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ANDAMAN AND NICOBAR SEA TURTLE PROJECT

PHASE I - GREAT NICOBAR ISLAND

Executive summary

- Great Nicobar is the most favoured of 5 islands known to be regularly used by nesting leatherback turtles (Dermochelys coriacea) in India. The other 4 are, in order of importance, Little Andaman, Little Nicobar, Rutland and Katchal, all in the Indian Union Territory of the Andaman and Nicobar Islands.

- Nesting of lower intensity also occurs at three other islands in the Union Territory viz. Teressa, North Cinque and South Cinque islands, but has ceased on at least two other beaches since surveys were undertaken in 1978 namely, at Karmatang No.9 and at Cuthbert Bay (near Betapur No.2), both in Middle Andaman where human settlements have proliferated.

- Both leatherbacks and olive ridleys (Lepidochelys olivacea) nest at least during the period November to April , the peak of the nesting seasons for both species being January-February.

- On Great Nicobar island, 811 excavations made by nesting leatherbacks were counted on 8 of 9 nesting beaches on the island. Tagging studies at a beach at the mouth of the Galathea River on the island showed that each leatherback nested an average of 4.9 times on average, within a season. A conservative estimate of the nesting population on the island in the 1991-92 season is 811/4.9 = 166 leatherbacks (811 divided by 4.9).

- Hatchlings (2 to 97 per clutch) emerged from only 64.3% of leatherback nests at the Galathea beach. Hatchlings from only 27.4% of the total eggs laid emerged from nests.

- Tagging studies of nesting olive turtles (Lepidochelys olivacea) at the Galathea beach suggested that 50% nested twice within the season, the other half nesting once. Nest counts for this species could therefore be multiplied by the fraction $\frac{2}{3}$ to estimate nesting population in any one nesting season.

- Great Nicobar is believed to be the second-most important nesting island for olive ridley turtles (Lepidochelys olivacea) in the Andaman and Nicobar group, next only to Middle Andaman where 338 nests were reported from Cuthbert Bay during the 1988-89 season. Four well-frequented olive ridley nesting beaches exist at Great Nicobar, on three of which a total of 280 nests were counted. A conservative estimate of the nesting population on the island in the 1991-92 season is 187 turtles.

- Hatchlings (54 to 125 per clutch) emerged from only 49% of olive ridley nests at the Galathea beach. Only 37.5% of all eggs laid resulted in hatchlings that emerged.

- The reasons for low hatchling emergence percentages in leatherback and olive ridley nests at the Galathea beach were primarily:
  a) predation of eggs and hatchlings by dogs and to a lesser extent by ocypode crabs.
  b) natural spoilage of hatching eggs by tidal seawater.
  c) compaction of nest sand by the movement of cattle and humans on the beach. Compaction decreases nest aeration and also physically obstructs emergent hatchlings.

- Recommendations:
  a) The collection of beach sand for construction purposes from all beaches (including beaches where nesting is sparse or absent) needs to be strictly prohibited and the ban enforced. Nesting beaches frequently receive sand from other beaches by natural longshore transport (accretion)

SEA TURTLE STUDY AND SURVEY PROJECT

FINAL REPORT, PHASE I, 15 Nov 1991 TO 17 May 1992

Submitted by Satish Bhaskar to the Madras Crocodile Bank
& to the Andaman & Nicobar Forest Dept.

25 July 1992.

Investigators Satish Bhaskar (Nov 91 - May 92)
Manjula Tiwari (Nov 91 - Jan 92)

The leatherback turtle, Dermochelys coriacea

Synopsis Available for the first time is a workable though conservative figure for the nesting population of the leatherback turtle in any one nesting season on Great Nicobar Island, the most important of India's nesting areas for this species (Bhaskar, 1979, 1980 & 1984; Tiwari, pers. comm., 1991). Of the 9 beaches presently in use for nesting by this species here, 8 that were surveyed gave a total count of 811 'excavations'. (The term 'excavation' here includes nests and false nests. The latter may constitute 10% of all excavations). Twenty five of the estimated 32 Dermochelys that nested at the beach at the mouth of the Galathea River (one of 4 beaches on the island where nesting preponderates) were tagged. Based on studies here, an estimated 166 individual Dermochelys nested on Great Nicobar this season. Each female nested 4.9 times on average (range 1-7 times, N= 27 turtles),, at an average renesting interval of 10.14 days (range 8 - 14 days, N = 59 intervals involving 17 turtles). Only 64.3% of Dermochelys nests emerged at the Galathea beach, due to spoilage of nests by tides, predation by dogs, and infiltration of Ipomoea and Pandanus roots into nests. Hatchlings from only 27.4% of total eggs laid emerged from nests.

Abbreviations used :

DC - Dermochelys coriacea

LO - Lepidochelys olivacea

EI - Eretmochelys imbricata, the Hawksbill turtle

CM - Chelonia mydas, the Green turtle

CCL - Carapace curved length

CCW- Carapace curved width

H - Hatchling

DIN - Hatchlings dead in nest

AIN - Hatchlings alive in nest

DPE - Embryos dead in pipped eggs

APE - Embryos alive in pipped eggs

UH - Unhatched eggs

VE - Eggs containing visible embryos

NVE - Eggs containing no visible embryos

DC nesting season

Though field work commenced at the Galathea beach about 1 month after the start of the DC nesting season, the date of the season's onset ~~xxxx~~ was determined quite precisely from the date of emergence of the season's first DC hatchlings , the night of 19/20 Jan 1992 and from a knowledge of the 'emergence period' (incubation period plus time taken between hatching and emergence of the hatchlings onto the beach surface) for a selected nest, 63 days. This first nest was therefore laid on or about 17/18 Dec 91. At the Galathea beach, the peak of the DC nesting season covered the 10-night period 16/17 Jan 92 to 25/26 Jan. during which 21 excavations were made. However, the maximum number of DC excavations

in any night, 6, were made on each of 2 nights 11/12 Jan 92 and 1/2 Feb. The limits of the DC nesting season are now known, with allowances to be made for natural year-to-year fluctuations. A fresh DC excavation was found at Betapur No.2, Middle Andaman on 15 Nov 1978 (Bhaskar 1979) and on 7 Apr 79 at Saphed Balu, Great Nicobar. Regular field work at the Galathea beach ended on 6/7 Mar 92 and the last untagged DCs encountered were tagged on 29 Feb/1 Mar, added evidence that nesting spills into April. The present survey confirmed that the majority of nests (over 90%) are made between December and March, though the season extends from November to April.

At the Galathea beach, a DC nest predated apparently by dogs and found on 10 Dec 91 had well-developed embryos, suggesting that this nest had been laid about 1½ months earlier, on about 26 Oct 91. On 10 Oct91, coastguard personnel sighted 3 leatherbacks at sea off Pulo Babi on Great Nicobar's west coast, at about 1 minute intervals. All the turtles were swimming towards the coast (pers. comm., Dy.Commandant S.B. Singh of the coast guard).

DC nesting intensity at the Galathea beach

Period	Start of season c.17/18 Nov to 12 Dec 91	12/13 D -21/22D	22 D -31D	1J- 10J	11 J -20J	21 J @30J	31 J -9 F	10 F -19F	20 F -29F	1M- 10M
Excavations	32	13	17	18	16	19	17	9	11	3

Three more DC excavations were recorded on the Galathea beach on the far side of the Galathea R. from the study beach.

Total DC excavations at the Galathea beach = 158.

DC excavation counts at 8 major nesting beaches on Great Nicobar

Beach	Renhong	Rokoret	Pulo Bet	Pulo Kunji	Dagmar	Alexandria	Galathea	Saphed Balu
Survey date	11-3-92	11-3	13-3-92	13-3-92	13-3 & 14-3	14-3-92 & 22-3-92	12-12-91 - 7-3-92	16-12-91 5-1-92
Excavations	86 (64P, 8m)	13 (6P)	0	21 (1P, 11m)	171 (25a, 45m)	343 (82a, 45m)	158 (13d)	19 (0)

The figures in parenthesis refer to nests predated on by domestic pigs (p), dogs (d), unspecified animals (a) and to those collected by man viz. by Nicobarese, who are presently exempt from the provisions of the Indian Wildlife Protection Act, 1972, which provides total legal protection to sea turtles, their eggs and derived products.

Counts at the Galathea beach and at Saphed Balu were nearly exact but those at all other beaches were biased heavily on the conservative side since the surveys there were undertaken towards the end of the nesting season, before which several nest sites had been obliterated by wind-blown sand, by rain, and by the tracks of turtles, pigs, dogs and man.

Data from DC nests that emerged

Parameter	N	Range	$\bar{x}$ Average	Σx^2	Σx	σ_{n-1} Sample S.D.	σ_n Population S.D.
Clutch size (big eggs)	35	39-148	90.4	303088	3164	22.402	22.079
Nest depth (cm)	29	49-86	70.07	152277	2090	7.682	7.548
Yolkless eggs	28	3-79	24.61	26579	689	18.88	18.54
Eggshells in hatched nests	35	4-108	54.7	139606	1914	32.06	31.59
Hatchlings emerged * onto beach plus AINs	26	2-97	37.04	54419	963	27.39	26.85
DIN (dead in nest)	35	0-26**	1.57	789	55	4.546	4.48
UH (unhatched yolked eggs)	35	4-104	35.43	67210	1240	26.17	25.79
VE (unhatched eggs with visible embryos) (subset of UH)	34	0-57	11.68	9301	397	11.89	11.714
NVE (unhatched eggs with no visible embryos). (subset of UH)	34	1-91	24.06	40708	818	25.24	24.87
"excess" eggshells***	26	0-41	12.31	8140	320	12.96	12.71
% excess eggshells / total eggshells	26	0-71.4	24.64	28565	640.6	22.61	22.17
For each clutch, % emerged Hs+AINs / clutch size	21	3.28-84.31	40.6	48620	852.6	~~25x22~~ 26.46	25.82
For each clutch, % that hatched / clutch size	35	6.31-95.74	58.65	150409	2053	~~29x28~~ 29.71	29.28
DPE (dead in pipped eggs)	34	0-10	0.68	123	23	1.804	1.778
AINs checked 12 hrs after emergence of the first batch, including 96 AINs from one nest	28	0-96	7.54	10239	211	17.9	17.57
AINs excluding 96	27	0-17	4.26	)23	115	4.528	4.444

* In the above table , row 6, AINs have been included because emerged nests were opened by the investigator in most cases on the day following emergence of the first hatchlings onto the beach, whereas in nests left to emerge naturally hatchlings may emerge in batches upto 5 days after emergence of the first batch from the clutch.

** $\bar{x}$ for DINs would have been 0.94 but for the fact that in a single nest 23 pre-emergent hatchlings died of overheating by the sun, just below the beach surface.

*** A count of eggshells from each hatched nest tallied with total hatchlings seen in the nest plus hatchling tracks leading to the sea in only 5 out of 26 i.e. in 19.23% of emerged nests. The number of eggshells exceeded or was equal to the above total.

Overall %excess eggshells i.e. $\frac{\sum \text{excess eggshells}}{\sum \text{eggshells}} \times 100 = \frac{320}{1331} \times 100$

$= 24.04\%$

(N = 26 emerged nests)

i.e. the fate of almost a quarter of the "hatched" eggshells seen in emerged nests could not be explained with precision by counts of eggshells, hatchlings in nests and emerged hatchlings.

Possible explanations for the discrepancy :

A. Predation by ocypode crabs on developing or pipped eggs or on hatchlings inside the nest. P redated eggs may dry during the incubation period and the eggshells may present the appearance of hatched eggs.

B. Hatchling predation on the beach by crabs and other predators.

C. Overlooking of tracks of hatchlings, or their obliteration by wind, rain or nesting turtles.

The discrepancy may arise from a combination of these reasons.

The olive ridley turtle, *Lepidochelys olivacea*

IN20 :

Synopsis Also for the first time, a practical estimate of the nesting population of the olive ridley at Great Nicobar is available. Of the 4 major *Lepidochelys* beaches on the island, 3 that were surveyed showed a total of 280 nests. Tagging studies revealed that 50% of ridley females nested at least twice within the season. The other half nested once. This gives a minimum population estimate of 187 nesting ridleys on Great Nicobar during the 1991-1992 nesting season. More nests were reported from Cuthbert Bay, Middle Andaman during the 1988-89 season(Misra 1990) - 338 nests. Nesting numbers in 'arribadas' like the ones at Gahirmatha, Orissa put numbers in the A.& N. Islands in the shade, but biological studies at non-arribada situations are unquestionably important.

A *Lepidochelys* bearing tag no. AN 18 renested after an interval of 13 days, believed to be the shortest interval ever recorded for this species. In 42 turtles tagged, 12 encountered renesting showed average renesting interval of 18.3 days (range 13 - 28 days, N = 12).

Only 49% of all ridley nests emerged at the Galathea beach. Hatchling emergence % was 76.5 % (N = 6 nests) of all eggs laid in nests that eventually emerged. ' Emerged' nests and 'emerged' hatchlings refer here to nests from which at least 1 hatchling emerged onto the beach surface, and to live hatchlings that emerged onto the beach or reached within 20 cm of the beach surface. In contrast, 'hatched' turtles refer to hatchlings that merely escaped from their eggshells. Only 37.5% of all eggs laid resulted in hatchlings that emerged.

Sizes of nesting LOs at Galathea beach and at Gahirmatha, Orissa

At the Galathea beach:

Parameter	N	Range	$\bar{x}$	Σx^2	Σx	σ_n	σ_{n-1}
Standard CCL (cm)	43	62.5-74	68.16	200037	2931	2.42	2.45
Standard CCW (cm)	43	63-71.5	67.42	195679	2899	2.15	2.17

Size of the smallest nesting female: CCL 62.5 cm, CCW 63.5 cm. This provides an idea of the size at sexual maturity at the Galathea beach. A slightly larger turtle (CCL 64½ cm and CCW 63½ cm) that was weighed after oviposition scaled 29 kg. The LOs nesting at Gahirmatha are significantly larger, as the following table shows :

Location	N	CCL (cm)			CCW (cm)			Minimum WEIGHT (kg)
		Average	Max.	Min.	Average	Max.	Min.	
Galathea beach	43	68.16	74	62.5	67.42	71.5	63	29** (N=1)
Gahirmatha*	277	72.64±2.18	76.5	66.0	71.64±2.29	77.5	64.5	35.6*** (N=50)

**After oviposition.

* Data from Kar & Dash, 1990.

***It is not stated whether this was before or after oviposition. A clutch wt. >5 kg is rare.

Renesting intervals for LOs at Galathea beach

Ridleys found renesting at the Galathea beach had renesting intervals of shorter duration (range 13-28 days, N=12) than those recorded at Gahirmatha by Kar & Dash (range 46-58 days, average 53 days, N=9). The intervals at the Galathea beach were 13,14,14,15,15,15,17,18,19,25,26 and 28 days.

The average renesting interval at the Galathea beach remains uncertain as it is unclear whether the 25,26 and 28-day intervals each result from 2 nestings or 3 . Individual LOs that nested thrice within a season have been tagged in Surinam.

Parameter	N	Range	$\bar{x}$	Σx^2	Σx	σ_n	σ_{n-1}
Renesting interval (days)	12	13-28	18.25	4295	219	4.985	5.207

LO population estimates

Of 91 nesting visits made by olive ridleys to the Galathea beach from the commencement of the tagging programme in December 91 upto the night of 6/7 March 92, 52 (i.e. 57.14% of the 91) visits were encountered by tagging personnel. Had all the 42 tagged turtles renested once each, the number of investigator—turtle encounters involving these turtles would have been $42 \times \frac{52}{91} = 24$.

Since only 12 tagged turtles were encountered, it follows that only 50% of the 42 tagged turtles renested. Extrapolating these figures, we obtain for a nesting population that made 103 nests during the season, a figure $= 103 \times 2/3$

$= 69$ turtles

This is an estimate of the minimum population of LOs that nested at the Galathea beach during the 91-92 season.

280 LO nests were found on Great Nicobar. The number of turtles involved $= 280 \times 2/3 = 187$

Encounter %

Thirty eight out of 91 nesting emergences were missed by tagging personnel during the period 23/24 Dec 91 to 6/7 March 92, giving an investigator-turtle encounter % of 58.24%.

Data from emerged LO nests

Parameter	N	Range	$\bar{x}$ Avg.	Σx^2	Σx	σ_n Population S.D	σ_{n-1} Sample S.D
Clutch size	17	83-129	109.1	206761	1856	15.99	16.48
Nest depth (cm)	13	29.5-43	37	18005	481.5	3.629	3.777
Emerged H tracks +AINs	6	54-125	85.33	48192	512	27.39	30.00
Eggshells (hatched eggs + eggs taken by crabs)	18	39-125	93.4	168200	1682	24.75	25.48
DIN (hatchlings dead in nest)	13	0-2	0.46	10	6	0.7458	0.7763
UH (unhatched eggs)	17	3-62	12.3	5721	209	13.61	14.03
VE (visible embryos)	17	0-20	3.76	786	64	5.66	5.84
NVE (no visible embryos)	17	1-62	9.88	5782	168	15.57	16.05
Excess eggshells	6	0-58	11	3401	65	21.2	23.22
% Excess eggshells / Total eggshells	6	0-51.8	9.63	2707	57.78	18.93	20.74
% Emerged Hs / Clutch size	6	50-96.9	77.2	38186	463.2	20.11	22.03
% Hatched eggs / Clutch size	6	48.28-96.9	77.56	38565	465.4	20.30	22.24
DPE (dead in pipped eggs)	14	0-5	0.857	38	12	1.407	1.46

LO emergence periods

Two natural nests that hatched on 24/25 Feb and 25/26 Feb 92 emerged in 55 and 54 days respectively , at the Galathea beach.

'Incubation periods' of 66 to 67 days ± 1 to two days have been reported for 10 LO nests that were fenced in to thwart predators, at Betapur, Middle Andaman (Misra 1990). The disparity in emergence periods at the two beaches provides evidence that such fencing-in of nests reduces incubation temperatures by over 2°C, resulting in the masculinization of hatchlings. It is believed that almost all the fenced hatchlings that reached the sea at Betapur were males.

LO hatchling production

Hatchling production at the Galathea beach during the 1991-92 season = Total no. of nests x % of total nests that emerged x avg. no. of {emerged H+AINs} per nest

$$= 103 \times \frac{37.5}{100} \times 85.33 \simeq 3296 \text{ hatchlings.}$$

$$\%\ \text{Hatchling emergence in emerged nests} = \frac{\Sigma\, H_{\text{emerged}} + \Sigma\, AINs}{\Sigma\, \text{Clutch size}} \times 100 = \frac{512}{669} \times 100$$

$$= 76.53\%\ (N=6 \text{nests})$$

Since only 49% of total nests emerged, the overall hatchling emergence% for all nests $= 76.53 \times \frac{49}{100}$

$$= 37.5\%$$

$$\text{Hatching \% for emerged nests} = \frac{\Sigma\, H_{\text{emerged}} + \Sigma AINs + \Sigma DINs}{\Sigma\, \text{Clutch size}} \times 100$$

$$= \frac{514}{669} \times 100 = 76.83\% (N=6 \text{ nests})$$

counts
Nesting ~~numbers~~ on islets surveyed

Island	Meroe	Trak	Treis	Tillanchong	Pulo Milo
Survey dates	31-3-92 to 4-4-92	4-4-92	4-4-92	9&10 Apr92	26-3-92 to 5-4-92
EI nests	1 0 (4)	23(2)	3(0)	4(0)	1(1)
EI or CM nests	8 (0)	0	0	12(0)	0

Figures in parenthesis are the number of sets of turtle tracks visibly associated with the nests recorded.

Recommendations

- The removal of beach sand for construction purposes at all the areas allotted for settlement between Campbell Bay and Km 35 along the north-south road on Great Nicobar has summarily eliminated nesting habitat , especially for Dermochelys on this section of coast. Nesting presently occurs predominantly on beaches outside the settlement areas; fortunately, these beaches will fall under the protection of the recently-gazetted National Parks on the island. However, in the absence of alternative sources of sand for construction, the sand on these beaches will always remain vulnerable to legal or illegal exploitation by settlers and departmental authorities. Safeguarding of sand and background vegetation at existing nesting beaches is of paramount importance.
- Feral and itinerant dogs take a heavy toll of turtle eggs and especially of hatchlings at the Galathea beach, at Saphed Balu and at Indira Point. Elimination or control of these dogs throughout the duration of the nesting and hatching seasons is vital.
- On beaches on Great Nicobar's west coast eg. at Renhong, Pulo Bet and at the Dagmar and Alexandria beaches, domestic pigs and dogs predate heavily on turtle eggs and hatchlings. A conservation education programme aimed at the small Nicobari communities at Renhong, Rokoret, Pulo Bet, Pulo Kunji and at Kopen Heat will help to reduce this drain.
- At least two nesting beaches on Great Nicobar are in use as picnic spots - the Galathea beach and the Indira Point area. Nest sand is ~~xxxxx~~ inadvertently compacted by human feet. This interferes with gas exchange within nests. Hatchlings also find it difficult to break free and emerge from the compacted sand above their egg chambers. Cattle that stray onto nesting beaches, especially the Galathea beach, also compact sand. Human use of nesting beaches should be restricted to the zone of hard-packed intertidal sand only (where turtles do not

Nest) when tides permit. Unfenced pathways leading down to this zone across the nesting zone need to be marked out and used during the nesting and hatching seasons.

- The continued presence of investigators on a turtle beach deters or at least inhibits humans from exploiting eggs and turtles there. This was the case at the Galathea beach following establishment of the field camp on 16 Dec 91. No turtles and only 3 nests were taken by humans upto 7 March 92 when the camp was shut down. The presence of conservationists and dedicated Forest Department staff through the nesting and hatching seasons is recommended.

- Tree stumps and debris (both naturally dispersed debris and sawn timber) that are washed up by the sea during storm surges and high tides or are brought down by rivers and deposited along a zone otherwise favoured by nesting turtles adversely affect the latter in 3 ways : they restrict nesting space, resulting in congestion of nests; they injure nesters, causing abrasions that may invite predation by sharks; and they may force turtles to nest at sub-optimal sites such as those prone to erosion by the sea, to seepage by saline water which can kill hatching eggs, and to infiltration by Ipomoea and Pandanus roots which may reduce hatching percentages. Debris- strewn beaches exist at the 3 most important nesting areas for DC and LC at Great Nicobar ; at the mouths of the Alexandria, Dagmar and Galathea rivers. Removal of the debris in early November before the start of the nesting seasons for these species is strongly recommended.

Vegetation behind nesting beaches should remain undisturbed since it provides optimal sand conditions (temperature, moisture and firmness) at nest sites & help orient emerged hatchlings towards the sea.

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