

RPT

ANO/0768

~~ANDAMAN AND NICOBAR SEA TURTLE PROJECT~~

FINAL REPORT, PHASE II. (South Reef Island).

Submitted to the Centre for Herpetology, Madras Crocodile Bank
and to the Andaman & Nicobar Forest Department

(by SMITISH BHASKAR, 8 - 3 - 1993.)

Harry,

Aside from minor corrections, my main suggestion is to fabricate some of the relevant S. Reef nesting data from the info in the synopsis to give a quick ready reference. This can then be done for the rest of the islands nesting pops.

2. The cinet cat may be eradicated from S. Reef - recs. to eradicate them from S. Reef may not be good.

3. A strong rec. to get rid of feral dogs in the islands is important.

H.I. agree, see visit stuff sheet. be removed & built upon for a 5 km scale.

RCM

ANDAMAN AND NICOBAR SEA TURTLE PROJECT

PHASE II - SOUTH REEF ISLAND

Executive summary

- South Reef island in the Andaman group is believed to rank among the islands most favoured by nesting Hawksbill turtles ^(*Eretmochelys imbricata*) in India. An estimated 41 Hawksbills made 116 nests and 11 Green turtles ^(*Chelonia mydas*) made 45 nests on the island during the period 7 July - 12 December 1992.
- Nesting occurs throughout the year for both species, with peaks in September-October for Hawksbills and around June for Green turtles.
- The degree of nesting by both species has remained steady over the 9 year period following a survey in 1983 when 80 Hawksbill nests and 40 Green turtle nests were counted.
- A conservative first estimate of the nesting Hawksbill population of 1992 in the entire Andamans is 205 turtles, of which a ^{20%} fifth nested on South Reef. The estimate for the entire Andaman and Nicobar group is 250 nesting Hawksbills per season.
- Preliminary tagging studies at South Reef suggest that, on average, Hawksbills nested ^{an average of} 2.85 times within a season, and Green turtles ^{an average of} 4 times.
- Islands known to be important for nesting Hawksbills in the archipelago in 1983 were South Reef, North Brother, Shark, South Brother, Kwangtung, North Cinque, South Cinque, East Twin, West Twin, Rutland, Interview, Latouche and Great Nicobar. In addition to these thirteen, four more islands in the Nicobars, ^{namely} viz. Heroe, Trak, Treis and Tillanchong were confirmed ^{in 1992 and 1993} to be important nesting locations for the species.

- The previously important Hawksbill nesting beach on the southwest corner of Rutland island was found to be devoid of sand in August 1992. No nests were present. Beach sand had been mined for construction purposes. *This activity remains a constant threat to sea turtle nesting beaches.*
- The most favoured Green turtle nesting beaches in the Andaman and Nicobar group are believed to occur on Interview, South Reef, South Brother, South Sentinel and Meroe islands.

Major management procedures recommended in order to conserve nesting Hawksbill and Green turtle populations in the Islands are:

- a) Protection of nesting beach sand and background vegetation.
- b) Elimination of ^{feral} dogs on Great Nicobar's nesting beaches.
- c) Curtailment of human use of nesting islands.
- d) Intermittent status surveys of nesting islands.
- e) Establishment of turtle hatcheries only at nesting beaches where extra-natural predation on eggs or on hatchlings is heavy.

*Recom * to come here from
The Back.*

TABLE OF CONTENTS

Page

SYNOPSIS	1
Description of South Reef Island	7
Sea kraits	8
Abbreviations used. (OVERVIEW) *	11
Nesting population estimates	12
Tags	14
Investigator - turtle encounter % . Size & weight	15
Non-nesting crawls. Clutch size . Nesting seasons	16
Temperature dependence of hatchling emergence periods	17
Predators	18
Tidal inundation of nests . Time of nesting .	20
Emergence of hatchlings	21
Abbreviations used for fauna	22
RECOMMENDATIONS	22
Tables :	
1. <u>Eretmochelys</u> . Data from nests	25
2. Measurements of nesting <u>Eretmochelys</u>	27
3. Data from renesting <u>Eretmochelys</u>	27
4. Renesting intervals for individual <u>Eretmochelys</u>	27
5. <u>Eretmochelys</u> . Individual measurements & dates tagged	28
6 & 7. Monthly nesting intensities	29
8. <u>Eretmochelys</u> . Weekly nests & non-nesting crawls	30
9. <u>Chelonia mydas</u> . Measurements & renesting intervals	30
10. <u>Chelonia mydas</u> . Data from hatched nests	31
Location map	32
Map of South Reef Island	33
<u>Eretmochelys</u> . Hatchling emergence period v. T control sand	34
References. Acknowledgements	35

* * *

~~CONFIDENTIAL~~

ANDAMAN AND NICOBAR SEA TURTLE PROJECT

Final report, PHASE II

Submitted to the Centre for Herpetology, Madras Crocodile Bank
and to the Andaman & Nicobar Forest Department
by SATISH BHASKAR on 8-3-1993.

Period covered by Phase II : 12-8-1992 to 18-12-1992 (4 months).

Field investigators : Satish Bhaskar, Aug-Dec 1992,
Mark Bastian, Aug-Nov 1992.

Dates covered by the field study : 24 Aug to 12 Dec 1992.

Importance of South Reef Island : - Nesting Hawksbill turtles
- Nesting Green turtles
- Aggregations of sea kraits
(2 species of Laticauda)
- Other marine, terrestrial
and avifauna

Description of South Reef island
over view to come here

SYNOPSIS

- An estimated 41 Hawksbill turtles (Eretmochelys imbricata)
and 11 Green turtles (Chelonia mydas) nested on South Reef
Island during the period 7 July - 12 December 1992.

- Of these, 27 Hawksbills and 5 Green turtles were tagged,
between 15 September and 12 December.

- The total number of sea turtle nests made on South Reef I.
during the period 12 September - 12 December was exactly 100,
of which Hawksbills made 80 and Green turtles 20. In add-
ition, 36 Hawksbill nests and 25 Green turtle nests made

come here
from page

7-10

before 12 September hatched on the island, giving grand totals of 116 nests for Hawksbills and 45 for Green turtles from mid-July to 12 December 1992.

- On average, each Hawksbill nested 2.85 times_A (renesting interval 14.2 days) and each Green turtle 4 times_A.
range 1-4, n=27 turtles
range 12-17, n=15 renestings
range 1-6, n=5 turtles
range 12-15, n=13 renestings
(renesting interval 13.4 days).

- Based on the present study and on nest counts during previous surveys, a conservative first estimate of the nesting Hawksbill population_A of 1992 in the entire Andamans is 205 turtles; a first estimate for the entire Andaman and Nicobar group is 250 nesting females.

- Both Hawksbills and Green turtles appear to nest throughout the year, but there is a definite peak in the nesting season for Hawksbills in September and October and for Green turtles in July. Surveys to determine whether the peak for Green turtles also includes the month of June are necessary.

- Average clutch size for the Hawksbill was 131 eggs (range 46-213, n=58 nests) and for the Green turtle 91 eggs (range 52-144, n=22 nests). The clutch containing 213 eggs is the largest recorded for any sea turtle nest in India.

- Excluding nests from which no hatchlings emerged (predated, sea-eroded and flooded nests), the overall percentage of eggs that hatched was 88% for the Hawksbill and 89% for the Green turtle.

- The estimated hatchling production from nests made on South Reef I. between 7 July and 12 December is 12,100 for Hawksbills and 3,300 for Green turtles. These figures take into account the loss of 11 Hawksbill nests from egg predation, sea erosion and flooding of nests, and of 4 Green turtle nests from egg predation.
- The percentage of non-nesting crawls made by Hawksbills was 21.6% (22 out of 102 crawls) and by Green turtles 23.1% (6 out of 26).
- The maximum number of nestings observed at South Reef for an individual Hawksbill was 4, and for an individual Green turtle, 6. Several turtles were seen only once, but only 56.25% (45 of 80) nesting visits by Hawksbills were intercepted by the investigators. Thirteen out of 14 i.e. 93% of nesting visits by Green turtles were intercepted.
- On the average, Hawksbill hatchlings emerged onto the beach surface 61 days after oviposition (range 55-73, n=15 nests), in control sand temperatures (explained on p.11) that averaged 28.8°C (range 27-30.1°C, n=15 nests).
- Hawksbills tended to nest lower down the beach than Green turtles, usually on exposed sand above the spring high tide line or among Ipomoea or Vigna creepers. Over 80% of Green turtle nests were made under the shade of Scaevola taccada bushes.

- The average depth of the base of the egg chamber (measured from the sand surface) in Hawksbill nests was 46 cm. (range 32-60 cm, n=53 nests) and in Green turtle nests 70 cm (range 60-81 cm, n=17 nests).
- Track widths of Hawksbill hatchlings ranged from 6 to 8½ cm those and of Green turtle hatchlings from 10 to 11 cm. Green turtle nests typically showed a 'leaving pit' (crater or 'body pit') that was greater than 25 cm deep. Those made by Hawksbills were less than 20 cm in depth.
- Nesting by turtles, in particular by Hawksbills was very infrequent on nights following daytime visits to the island by boat crews, unlike on nights that followed 'undisturbed' days. However, the frequencies were not quantified.
- Nesting by both species was also found to be infrequent on otherwise favoured beaches where humans moved about during the day or used torches at night. Individuals of both species have been observed swimming parallel to the shore, and less than 2 metres from it, in shallow water less than half a metre deep, as they are silhouetted against the sandy seabed in bright moonlight with the moon near its zenith. These turtles are clearly intent on selecting a nesting site; disturbed turtles frequently nested on unsuitable shores of the island, usually on the side opposite to the site of the disturbance where the

nests were subjected to excessively low temperature regimes and to flooding and erosion by the sea. Some disturbed turtles apparently chose to nest on a neighbouring island. Having done this, at least one individual (a Green turtle) renested later on South Reef I.

- The degree of nesting both by Hawksbills and by Green turtles on South Reef has remained remarkably constant at least over the last 9 years. However, on the previously important Hawksbill nesting beach on the south-west corner of Rutland, nesting has been drastically reduced or even eliminated by mining of beach sand, and probably also by egg collection and capture of turtles, at sea and of nesters on land. The impact of tourism on the Cinque Islands, which were important Hawksbill nesting islands upto 1983 at least, remains to be evaluated.
- No large predators of turtle eggs or hatchlings (eg. monitor lizards or wild pig) occur on South Reef, which is also usually uninhabited by humans. However, the island has numerous ^(Rattus rattus) rats some of which prey on emerged and emergent hatchlings. A family of introduced civet cats (Paradoxurus tytleri) destroyed 4 Hawksbill nests during the 3-month study period. Visiting parties of divers and fishermen took another 8 nests (4 of each species). It cannot be doubted that the degree of predation by humans, and visits to the island, will be higher during the period of calm weather, January to April.

- Other than the boat belonging to the Forest Department, only 3 boats - all mechanized dugouts or 'dongies' were seen near the environs of South Reef Island during the period of rough weather ending on 16 Nov 1992. One of these boats, owned by divers, was based near Mayabunder. The others, based at 'Gol tikri' belonged to shark fishermen, who made two round trips past the South Reef area. After 16 Nov (when the weather calmed) and upto 12 Dec, 5 parties of divers, from the Webi area near Mayabunder came ashore or were seen near South Reef Island.
- Other than our turtle camp, there existed on South Reef the abandoned remains of three temporary camps, apparently those of fishermen or divers.
- An estimated 800 individual sea kraits (Laticauda spp.) including both sexes came up from the sea and entered the forested parts of the island during the period Sep to Dec. Courtship, temperature regulation and moulting were observed, but no mating. Two species - Laticauda colubrina and an unconfirmed species - used the island, their relative abundance being about 200:1 respectively. No sea krait hatchlings or eggs were found on the island during the period 24 Aug - 12 Dec.



Description of South Reef Island

& p 0 & page 1

From the air, South Reef is shaped roughly like a boat viewed side-on, with its long axis oriented NNE-SSW.

It is situated at about 12°46'N, 92°40'E, nearly 2 km SSW from the southern tip of Interview Island. The longest dimension - along the east coast - is 440 metres and the greatest width 90 metres. The island is surrounded by a fringing coral reef except for narrow gaps at its northern end, where individual coral heads exist.

Landing by any but small boats (less than 3/4 metre draft) is impractical or difficult, and even this requires favourable tides and weather which, however, prevails from about mid-November to mid-May. Between June and mid-November, landings are safe only during calm spells, on the east coast. The island is well forested despite the presence ^{near} the east coast of three small clearings, the sites of temporary camps apparently used by divers and fishermen. The fringing reef is broadest (about 250 m) off the island's western coast, where most of the beach sand is confined to a 20 metre long, 5 metre broad stretch near the island's centre. Nesting by sea turtles mainly occurs on the 440 metre eastern beach and on the contiguous 90 metre long south-western beach. Nesting also occurs on the 75 metre long northwestern beach. Except for the 20 metre stretch alluded to, most of the

island's western shore is characterized by large fallen trees, some coral rubble and very little exposed sand, on which turtles do not often nest except when disturbed off the more favoured eastern, north-western and south-western beaches.

Other than rats, a few civet cats and a species of small bat, no mammals appear to live on the island. Scorpions and centipedes occur but are not commonly seen. Two bee hives were found, the bees obtaining at least some of their nectar from blossoms of Morning Glory (Ipomoea pes-caprae), creepers which are also important to nesting turtles because they help bind beach sand, facilitating the building of egg chambers by nesting turtles in the dry season, and retarding sea erosion.

SEA KRAITS :

Two of the 5 known species of sea kraits (Fam. Laticaudidae) come ashore onto South Reef. The commoner one, Laticauda colubrina, was frequently encountered at night during 'turtle walks' as they climbed slowly up the beach into the forest, or as they left the forest to return to sea. During the day, individual snakes or small aggregations of 2 to 4 snakes, usually including males and one female could be found in the forest in cool shady places in crevices in fallen trees, between tree buttresses,

under the loose bark of fallen trees, inside hollow boles of rotted trees, under thick stands of Pandanus vegetation, inside rainwater puddles trapped between buttresses, under mats of dry fallen leaves, and in one instance each, inside a beached coral boulder having a hole in it, under a thick, nearly flat block of wood washed up by the sea, and under the plastic groundsheet I slept on. The kraits were strongly attracted to the light from our 'dibri' (a diesel-burning lamp made from a used bottle) and often crawled against our feet as we sat writing by lamp-light. They never attempted to bite, and also showed no aggressive behaviour when handled, or when accidentally stepped upon, or even when hurt by the tagging operation. A total of 366 sea kraits were tagged, using red plastic number-plates most of which were threaded through fishing line tied to the snakes' tails through a small hole made by a nail and hammer. Divers I met in the area were also emphatic that the snakes never attempted to bite humans underwater. Several of these Yellow-lipped sea kraits came ashore after a heavy, undigested meal. The stomach of a dead specimen (trapped between coral rocks) yielded an eel that had been swallowed tail-first. Only the posterior 10 cm of the $\frac{1}{2}$ metre long eel had been partly digested. Several sea kraits showed bite-marks on the torso, apparently received from moray eels.

During the period 12 Sep - 12 Dec 1992, an estimated 800 sea kraits came ashore onto South Reef. Several individuals stayed on land for more than a week, including a large female that was observed

for 17 days. No eggs or hatchlings were found during the survey period, and we feel that the laying and hatching season occurs at some time between January and July. Activities observed included moulting, habitat selection (apparently for temperature regulation) and courtship, but no mating. Stranding females were sometimes followed by males which located the females by scent and clambered onto their backs, sometimes in a direction opposite to that of the female. Several individuals, both males and females, carried ticks. These were found most frequently on the dorsal margin of the tail. Healed indentations marking the sites of tick bites were commonly present on the tail.

Two individuals of a different species of Laticauda, possibly L. laticaudata, were also found in the forest. These were smaller than the smallest of the males of the species L. colubrina met with, but possessed far more black bands - over 70, as compared to 35-49 for the 364 individual L. colubrina that were tagged. The largest females of the latter species measured 170 cm in length and 17 cm in maximum circumference. Males were smaller, but had proportionately longer tails.

Surveys to locate and protect other islands and areas where sea kraits form aggregations, before these populations are exterminated, are considered vital.

Abbreviations used :

NNC = Non-nesting crawl

CCL = Carapace Curved Length

CCW = Carapace Curved Width

DIN = Hatchlings dead in nest

AIN = Hatchlings alive in nest

VE = Eggs with visible embryo

NVE = Eggs with no visible embryo

UH = Unhatched eggs

HEP = Hatchling emergence period

(Incubation period + days taken to reach surface)

T_{control} = Sand temperature measured at nest depth, 1 metre from an emerged nest, on the day following hatchling emergence. (°C)

OVERVIEW

During a sea turtle survey in 1983-84 (Bhaskar, 1984) at least 335 Hawksbill nests were counted on 10 islands in the Andamans. South Reef still remains, among the 3 most important of these, the other two being North Brother I. and Snark I. The other islands were Kwangtung, Interview, North Reef, Latouche, the two Cinque Islands, and South Brother. In addition, the two Twin Islands were reconfirmed to be favoured by nesting Hawksbills. The south-west corner of Rutland Island, which was also an excellent Hawksbill nesting area upto the 1980's is now practically devoid of beach sand as a result of sand mining. It is feared that South Cinque Island will also cease to be used by nesting Hawksbills with the expansion of tourism there. Surveys to evaluate the importance to

nesting Hawksbills of several other islands, in particular 7 islands off the north-west coast of North Andaman are necessary.

In the Nicobars, the island most favoured by nesting Hawksbills is undoubtedly Meroc. In addition, Tillanchong, the southern tip (Pygmalion or Indira Pt.) of Great Nicobar Island, Trak, Treis and to a lesser extent Menchal and Pulo Milo are all used by nesting Hawksbills. Nesting at Car Nicobar has been practically eliminated by human exploitation of turtles and turtle eggs. Surveys remain to be conducted on Little Nicobar, Chowra, Batti Malv and on parts of Kamorta. In addition, all the Nicobar islands remain to be re-surveyed, to update the status of nesting turtles there.

During the 1983-84 survey, at least 191 Green turtle nests were recorded, from 4 islands: Interview (105 nests), South Reef (40), South Brother (37) and Snark (12). The number recorded from South Reef in 1992 was 45.

NESTING POPULATION ESTIMATES

An estimated 41 Hawksbills made 116 nests on South Reef during the period c. 9 July to 12 December 1992. Of these, 27 nesters were tagged, between 15 Sep and 12 Dec, during which period 77 nests were made. *The rate of nesting is slow - table 1*
Eighty of the 116 nests were made while the investigators were on the island, 12 Sep - 12 Dec. Fifty five days was found to be the minimum 'hatchling emergence period' (HEP), so that an additional 36 nests that

emerged during the 55-day period following 12 Sep conclusively proved that at least 36 nests had been made ^{by Hawksbills} prior to our arrival .

Avg. no. of nests per Hawksbill

$$= \frac{\text{Total nests made after tagging commenced}}{\text{No. of Hawksbills tagged}} = \frac{77}{27} = 2.852$$

$$\text{Population of } \overset{1992's}{\text{nesting Hawksbills}} \text{ on South Reef Island} = \frac{116}{2.852} \approx 41$$

Nesting population estimate for the entire Andamans and Nicobars:

Assuming that the 1983-84 numbers have been maintained, ^{approximate} the following ^{extrapolations} can be made:

S.Reef accounted for 80 out of 335 nests counted on 10 Islands in 1984.

Therefore, the no. of nests on these 10 islands in 1992

$$= \frac{116}{80} \times 335 = 486.$$

Adding a conservative figure of 100 nests for the two Twin Islands, the remaining 20-odd unsurveyed islands in the Andamans, and for stray nesting,

Total No. of Hawksbill nests in the Andamans in 1992 = 586

$$\text{No. of nesting Hawksbills for the year 1992} = \frac{586}{2.852} = 205.$$

Based on recent surveys of this species (Bhaskar 1992), the numbers that nested in 1992 in the Nicobars may be less than 1/4 th this figure. A yearly nesting population of

about 250 Hawksbills in the Andamans and Nicobars is therefore a conservative first estimate. Total nesting populations will be estimated after remigration intervals are known.

For the Green turtle at South Reef Island, an estimated 11 individuals made 45 nests during the period c.9 July to 12 December 1992. Of these, 5 nesters were tagged, between 15 Sep and 12 Dec, during which period 20 nests were made. *Tab*
As was reasoned for Hawksbills, nest emergences proved that at least 25 Green turtle nests were made before our arrival on 12 Sep.

Average number of nests per Green turtle = $\frac{20}{5} = 4$.

Population of 1992's nesting Green turtles on South Reef I.
= $\frac{45}{4} = 11$.

Pending surveys in June, believed to be one of the peak months for nesting, population estimates for the entire Andamans and Nicobars are not being attempted.

TAGS : The tags used for both species were of non-corroding metal wire of English make, strung through red plastic number plates inscribed with the numbers 'AN 301' through to 'AN 320' and with 'AN 76' through to 'AN 88'. Tagging was not attempted before the turtle began dropping eggs, except in the case of non-nesting turtles that were about to re-enter the sea. The site of the tag was the first large scale on the trailing edge of the left fore-flipper. No injuries suggesting loss of a tag were seen on any turtles.

TURTLE-INVESTIGATOR ENCOUNTER % :

$$\text{Encounter \%} = \frac{\text{No. of nestings seen during a given period}}{\text{No. of nests made during this period}}$$

$$= \frac{45}{80} \times 100 = 56.25\% \text{ for Hawksbills}$$

For Green turtles, encounter %

$$= \frac{13}{14} \times 100 = 92.86\%$$

SIZE AND WEIGHT:

The only Hawksbill weighed, Tag no. AN 318, scaled 36⁵/₂ kg. At CCL/CCW measuring 71²⁵/₄ cm/ 65⁵/₂ cm, this was a small individual: only 4 of the remaining 26 tagged Hawksbills were smaller, ^{Table 3.5.5} at 71/65⁵/₂, 71⁵/₂/62⁵/₂, 71⁵/₂/62 and 71⁵/₂/58⁵/₂ cm. It is estimated that the last individual, the smallest, weighed about 34 kg. However, in Dec 1983, a Hawksbill measuring 65⁵/₂/60 cm was recorded nesting on South Reef. This remains the smallest Hawksbill found nesting in India and can be regarded as being close to the minimum size of sexually mature females of this species. *Table 6 A & B*

The largest tagged Hawksbill (Tag no. AN 316) measured 85²⁵/₂/79²⁵/₂ cm, but this was still slightly smaller than the smallest of the 5 tagged Green turtles (Tag no. AN 85, measuring 86⁵/₂/81 cm).

The largest of 5 nesting Green turtles measured only 93⁵/₂/81⁵/₂ whereas at Nancowry and Trinkat Islands in 1979 the Nicobars 6 of 9 Green turtle shells measured were larger. Three of these measured over 100 cm CCL, the

largest being 108/94 cm. Green turtles in the South Reef area apparently do not grow to large sizes, possibly due to predation by sharks, by humans, or by both.

NON-NESTING CRAWLS

$$\text{Percentage of non-nesting crawls} = \frac{\text{No. of NNCs}}{\text{Total crawls}} \times 100$$

$$\text{For Hawksbills, NNC \%} = \frac{22}{102} \times 100 = 21.57\%$$

$$\text{For Green turtles, NNC \%} = \frac{6}{26} \times 100 = 23.1\%$$

CLUTCH SIZE

For Hawksbill nests that emerged, the average clutch size, 131.2 eggs (range 46-213, n=58 clutches) was found to be almost identical to that for Hawksbills listed in Bhaskar 1984 (131.5 eggs, n=6 nests). The average hatching % was about 5% lower in 1992 compared to that for the 6 nests in 1984 : 88.1% vs. 93.3%. (Table 5)

For Green turtle ^{nests} that emerged, the average clutch size was about 40 eggs less than for Hawksbills -- 90.6 eggs (range 52-144, n=22 nests).

NESTING SEASONS

Evidence from nest counts between 12 Sep and 12 Dec 1992 (80 nests) and from nests that emerged during the period 12 Sep to 11 Nov (36 nests) points to a start of the Hawksbills main nesting season in

July. The earliest hatchlings we saw came from Hawksbill nests that erupted onto the beach surface on 12 Sep. Assuming an 'emergence' period (i.e. incubation period + time taken for hatchlings to emerge onto the beach surface) of 55 days, these nests were made on about 19 July. However, it is practically certain that nesting began earlier than 19 July, *Table 6* September and October are the peak nesting months. Nesting by Hawksbills in the Andamans has now been recorded in every month of the year except in June, during which surveys remain to be undertaken. Round-the-year nesting is likely.

As is the case for Hawksbills, Green turtle nests have now been found, or their occurrence established, in every month of the year except June, for which surveys are lacking. Nesting most probably *Table 7*

occurs round the year. There is a peak in the nesting season in July. It is to be confirmed whether or not this peak includes the month of June also.

TEMPERATURE DEPENDENCE OF HATCHLING EMERGENCE PERIOD

Hawksbill hatchlings from two nests made on the same night, 27/28 Sep, and containing comparable numbers (in 60 and 68 days) of eggs (82 and 114) emerged 8 days apart, in control sand temperatures measuring 29.5°C and 28°C respectively. A 1.5°C difference in control temperature therefore altered HEP by 8 days, and doubtlessly also resulted in differing hatchling sex ratios. The number of

hatched eggs in the respective clutches - a measure of metabolic heating of the clutch during incubation- were 75 and 100. During the period Sep- Dec, Hawksbill nests took an average of 61.47 days to emerge (range 55 - 73, n=15 nests) at an average control sand temperature of 28.8°C (range 27-30.1°C, n=15 sites). The largest rise in temperature due to metabolic heat, 3.4°C, was recorded for a Hawksbill nest for which temperature at emergence was 30.6°C and control sand temperature 27.2°C. The number of eggs in this clutch was not recorded. However, for a nest containing 121 eggs, a 2.5°C rise was recorded.

The only Green turtle nest for which temperature data was collected after emergence showed metabolic heating of at least 2°C (nest temperature = 30.8°C, control sand temperature = 28.8°C). Only one nest was monitored for hatchling emergence period. This nest emerged on 11 Nov, 53 days after oviposition.

PREDATORS

South Reef and several other islands important to nesting Hawksbills in the Andamans and Nicobars are characterized by the absence of monitor lizards and wild pig, which are the main natural predators on turtle eggs and hatchlings on land at less favoured nesting sites. The island is usually uninhabited by humans, and feral dogs - another major predator on turtle eggs and hatchlings - would not survive on the

waterless island. A family of civet cats (Paradoxurus tytleri), an introduced species, lives on the island's northern end took 4 Hawksbill nests during the 3 month period 12 Sep- 12 Dec. Ghost crabs (Ocypoda sp.) burrow into nests and take hatchlings and eggs, and also take hatchlings on the beach surface, but their net effect is low (estimated predation less than 5% of eggs laid).

Rats (Rattus rattus) abound on the island and take a small number (less than 3%) of emerged and emergent hatchlings. The nest of a White-bellied sea eagle (Haliaeetus leucogaster) exists on a tree on the island's western shore (where less turtles nest than on the eastern shore), but the eagle was never observed preying on turtle hatchlings on land or at sea.

Several species of sharks occur in the waters around South Reef Island, including the Tiger shark Galeocerdo cuvieri, one individual of which had the head and flipper of an adult Hawksbill in its stomach (Bhaskar 1984). Despite the recent spurt in shark fishing in the area (for the shark-fin market), these fish are believed to be responsible for much of the natural predation that turtles and their young suffer at sea. Several barnacle-infested Hawksbills were among those that nested, but none with shark-bite injuries or missing appendages were seen, except for one with a 14 cm wide, 3cm deep bite-shaped indentation on the edge of its carapace.

Parties of humans (divers and fishermen)

who visited the island took a total of 8 nests, including 4 each of Hawksbills and Green turtles. Three were taken in September and 5 in December. Fishing activity in the area in the months preceding 12 December was low: no turtles were captured in the area and no nesters came up with evidence of harpoon injury on their carapaces, unlike the case in 1984 when two of three nesting females seen had spear injuries. The nearest permanent human presence still remains at the Police camp situated about 10 km away on Interview Island's western shore, and a Forest Department camp also about 10 km away, on Interview's eastern shore.

TIDAL INUNDATION OF NESTS

During the survey period, 3 nests, all made by Hawksbills were lost to inundation by tides - one on the island's western coast and two on its north-western coast, where erosion by the sea was heaviest. Loss of nests to flooding and erosion is of minor consequence at South Reef during this period (three out of 80 nests, i.e. 3.75%).

TIME OF NESTING

Over 95% of nesting by Hawksbills took place before 0145 hrs Indian Standard Time. Nesting began well after nightfall in all instances except one, where a Hawksbill emerged to nest at 1500 hrs on 1 Oct 1992. This is the first record

of daylight nesting by a Hawksbill in India. All other Hawksbills stranded later than 1800 hrs . The first turtles tended to arrive progressively earlier as the winter solstice approached. Green turtles usually arrived a bit later than Hawksbills, and being heavier and deeper in 'draft' (and therefore more prone to injury on the fringing reef) were more dependent on the proximity of time of high water than were Hawksbills. Despite this, individuals of both species occasionally stranded at or around the time of low tide. One such Hawksbill crossed a 70 metre stretch of exposed, rugged intertidal reef in order to nest on the island's western coast.

Emergence of hatchlings

Unlike at the Leatherback (Dermochelys coriacea) and Olive Ridley (Lepidochelys olivacea) nesting beach at the mouth of the Galathea River on Great Nicobar, it was found to be impossible to count, with any accuracy, the tracks of individual hatchlings that had emerged from hatched nests, especially in the case of Hawksbills, which are smaller and lighter than Green turtles. The estimated hatchling production at South Reef, 21,100 for Hawksbills and 3,300 for Green turtles, is based on counts of eggshells and not of hatchling tracks. However, the figures are believed to be reasonably accurate.

All except 3 of 103 nests (79 Hawksbill nests and 24 Green turtle nests) are believed to have emerged during the night. One Hawksbill nest emerged at 1430 hrs on an overcast day, and one of each species at 1630 and 1645 hrs. respectively.

Abbreviations used for fauna :

- EI=Hawksbill turtle Eretmochelys imbricata.
CM =Green turtle Chelonia mydas.
SK = Sea krait Laticauda spp.
CP = Saltwater crocodile Crocodylus porosus.
MF = Megapode Megapodius freycinet.
PR = Regal python Python reticulatus.
SA = Andaman pig Sus andamanensis.
CF = Andaman greyrumped swiftlet Collocalia fuciphaga
inexpectata.
BL = Coconut crab Birgus latro.
AGA= Andaman teal Anas gibberifrons albobularis.
OH = King cobra Ophiophagus hannah.
PG = Fruit bat Pteropus giganteus.

RECOMMENDATIONS

1. From the standpoint of Hawksbill and Green turtle conservation, the islands listed below urgently need to be set aside as sea turtle sanctuaries. Other prominent fauna that will receive incidental protection by doing so are also listed for each island. The following activities are to be totally prohibited on these islands:

- Mining of beach sand.
- Tourism
- Construction of wells, roads and permanent or temporary structures on or within 1½ km of each island.
- Felling of timber, small trees, and clearing of vegetation including seashore vegetation.
- Visits by humans by day and by night except with prior permission from the Forest Department.
- Plying of boats within 1½ km of the islands coast.

Snark (Shark)	EI, SK.
Kwangtung	EI, SK.
South Reef	EI, SK, CM.
North Reef	EI, SK, AGA.
Latouche	EI, SK.
Interview	EI, SK, CM, SA, OH, CF.
North Cinque	EI, PG.
South Cinque	EI.
West Twin	EI, SK, CM.
East Twin	EI, SK, CM.
North Brother	EI, CM.
South Brother	EI, CM.
South Sentinel	EI, BL, CM.
Tillanchong *	EI, BL, CM, SA, SK, MF, CP, PR.
Meroe *	EI, BL, CM, SK, MF.
Trak *	EI, CM.
Treis *	EI, CM.

* Camping by Nicobarese (who have traditionally used these islands to fish and to harvest coconuts) should be permitted, but ^{not} the use of firearms and dogs.

2. To locate unrecorded sea turtle nesting areas, surveys need to be undertaken at several islands. The most promising ones are 7 islands off the north-west coast of North Andaman viz. West, Whitecliff, Reef, Beef, Paget, Point and Sugar Loaf Islands, and South Sentinel Island off the north-west coast of Little Andaman. Other unsurveyed islands include Little Nicobar, Chowra, Menchal, Batti Malv, Narcondam, Barren, Pocock, and the Turtle Islands.
3. All known turtle islands need to be re-surveyed every once in four years.
4. Valuable studies on sea kraits could be undertaken at South Reef.
5. The numbers of sea kraits coming ashore at Rutland ^{over the last 9 years} have decreased catastrophically. Humans on shore can easily exterminate these venomous but completely harmless-to-Man reptiles, as the latter are strongly attracted ^{to} lights at night. Surveys are therefore urgently needed to identify and notify as Sanctuaries all remaining islands and areas where sea kraits come ashore in numbers.
6. Rats and civet cats need to be eradicated from South Reef Island.

TABLE 1. ERBIMCCHIELYS. 7 DATA FROM NESTS

Parameter	n	Range	Avg. x	$\sum x$	$\sum x^2$	Pop. SD σ_n	Sample SD σ_{n-1}
Clutch size	58 clutches	46 - 213	131.2	7609	1047349	29.10	29.38
Nest depth of top eggs (cm)	6 clutches	20 - 37	26.83	161	4563	6.362	6.969
	53 clutches	32 - 60	45.84	2429.5	113557	6.427	6.489
Vertical span (cm) top eggs to bottom eggs	5 clutches	8 - 19	13.6	68	1006	4.03	4.506
Eggshells in hatched nests	55 clutches	33 - 190	114.95	6322	773478	29.17	29.44
Hatching % per nest * ($\frac{\text{Eggshells}}{\text{Clutch size}} \times 100$)	55 clutches	25.58 - 98.92	88.22%	4852.1	435310	11.48	11.59
Overall hatching % * ($\frac{\sum \text{Eggshells}}{\sum \text{Clutch size}} \times 100$)	6322 out of 7178 eggs from 55 hatched nests	--	88.07%	--	--	--	--

* excludes data from unhatched and eroded nests.

TABLE 1. (contd.) ERETMOCHELYS. DATA FROM NESTS

Parameter	n	Range	AVG. \bar{x}	Σx	Σx^2	Pop. SD σ_n	Sample S.D. σ_{n-1}
Unhatched eggs * (UH) (VE + NVE)	56 clutches	1-96	15.71	880	27396	15.57	15.71
'Infertile' eggs * (NVE)	56 clutches	0-24	4.82	270	3054	5.594	5.644
'Infertile' eggs (NVE) % w.r.t. clutch size *	55 clutches	0-16.41	3.574	196.5	1536	3.893	3.929
Overall 'infertile' egg % ($\frac{\Sigma NVE}{\Sigma \text{Clutch size}} \times 100$) *	262 out of 7178 eggs from 55 clutches	—	3.65%	—	—	—	—
Hatchlings dead in nest (DIN) *	56 clutches	0-6	0.57	32	88	1.116	1.126
Overall DIN % ($\frac{\Sigma \text{DIN}}{\Sigma \text{Clutch size}} \times 100$) *	31 out of 7178 eggs from 55 clutches	—	0.43%	—	—	—	—
AIN including 39 pre-emergent hatchlings from 3 nests *	56 clutches	0-19	1.61	90	820	3.423	3.504
AIN excluding 39 pre-emergent hatchlings from 3 nests *	53 clutches	0-7	0.944	51	199	1.671	1.687
Hatchling emergence period (days)	15 nests	55-73	61.47	922	57004	4.703	4.868
Beach sand control temp. (°C) **	15 sites	27-30.1	28.76	431.4	12420	0.937	0.942

* excludes data from unhatched and eroded nests

** measured 1 metre from emerged nests at nest depth (35 cm) after emergence of first hatchlings.

TABLE 2. MEASUREMENTS OF NESTING ERETMOCHELYS.

Parameter	n	Range	Avg. \bar{x}	$\sum x$	$\sum x^2$	Pop. S.D. σ_n	Sample S.D. σ_{n-1}
Standard Carapace Curved Length (cm)	27 turtles	71 - 85½	77.70	2098	163493	4.173	4.252
Standard Carapace Curved Width (cm)	27 turtles	58½ - 79¼	68.48	1849	127191	4.589	4.677

TABLE 3. DATA FROM RENEETING ERETMOCHELYS.

Parameter	n	Range	Avg. \bar{x}	$\sum x$	$\sum x^2$	Pop. S.D. σ_n	Sample S.D. σ_{n-1}
Overall reneeting interval (days)	15 reneetings	12 - 17	14.13	212	3022	1.31	1.356
Average reneeting interval for each turtle (days)	9 turtles	12.67 - 15.5	14.2	127.8	1823	0.888	0.948

TABLE 4. RENEETING INTERVALS FOR INDIVIDUAL ERETMOCHELYS.

Tag numbers of turtles ***	307	310	313	316	319	78	80	81	82
Reneeting intervals (days)	13, 12, 13	15, 16	15	14	13	14, 13, 17	14	15	13, 15

*** The number on each tag was preceded by the letters 'AN'.

TABLE 5. ERETHOCHELYS. INDIVIDUAL MEASUREMENTS AND DATES OF TAGGING.
 * The number on each tag was preceded by the letters 'AN'.

Tag no.*	Standard CCL (cm)	Standard CCW (cm)	Date of tagging in 1992
301	84	72	16 Sep
302	71½	62½	17
303	74½	66½	18
304	81	69½	18
305	83½	78	22
306	76½	65	23
307	78½	69½	25
308	80½	72	27
309	79½	70	27
310	71½	62	28
311	74	65½	1 Oct
313	76	67	10
314	79	67	11
316	85½	79½	13
317	76½	66	13
318	71½	65½	13
319	78½	69½	21
320	84	76	22
78	71½	58½	27
79	71	65½	1 Nov
80	79¾	65¾	1
81	80	71	1
82	78½	69	2
83	77	68½	3
84	75	65½	10
86	83	73½	2 Dec
**87, 88	77	69	6

** Double tagged turtle.

TABLE 6. ERETMOCHELYS. Monthly nesting intensities.

Month	No. of days	No. of nests	Avg. no. of nests/day
July	c. 11	8	.727
Aug	31	16	.516
Sep	30	37	1.23
Oct	31	32	1.032
Nov	30	19	.633
Dec	11	4	.364
	144	116	.806

Table 7. CHELONIA MYDAS. Monthly nesting intensities on South Reef in 1992.

Month	No. of days	No. of nests	Avg. no. of nests/day
July	c. 11	16	1.455
Aug	31	7	.226
Sep	30	5	.167
Oct	31	5	.161
Nov	30	9	.3
Dec	11	3	.273
	144	45	.313

TABLE 8. ERETMOCHELYS. Weekly number of nests and NNCs
at South Reef in 1992

Period	No. of days	No. of nests	No. of NNCs
Upto 24 Aug	c.34	20	?
25 Aug - 11 Sep	18	16	?
12 - 18 Sep	7	9	2
19 - 25 Sep	7	7	1
26 Sep - 2 Oct	7	14	2
3 - 9 Oct	7	7	2
10 - 16 Oct	7	10	1
17 - 23 Oct	7	5	1
24 - 30 Oct	7	6	3
31 Oct - 5 Nov	7	6	5
6 - 12 Nov	7	4	0
13 - 19 Nov	7	3	0
20 - 26 Nov	7	4	1
27 Nov - 3 Dec	7	2	1
4 - 11 Dec	8	3	3
	144	116	22 (minimum)

TABLE 9. CHELONIA MYDAS. Measurements & renesting intervals.

Tag no.	CCL (cm)	CCW (cm)	Tagged on	Renesting intervals RI (days)	Avg. RI (days)
AN 312	90	83½	9 Oct	13, 14, 12, 12, 13	12.8
AN 315	89½	84	12 Oct	12	12
AN 76	93	85½	26 Oct	15, 13, 12	13.33
AN 77	93½	81½	26 Oct	14, 13, 14	13.67
AN 85	86½	81	16 Nov	15	15



Car Nicobar



NICOBAR ISLANDS

SEA TURTLE
NESTING

Andaman
Sea

Batti Malv °

o* Tillanchong

Chowra °

Isle of Man

no* () Teresa

Bompoka

Kamorta

Trinkat *o

no* () Katchal

Nancowry

Bay of
Bengal

- o Green turtle
- * Hawksbill
- o Leatherback
- " Olive ridley

o* Meroe

o* Trak - Treis *o

* Pulo Milo - Kabra

o* () Little Nicobar

Menchal

Kondul °

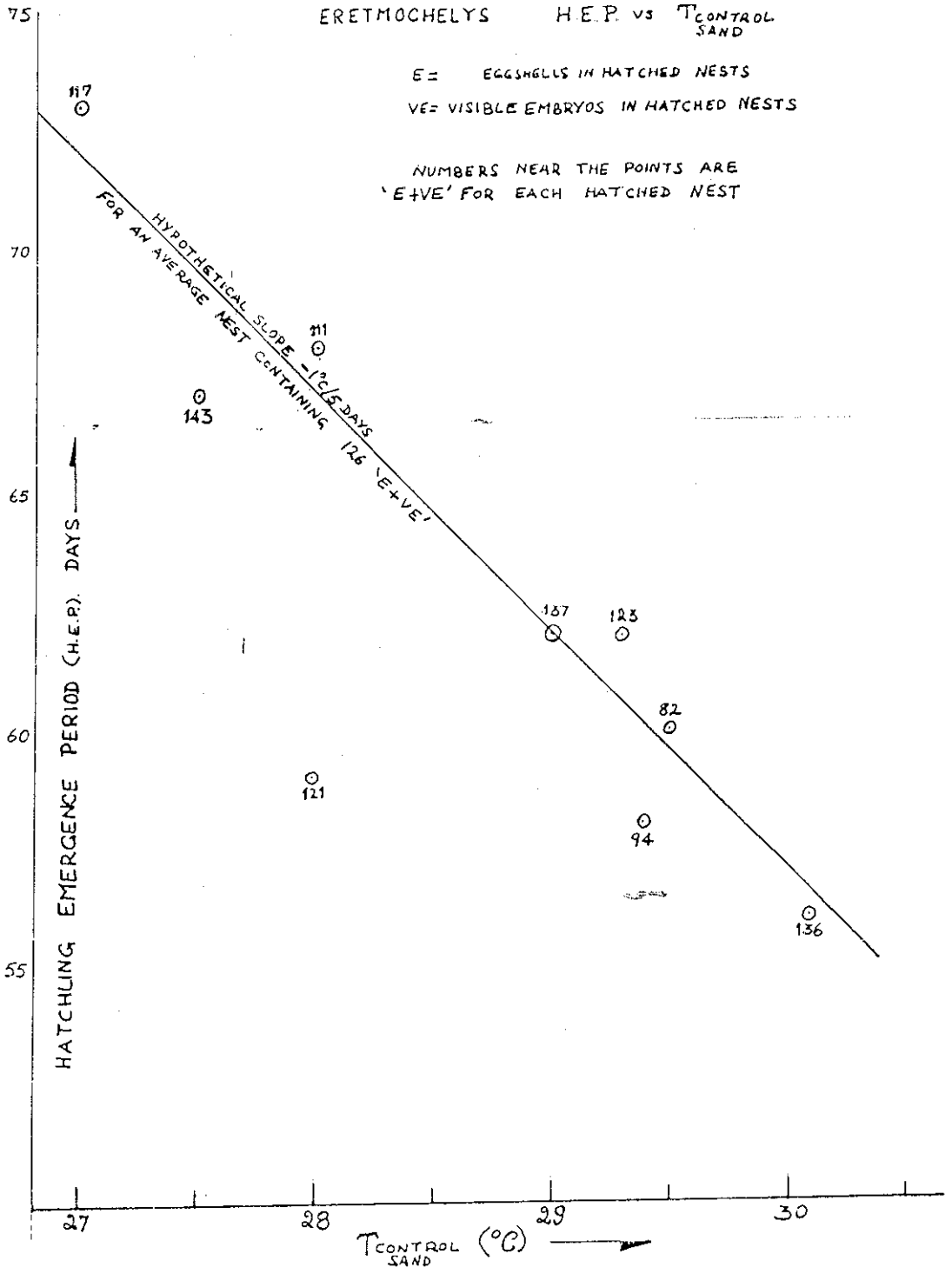
() *ou Great Nicobar



ERETMOCHELYS H.E.P. vs $T_{\text{CONTROL SAND}}$

E = EGGSHELLS IN HATCHED NESTS
 VE = VISIBLE EMBRYOS IN HATCHED NESTS

NUMBERS NEAR THE POINTS ARE
 'E+VE' FOR EACH HATCHED NEST



SCALE 1:1000

OR 1CM = 10M



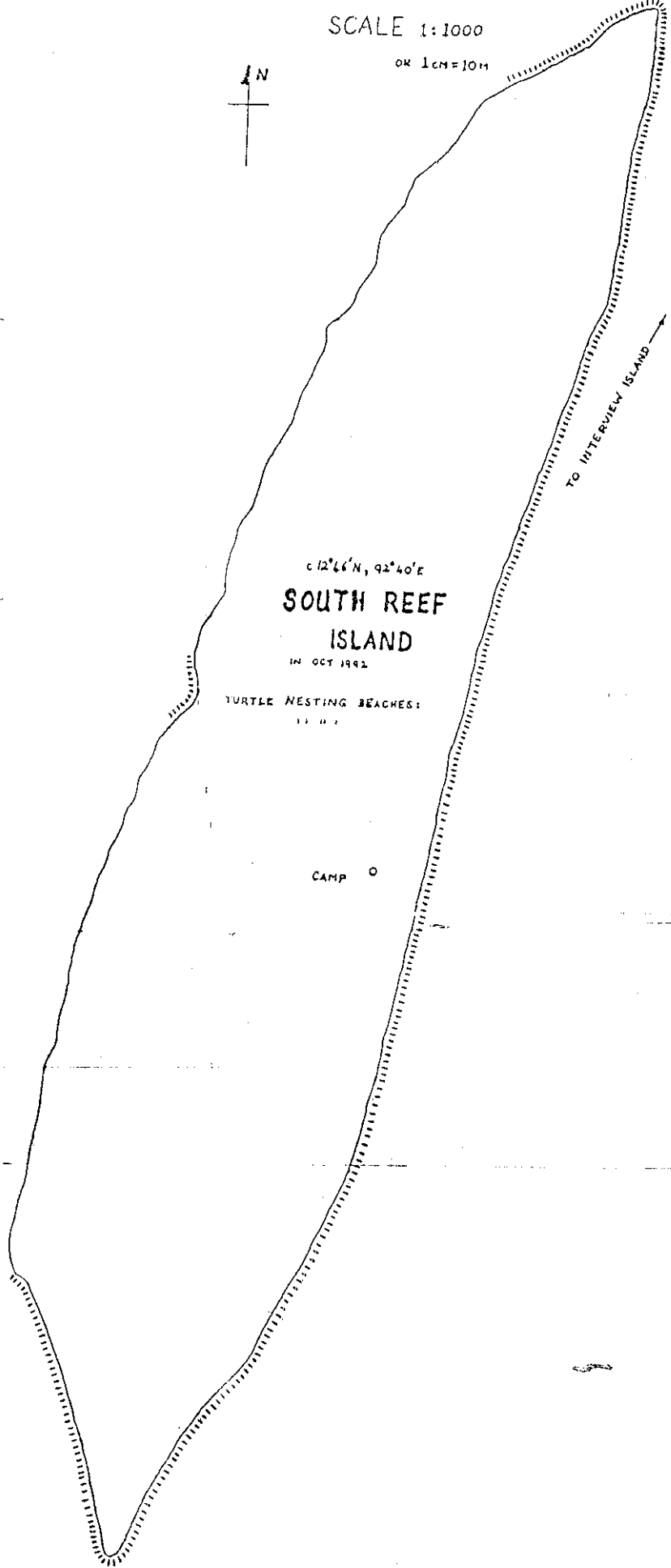
c 12° 46' N, 92° 40' E
**SOUTH REEF
ISLAND**

IN OCT 1992

TURTLE NESTING BEACHES:
.....

CAMP ○

TO INTERVIEW ISLAND →





Car Nicobar



NICOBAR ISLANDS

SEA TURTLE
NESTING

Andaman
Sea

Batti Malv °

o* Tillanchong

Chowra °

Isle of Man

uo* () Teressa

Bompoka

Kamorta

Trinkat *o

uo* () Katchal

Nancowry

Bay of
Bengal

- o Green turtle
- * Hawksbill
- () Leatherback
- u Olive ridley

o* Meroe .

o* Trak . Treis*o

* Pulo Milo * Kabra

o* () Little Nicobar

Menchal

Kondul °

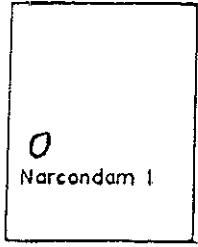
() *ou Great Nicobar

1 KM

ANDAMAN ISLANDS

sea turtle
nesting

- * LANDFALL I. ———
- * WEST I. ———
- * WHITE CLIFF I. ———
- * THORNHILL I. ———
- * BROWN HILL I. ———
- * PAGET I. ———
- * POWRI I. ———
- * CHANNEL I. EAST I. ———
- * DOCKOCK I. ———
- * COFFEE DERA TRAK I. ———
- * EXCELSIOR I. ———
- * DELGARDO I. ———
- * TRILBY I. ———
- * TEMPLE I. ———
- * TURTLES IS. ———
- * SMITH I. ———
- * ROSS I. ———
- * BRUSH I. ———
- * CRAGGY IS. ———
- * SNARK I. ———
- * KWAN TUNG I. ———
- * LATOUCHE I. ———
- * NORTH REEF I. ———
- * INTERVIEW I. ———
- * SOUTH REEF I. ———
- * TUFT I. ———
- * HUMP I. ———
- * FLAT I. ———
- * SPIKE I. ———
- * BLUFF I. ———
- * DEFENCE I. ———
- * PETRIE I. ———
- * MONTGOMERY I. ———
- * SANDY I. ———
- * TARMUGLI I. ———
- * BOAT I. ———
- * TWIN IS. ———
- * SOUTH SENTINEL I. ———
- * NORTH CINQUE I. ———
- * SOUTH CINQUE I. ———
- * PASSAGE IS. ———
- * SISTER IS. ———
- * BROTHER IS. ———
- * NORTH ANDAMAN I. ———
- * MIDDLE ANDAMAN I. ———
- * SOUTH ANDAMAN I. ———
- * LITTLE ANDAMAN I. ———
- * RAMNAGAR OLIVER I. ———
- * SOUND I. ———
- * AVES I. ———
- * KARMATANG IS. ———
- * BETAPUR IS. ———
- * BUTTON IS. ———
- * OUTRAM I. ———
- * INGLIS I. ———
- * HAVELOCK I. ———
- * NEILL I. ———
- * SIR HUGH ROSE I. ———
- * MADHUBAN I. ———
- * ROSS I. ———
- * PORT BLAIR ———
- * SNAKE I. ———
- * CORBYN & COVE ———
- * RUTLAND I. ———

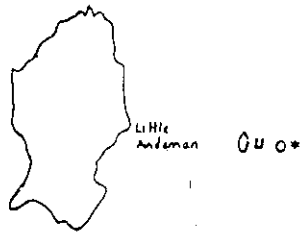


BARREN I.
○

Andaman Sea

Bay of Bengal

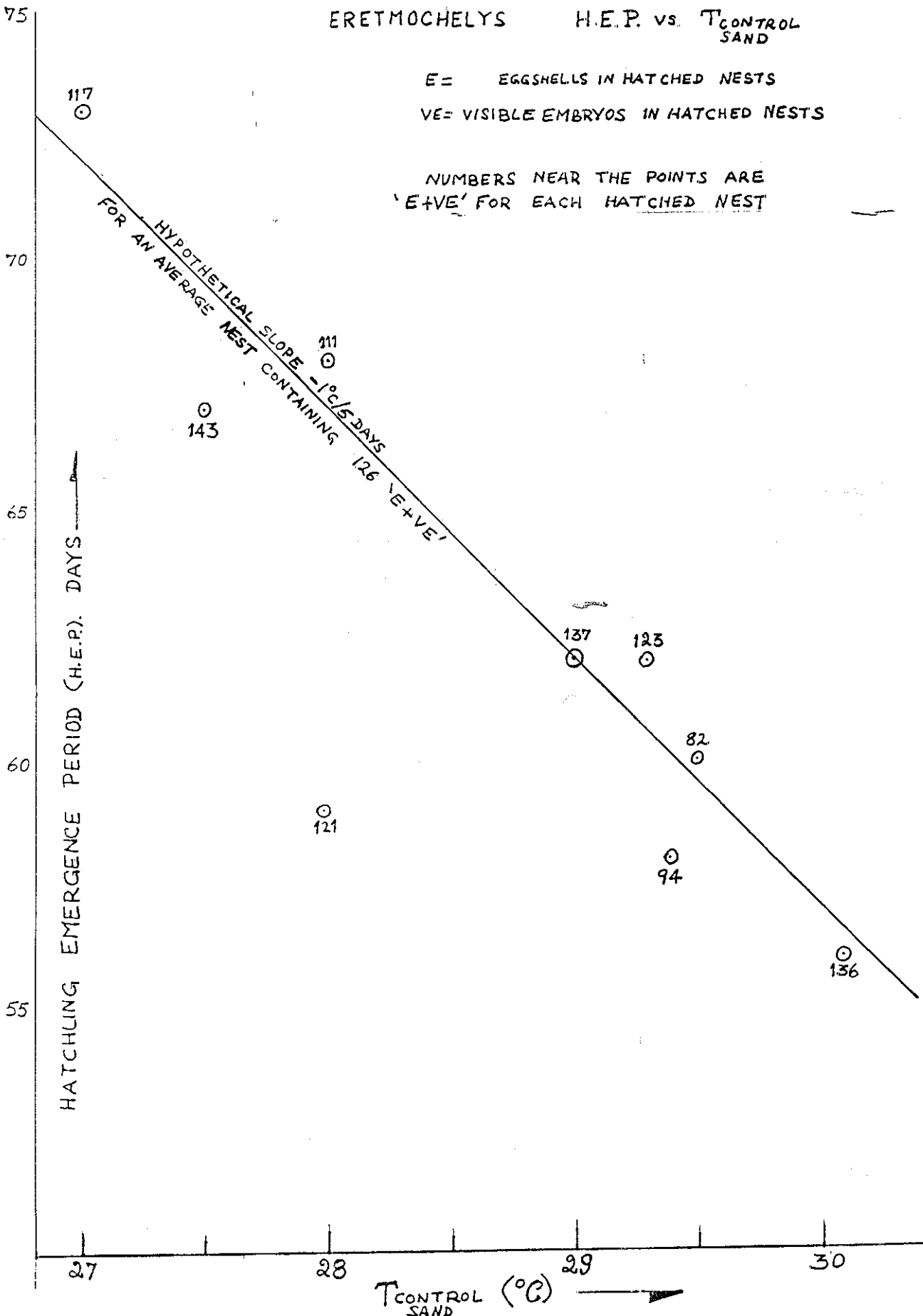
- Green turtle
- * Hawksbill
- Olive ridley
- Leatherback
- Marine National Park



ERETMOCHELYS H.E.P. vs. $T_{\text{CONTROL SAND}}$

E = EGG SHELLS IN HATCHED NESTS
VE = VISIBLE EMBRYOS IN HATCHED NESTS

NUMBERS NEAR THE POINTS ARE
'E+VE' FOR EACH HATCHED NEST



SCALE 1:1000

OR 1cm=10m



c 12° 46' N, 92° 40' E

**SOUTH REEF
ISLAND**

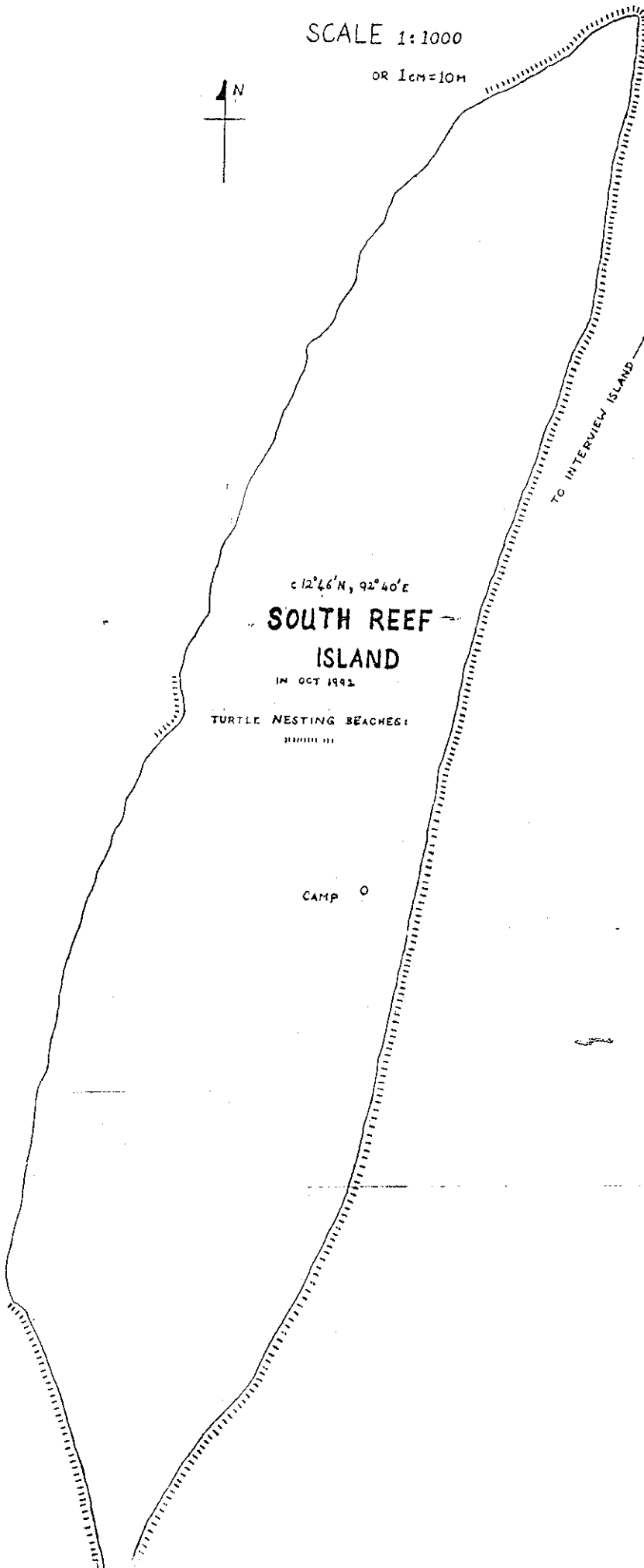
IN OCT 1992

TURTLE NESTING BEACHES:



CAMP ○

TO INTERVIEW ISLAND →



ANDAMAN ISLANDS

sea turtle
nesting

LANDFALL I. — CHANNEL I. EAST I. O*

WEST I. — DOCKOCK I. O*

WHITE CLIFF I. — COFFERDARA I. O*
 THORNHILL I. — TRAK I. O*
 REEF I. — EXCELSIOR I. O*
 BROWN HILL I. — DELGARNO I. O*
 PAGES I. — TRILBY I. O*
 POINT I. — TEMPLE I. O*
 — TURTLE IS. O*

North Andaman I.

Digapur

SMITH I. O*
 ROSS I. O*
 BRUSH I. O*
 CRAGGY IS. O

Narcondam I

SNARK I. O*
 KWANGTUNG I. O*
 LATOUCHE I. O*
 NORTH REEF I. O*

RAMNAGAR O*
 OLIVER I. O*
 SOUND I. O*

INTERVIEW I. O*

AVES I. O*

SOUTH REEF I. O*

KARMATANG O*

TUFT I. O*
 HUMP I. O*

BETAPUR O*

FLAT I. O*

Middle Andaman I.

BARREN I.

SPIKE I. O*
 BLUFF I. O*

BUTTON IS. O

OUTRAM I. O

INGLIS I. O

DEFENCE I. O*
 PETRIE I. O*
 MONTGOMERY I. O*

HAVELOCK I. O

South Andaman I.

MADHUBAN O*

NEILL I. O

SANDY I. O*

SIR HUGH ROSE I. O

TARMUGLI I. O*

ROSS I. O*
 PORT BLAIR O*
 SNAKE I. O*
 CORBYN'S COVE O*

North Sentinel I.

BOAT I. O*

Andaman Sea

TWIN IS. O*

RUTLAND I. O*O

Bay of Bengal

NORTH CINQUE I. O*O

SOUTH CINQUE I. O*O

PASSAGE IS. O*
 SISTER IS. O*

SOUTH SENTINEL I. O*

Green turtle

Hawksbill

Olive ridley

Leatherback

Marine National Park

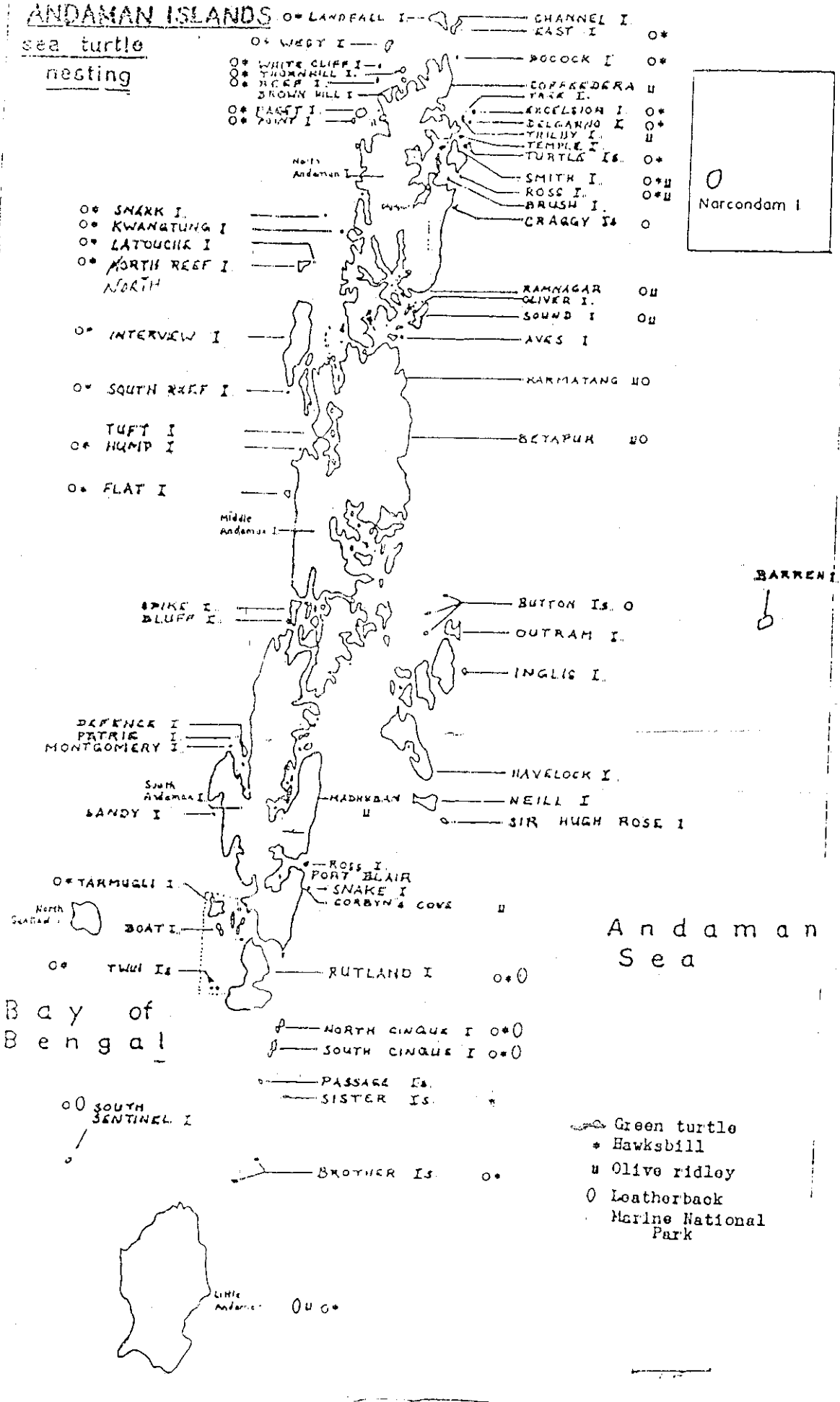
BROTHER IS. O*



Little Andaman I. O*O*

ANDAMAN ISLANDS

sea turtle
nesting



- * LANDFALL I.
- * WEGY I.
- * WHITE CLIFF I.
- * HAWK HILL I.
- * HOOK I.
- * BROWN HILL I.
- * BANG I.
- * POINT I.

- * CHANNEL I.
- * EAST I.
- * ROOOCK I.
- * COPPEREDRA PARK I.
- * EXCELSION I.
- * BELGANO I.
- * TRILBY I.
- * TEMPLE I.
- * TURTLE IS.
- * SMITH I.
- * ROSS I.
- * BRUSH I.
- * CRAGGY IS.

○
Narcondam I

- * SNARK I.
- * KWANGTUNG I.
- * LATOCHIK I.
- * NORTH REEF I.

- * INTERVIEW I.
- * SOUTH REEF I.
- * TUFT I.
- * HUMP I.
- * FLAT I.

- * RAMNAGAR OLIVER I.
- * SOUND I.
- * AVES I.
- * KARMATANG I.
- * BETAPUK I.

- * SPIKE I.
- * BLUFF I.

- * BUTTON IS.
- * OUTRAM I.
- * INGLIS I.

- * DEFENCE I.
- * PATRIE I.
- * MONTGOMERY I.

- * HAVLOCK I.
- * NEILL I.
- * SIR HUGH ROSE I.

- * SANDY I.

MADHUBAN

- * TARMUGLI I.
- * BOAT I.

ROSS I.
PORT BLAIR
SNAKE I.
CORBYN'S COVE

- * TWUL IS.

RUTLAND I

Bay of Bengal

- * NORTH CINQUE I.
- * SOUTH CINQUE I.

- * PASSAGE IS.
- * SISTER IS.

- * SOUTH SENTINEL I.

- * BROTHER IS.



Little Andaman

- Green turtle
- * Hawksbill
- u Olive ridley
- Leatherback
- Marine National Park

ERETMOCHELYS

H.E.P. vs. $T_{\text{CONTROL SAND}}$

E = EGGSHELLS IN HATCHED NESTS

VE = VISIBLE EMBRYOS IN HATCHED NESTS

NUMBERS NEAR THE POINTS ARE
'E+VE' FOR EACH HATCHED NEST

HYPOTHETICAL SLOPE - 1°C/5 DAYS
FOR AN AVERAGE NEST CONTAINING
126 'E+VE'

HATCHLING EMERGENCE PERIOD (H.E.P.) DAYS

$T_{\text{CONTROL SAND}}$ (°C) →

27

28

29

30

117

143

121

137

141

94

82

136

123

REFERENCES

- Bhaskar, S., 1979A. Sea turtles in the South Andaman Islands. Hamadryad, Jan 1979. 4(1); 3-5
- 1979B. Sea turtle survey in the Andaman and Nicobars. Hamadryad, 1979 Sep. 4(3):2-26
- 1984. Sea turtles in North Andaman and other Andaman Islands. Contract report to WWF-India. pp.1-46
- 1992. Sea turtle study and survey project. Phase I. Report to the Madras Crocodile Bank and to the Andaman & Nicobar Forest Department. pp. 1-15

ACKNOWLEDGEMENTS

This project is being funded by the Centre for Herpetology, Madras Crocodile Bank and was actively supported by the Andaman and Nicobar Forest Department through the offices of the Principal Chief Conservator of Forests and the Chief Wildlife Warden at Port Blair.

Dr. P. Devraj, Deputy Conservator of Forests, Wildlife Div. II and Mr. James Kurien, Divisional Forest Officer at Mayabunder both organized valuable logistic support.

I am especially indebted to Mr. Bonny, Camp Officer at Interview Island, and to his indomitable crew of 'Ranchis', including Marianos and several others who took calculated risks at sea during adverse weather in the monsoons in order firstly, to land us with our supplies on South Reef Island, and secondly, to bring us drinking water, stores and mail from Interview Island and Mayabunder more or less regularly,

Finally, I thank Mr. Harry Andrews, Dy. Director of the Centre for Herpetology, Mrs. Romaine Andrews, Mr. Allen Vaughn (Forest Dept., Mayabunder), Mr. Robert Khin of Webi, Ashu and Frieda Aungthong, and Percy and Iris Myers, all at Port Blair, for their support and hospitality.

*

*

*