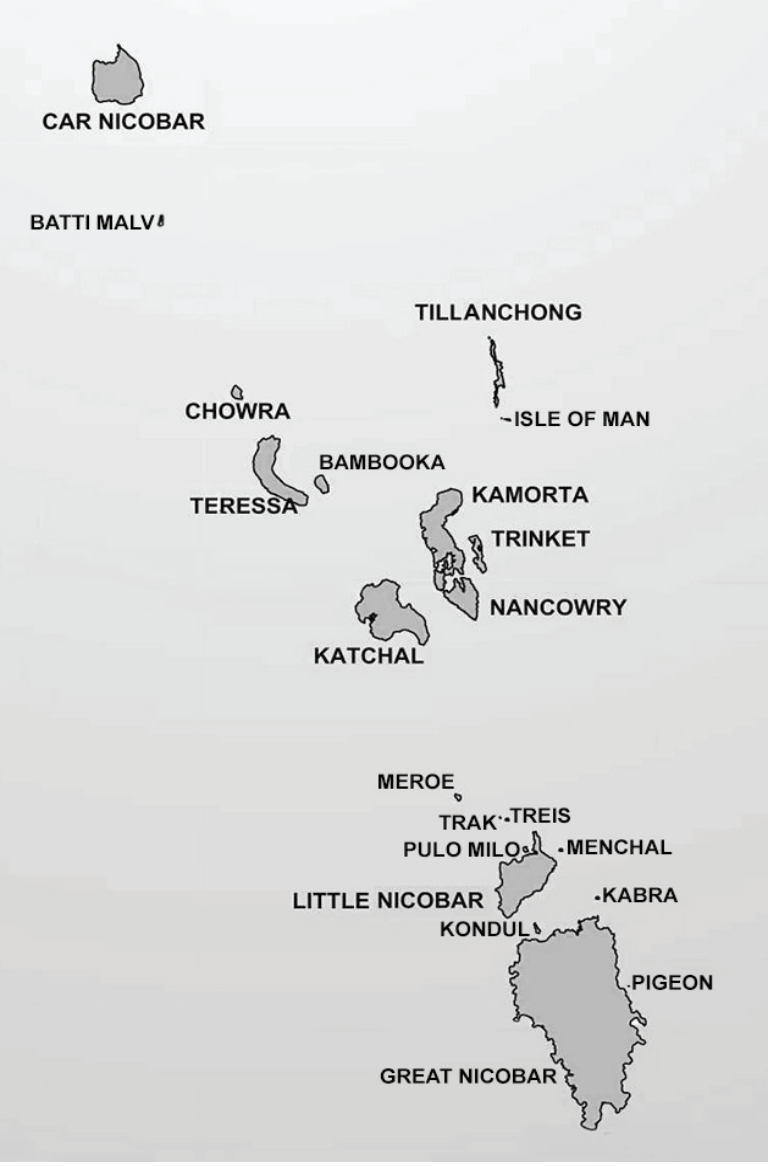

Figure 1. Nicobar Islands.

either a nest or a false crawl (Shenoy *et al*., 2011; Dodd, 2016). The location of each nest was recorded using a GPS.

All nests were examined for evidence of predation based on tracks and other signs. Wherever possible, the identity of the predator was established based on tracks. The surveys were non-invasive and did not involve any direct handling of the turtles, eggs or hatchlings. The surveys were conducted during the day and there were no instances of nesting directly observed. This was done due to logistical feasibility for conducting a survey over a large area and non-availability of necessary permits for the direct handling of nests and eggs.

RESULTS

Of the 21 islands in the Nicobar group, three islands (Pigeon, Kabra and Isle of Man) did not have any sandy beaches and three islands (Trak, Meroe and Batti Malv) were not accessible due to unfavorable sea conditions. We surveyed the remaining fifteen islands of the Nicobar group for sea turtle nesting activity. We recorded 2140 nests and 21 false crawls were recorded on 12 islands. The highest number of nests for all the four species were recorded on the Great Nicobar Island followed by the Little Nicobar Island.

Leatherback turtles

A total of 1,068 leatherback nests were found on five of the fifteen islands surveyed (Table 2). The islands of Great Nicobar and Little Nicobar together comprised 94% of the total nests found in the Nicobar region. No nests were found on Teressa and Tillanchong Islands where leatherback nesting had been reported in the past (Andrews *et al*., 2006a; Chandi, pers. comm.). Earlier studies in the region indicated that leatherback turtles nest 4.9 times a year on average (Bhaskar, 1993; Andrews *et al*., 2001). Based on this, the estimated number of leatherback turtles nesting in this region during the 2015-2016 nesting season would be approximately 200 individuals.

Other sea turtles

Green turtles were found to be the most widespread species nesting in this region. The study identified 519 nests on 12 of the 15 islands surveyed (Table 1), including on Chowra, where green turtle nests had not been previously documented (Chandi, pers. comm.).

Hawksbill tracks were only found on Great Nicobar Island, though the species has previously been reported to nest on beaches of Tillanchong, Teressa, Trinket, Katchal, Meroe, Treis, Trak, Kabra, Pulo Milo, Little Nicobar and Menchal Islands (Andrews *et al*., 2001).

Four hundred and eighty two olive ridley nests were observed on Great Nicobar, Little Nicobar, Trinket, Teressa, Katchal and Car Nicobar Islands. Almost 97% of the nests observed were found on Great Nicobar Island.

DISCUSSION

Seasonality

The surveys were designed to be conducted towards the end of the peak nesting season of leatherbacks and olive ridleys. The leatherback nesting season in the Nicobar Islands is October through March, with a peak in December/January (Andrews *et al*., 2006a). Olive ridley nesting runs from November through April, with a peak in January (Andrews *et al*., 2006a). The reported

Table 1. Sea turtle nesting data for the Nicobar Islands.

	Sea Turtle Species				
Island	**Leatherback**	**Green**	**Olive Ridley**	**Hawksbill**	**Total**
Great Nicobar	775 (1)	322 (4)	472 (6)	71	1640 (11)
Little Nicobar	229	4	6	0	239
Katchal	57	40	1	0	98
Car Nicobar	0	72 (4)	1	0	73 (4)
Teressa	0	42 (2)	1	0	43 (2)
Trinket	0	19 (1)	1	0	20 (1)
Kamorta	6	2	0	0	8
Chowra	0	6 (1)	0	0	6 (1)
Tillanchong	0	5	0	0	5
Nancowry	1	4	0	0	5
Treis	0	2	0	0	2
Bambooka	0	1 (2)	0	0	1 (2)
Menchal	0	0	0	0	0
Pulo Milo	0	0	0	0	0
Kondul	0	0	0	0	0
Grand Total	1068 (1)	519 (14)	482 (6)	71	2140 (21)

( ) represents false crawls

Table 2. Leatherback turtle nest and predation data for the Nicobar Islands.

Location	No. of Nests	No. of Nests Predated (%)
Great Nicobar Island	775	673 (86.8%)
East of Indira Point	2	2
Koshindon	2	0
Laxmi Nagar	1	0
North of Alexandria	46	42
South of Alexandria	20	15
North of Dagmar	123	113
South of Dagmar	43	33
Pulo Bed	16	10
Pulo Kunji	57	45
Re Pinsuöt	7	2
Renhong	17	9
Safed Balu	3	2
Patatiyö	6	0
Galathea	410	388
South of Galathea to Rock	2	0
West of Indira Point	20	12
Kamorta Island	6	1 (16.6%)
Pilpilo	6	1
Katchal Island	57	7 (12.2%)
South	21	7
West	36	0
Little Nicobar Island	229	53 (23.1%)
Bahua	40	0
Kiyang	99	43
Muhincohn	88	10
Thavithö	2	0
Nancowry Island	1	0 (0%)
Katholö	1	0
Grand Total	1068	734 (68.7%)

nesting season for green turtles for this region is May to September, peaking in June and July (Namboothri *et al*., 2012). The nesting season for hawksbill sea turtles commences in July and end by early December (Andrews *et al*., 2006a). Nests of both green and hawksbill turtles were documented during our survey period, suggesting that they may nest year round in this region, as green turtles do in nearby Thailand (Yasuda *et al*., 2008) and on Tromelin Island in the western Indian Ocean (Derville *et al*., 2015). Nevertheless, as our surveys were limited to a seven week stretch in the early part of the year, it is likely that we did not fully characterise nesting effort of green and hawksbill turtles in the region.

Nesting beaches and nesting

Prior to the 2004 tsunami, the islands of Great and Little Nicobar were important nesting sites for leatherback turtles (Andrews *et al*., 2006a). Harbouring 87% of all turtle nesting in the region, the beaches of Great and Little Nicobar Islands continue to be crucial nesting sites in the region for all four sea turtle species. The most important nesting sites include Galathea, Alexandria and Dagmar Bay on Great Nicobar Island and Pulo Kiyang and Bahua (previously referred to as Dahayu/Dahvu by Bhaskar (1994) and Andrews *et al*. (2006a)) on Little Nicobar Island. The current surveys revealed that most of the beaches in this region have formed again and leatherbacks

Table 3. Records of leatherback nests laid per year in Great and Little Nicobar Islands.

	Survey Period (Source)												
	Apr 1979 (Namboothri et al., 2012)	Feb 1981 (Namboothri et al., 2012)	Nov 1991-Mar 1992 (Namboothri et al., 2012)	Mar 1993-Apr 1994 (Namboothri et al., 2012)	Dec 1995-Feb 1996 (Andrews et al., 2006a)	Dec 1997-Feb 1998 (Andrews et al., 2006a)	Nov 2000-Apr 2001 (Andrews et al., 2006a)	Oct 2001-Apr 2002 (Andrews et al., 2006a)	Nov 2003-Apr 2004 (Andrews et al., 2006b)	Nov 2004 (Andrews et al., 2006b)	Feb 2011 (Namboothri et al., 2011)	Feb 2015 (Jadeja et al., 2015)*	Mar 2015-Apr 2016 (current study)
Great Nicobar Island													
Galathea	-	-	158	237	282	124	524	425	575	84	146	7*	410
Alexandria	80	55	343	-	-	-	866	-	-	-	-	-	66
Dagmar	80	8	171	-	-	-	362	-	-	-	-	-	166
Little Nicobar Island													
Pulo Kiyang	-	-	-	115	-	-	-	-	-	-	-	-	99
Bahua	-	-	-	50	-	-	-	-	-	-	-	-	40

*Jadeja *et al*. (2015) only reported 7 nests in Galathea, Great Nicobar Island. This was probably as a result of non-detection of older nests and nesting evidences. Namboothri *et al*. observed 146 nests in 2011 and Swaminathan and Chandi conducted a survey in 2012, which was abandoned as a result of an earthquake and subsequent tidal wave, observed more than 2 nests every meter.

continue to nest in high numbers (Table 3). The numbers for Alexandria and Dagmar from 2016 indicate a decline in comparison to the data from the 1978 to 2001.

However, regions which were severely damaged by the 2004 tsunami still have dead trees and tree debris along the coast, particularly on Great Nicobar Island, which is likely obstructing sea turtles from accessing the nesting beach and also reducing the nesting area. Several previously known nesting beaches were either partially or fully inundated during high tide, forming creeks along the coast.

Predation

Of the 2,140 nests that were recorded in the Nicobar region, 57% (1,223 nests) were predated by either feral dogs, water monitor lizards or in some cases feral pigs. While monitor lizards are natural predators of leatherback nests and occur on many beaches, predation by feral dogs and pigs that once belonged to the Nicobari settlements that existed prior to the 2004 tsunami was found to be particularly high on the Great Nicobar Island. Namboothri *et al*. (2011) also observed that approximately 70% of the nests on Galathea were predated by feral pigs during the 2011 survey.

RECOMMENDATIONS

The ongoing leatherback monitoring programme in Little Andaman has revealed a stable increase in the nesting population, with over hundreds of nests laid every season, and also reformation of the nesting beaches (Swaminathan *et al*., 2016). The satellite telemetry study of ten leatherback turtles nesting in Little Andaman has indicated two corridors for migration, one on the southeastern corridor towards Papua New Guinea and Australia, and one along the southwestern corridor towards Madagascar and east coast of Africa (Namboothri *et al*., 2012; Swaminathan *et al*., 2016). A long-term monitoring programme should be re-established at Galathea Bay to monitor the nesting beach and to understand long-term trends in nesting and reproductive efforts. Further studies on remigration intervals through tagging, genetic studies on population structures, and satellite telemetry studies to understand migration patterns of leatherback turtles nesting are required in this region. Accessibility of the nesting sites remains an issue, but the roads are in the process of being re-laid and should reach the nesting beach in the coming years. Several rapid and intensive surveys need to be carried out on prime nesting beaches where regular monitoring efforts are logistically impossible. In regions where predation

from feral dogs and pigs are high, the feral animals need to be either controlled or culled to reduce the pressure.

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CELEBRATING A MARINE TURTLE SANCTUARY IN MADAGASCAR

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The north-west coast of Madagascar is a hotspot for marine turtles (Humber *et al*., 2016). The tiny archipelago of Nosy Iranja lies 40km south of Nosy Be (Figure 1), the largest island on the Malagasy coast. It is composed of two islets (Iranja Be and Iranja Kely) linked by a sand bank covered by water at high tide. Although both islands are only around half a square kilometre in area, their beaches host one of the most studied nesting sites in the country. Marine turtle nesting has been studied in Madagascar since the year 2000 (Bourjea *et al*., 2006), when WWF Madagascar hired someone to monitor nesting activities and initiated baseline studies at the same time that the first hotel was built on the smaller islet, Iranja Kely. This was a turning point for marine turtles on Nosy Iranja.

Since 2004, with the support of Kelonia, the sea turtle observatory of Reunion island, multiple scientific projects have been conducted and sea turtle reproduction has been monitored on Iranja Kely. Tourism has developed on the island despite the political crisis and the indeterminate closure of the largest resort in 2013. Meanwhile, other hotels have been constructed on Iranja Be and the growing number of visitors have generated incomes for the local communities. The marine turtle poaching that used to be common is rarely reported on these islands nowadays. Recently, two locally managed marine protected areas (MPAs) were created with the support of the Wildlife Conservation Society (WCS): "Ankivonjy", that includes the Nosy Iranja islets, and "Ankarea" that encompasses the Mitsio archipelago in the north. Both MPAs were officially recognized by the Malagasy government in 2015.

To increase awareness about the importance of these protected areas for marine turtles, the first Marine Turtle Festival took place on the archipelago at the end of May 2016. It was organized by the Wildlife Conservation Society in partnership with Kelonia and was predominantly funded by Prince Albert II of Monaco Foundation. The festival lasted 3 days and the target audiences were local communities, regional authorities, and tourists. But the event's messages also reached the larger community thanks to regional and national media coverage. Activities such as sports and traditional song and dance contests, concerts, and public dancing helped to attract people. They were complemented by seminars given by representatives from Kelonia and the University of Marine Studies of Toliara, a photographic exhibition, and documentary screenings. Attendees also had the opportunity to observe a green turtle nest emergence. This, more than many speeches,