

RPN
BHA 20767Editor's Note

A kindly critic of Hamadryad wrote me a short and nasty post card some months ago. "You and your Andamans!" he said. "Can't you think about anything else?"

No. All of us at the Snake Park have the Andaman and Nicobar fever, which is transmitted through contact with these fascinating islands. Our post card friend has obviously not been there.

So we have this group of over 300 islands in the Bay of Bengal- one of the last strongholds of the rain forest in India. It is a bird and reptile paradise. When our field staff stagger back to Madras (with malaria or jaundice or just general decay) from the Islands, there are endless nocturnal story-telling sessions of king cobra and crocodile nests, unrecorded sea turtle nesting beaches, Laticauda nesting colonies, and much more.

Satish Bhaskar has been with the Snake Park for over three years, involved mainly in the study of sea-turtles on the Indian sub-continent. He is a self-made marine biologist, in his element when being circled by sharks or stung by jellyfish. He has carried out extensive surveys for the Snake Park, covering almost every important nesting beach on the mainland, the Lakshadweep Islands (Laccadives) and, recently, the Andaman and Nicobar Islands.

The Andaman and Nicobar survey covered an eight month period, from September 1978 to May 1979. The aims were to locate sea turtle nesting areas, and regions where they are exploited, preliminary to drawing up a conservation plan; determining nesting seasons for each species; the extent of human encroachment on nesting beaches; extent of predation, natural and by man; collection of data for future projects on sea turtles.

So, since we can't think about anything but the Andamans, and because we feel Bhaskar's report is a valuable contribution to science, it seems appropriate to devote the entire September '79 issue to his survey.

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SEA TURTLE SURVEY IN THE ANDAMAN AND NICOBARS

By Satish Bhaskar

Four species of sea turtles, representing four of five surviving genera are presently known from Andaman and Nicobar waters.

Zoological Name	English Name	Local (Hindi) Name	Native (Great Andamanese) Name	Car Nicobar Name	Central Nicobarese Name
Chelonia mydas	Green Turtle	Dudh kacchua	Yadi-da	Kap-troeje	Kap-ka
Dermochelys coriacea	Leather-back	Sher kacchua	-	Kap-chyoot	Kap-heebu
Eretmochelys imbricata	Hawks-bill	Kangha (comb) kacchua	Tau-da	Kap-sah	Kap-kael*
Lepidochelys olivacea	Olive Ridley	Gadha ⁺ kacchua	-	-	-

All four species nest in the Andaman & Nicobar Islands, and atleast two - the Green and the Hawksbill - feed there.

Areas Surveyed

In the interest of brevity it will be better to list the areas and islands not surveyed.

1. The island of North Andaman and all the adjacent offshore islands were not visited.
2. The entire west coast of Great Andaman north of Constance Bay (which marks the southern limit of the Jarawa tribal reserve) was left unsurveyed.
3. The Sentinel Islands and all islands between, and including, the Cinque Islands and South Brother Island.
4. All islands in the souther Nicobars excluding Great Nicobar.
5. The Button Islands, Narcondam, Barren and Tillanchong Islands.

Practically all the remaining sandy coasts in the Andaman and Nicobars were visited.

+ This name might refer to the Green Turtle and "Dudh kacchua" to the Olive Ridley.

* Additional Central Nicobarese names for various kinds of sea turtles are Kap-ngah, Kap-riak and Kap-sanang. Species correlations for these names are yet to be confirmed.

Survey Methods

1. Sandy beaches were located and surveyed on foot wherever possible, for evidence of turtle tracks, nests, excavations, shells, carcasses, skeletal remains or eggs shells.
2. Fishermen, settlers and tribals were interviewed for data concerning nesting areas, seasons, species present etc.
3. Sightings of turtles at sea or on land while nesting or while emerging from nests as hatchling were recorded.
4. Clutches of turtle eggs were located by digging.

Data usually collected (see appendix I) included:

- a) Number of eggs in clutch
- b) Track width
- c) Depth of topmost and deepest eggs
- d) Sand temperature at nest level
- e) Size of eggs using vernier calipers
- f) Evidence of predation on eggs
- g) Nesting habitat

(Eggs were carefully replaced in a manually excavated "nest" after data had been collected.)

5. Turtle carapaces or carcasses found on shore were measured for carapace curved length and curved width and skulls for head width.

Important Nesting Areas Located

Stated in order of importance, these are

- 1) Great Nicobar Island: About 80 Leatherback excavations were found in April '79 at each of two beaches that straddle the mouths of the Alexandria and Dagmar rivers. The nests appeared to have been made one to four months earlier. Nesting by other species also occurs, particularly by Hawksbills in the area near Pygmalion Point.
- 2) Little Andaman: About 70 Leatherback excavations were present on the beach in January '79 at West Bay, and a few at South Bay.
- 3) The Twin Islands: These are two small uninhabited islets off the western coast of Rutland Island. A total of about 30 fresh excavations probably all made by Hawksbills were found in October '78.
- 4) Rutland Island: On the western coast of the island south of Woodmason Bay is a long sandy beach where evidence of nesting by four species was present, though the nesting intensity, at least in October '78 was low. On the southern coast of Rutland Island were 10 fresh Hawksbill excavations made in October '78.
- 5) The Betapur Coast: Nesting by four species occurs on the east coast of Middle Andaman especially near Betapur No. 3 and Betapur No. 2.
- 6) Katchal Island: Nesting by at least 3 species occurs on the southern coast of the village of Hintona.

These locales are all comparatively remote and undisturbed by man.

It should be mentioned here that uninhabited South Sentinel Island (which was not visited during the survey) is frequented by nesting Green turtles (Davis & Altevogt, Yojana, Aug 15 1976).

Other areas and islands reputed to support considerable numbers of nesting turtles are listed below and are worthy of future investigation.

1. South Reef Island
2. Turtle Island near Smith Island
3. Ross Island in North Andaman (not to be confused with Ross Island near Port Blair)
4. Aerial Bay in North Andaman
5. Tillanchong Island
6. The Button Islands
7. Pulo Milo Island
8. The Brother Islands

In addition, some of the uninhabited islands in the southern Nicobar group (Meroc, Trak, Treis, Kabra, Menchal) as also Little Nicobar Island may be important rookeries for one or more species of sea turtle. These, together with other islands near North and Little Andaman will have to await future surveys.

Evidence of sparse nesting was found on inhabited areas

such as the east coast of South Andaman, on Car Nicobar, Teressa and Trinkat, but it is obvious that no fruitful studies or conservation action could be undertaken at these places, other than vigorous enforcement of the law protecting sea turtles, and the initiation of hatchling release programmes.

Legal Status

Since Sep 1977, sea turtles have been placed in Schedule I of the Indian Wildlife (Protection) Act, 1972. This stipulates that all sea turtles are totally protected and that anyone found killing a sea turtle or collecting its eggs or dealing in sea turtle products is liable to imprisonment upto 6 years and a fine of a minimum of Rs.500/- (about\$60)

Human Exploitation of Eggs

I watched a poacher on the Betapur coast prepare a turtle-egg omelette very wastefully, discarding the albumen, only the yolk being used. About 25 eggs from a Hawksbill clutch were used (the remaining eggs were stored away for illegal sale at the rate of 10 paise per egg). Notwithstanding widespread knowledge of the fact that sea turtles are protected, the eggs of all species are actively sought for almost everywhere in the Andaman and Nicobar Islands. Besides the colonization of nesting beaches by man and the hunting of adult turtles, this constitutes the greatest threat to the future existence of turtles.

Prior to the legal ban in 1977, turtle eggs were reportedly on sale at Port Blair and Diglipur.

Bonington (1931) reported often seeing turtle eggs hanging up in nets in huts of the Onge tribals, in Little Andaman.

Exploitation of Turtles for Meat

In the Andamans, turtles of all species except apparently the Leatherback were, until the legal protection accorded to them in 1977, actively hunted for their meat. In the Nicobar group, turtle meat is still consumed regularly-- usually cooked, but sometimes raw, when it is minced and mixed with coconut.

The Green turtle and the Hawksbill are the species usually eaten. People of most communities will eat turtle. They include Bengalis, "Ranchis", Tamilians, Andhraites and Karens as well as the descendants of settlers and the tribals--Nicobarese, Onges, and Great Andamanese. The Leatherback is apparently killed only for its oil -- whether for medicinal purposes or for fuel was not ascertained. Turtles found nesting do not often escape slaughter. Two labourers found and killed a nesting Hawksbill on 4th or 5th April 1979. On my arrival at Pygmalion Point on 6 April the Hawksbill was hidden under the sand, where I found it accidentally while digging for eggs.

Green turtle meat brought to the Port Blair market from landing centres at the settlements of Wandoor and Chidiatapū fetched Rs.3 to Rs.5 per kg prior to September 1977, when sea-turtles received legal protection. (Price at Port Blair in the 1880's: about Rs.5 for an entire full grown Green turtle--E.H. Man).

Maxwell (1911) states that there was a regular trade in Green turtles between the Andamans and Calcutta and that in the Nicobars, Green turtles were extensively killed for consumption.

Boden Kloss (1902) quotes an inhabitant of Pulo Milo island who believed that during his lifetime, many islanders died of poisoning after having eaten turtle meat.

Turtle Shells and Skulls

Shells stripped of meat are often hung on trees near Nicobarese homes. This apparently is done after a turtle has been speared by a novice for the first time, and ensures good luck in future hunts. Turtle shells are also used as feeding troughs for chickens and as containers for transporting coconuts. In the Andamans, affluent curio-collectors have maps engraved onto turtle shells for display.

Turtle carapaces are frequently seen hanging on the walls of huts belonging to Onge tribals. Their significance was not determined. In 1902, Boden Kloss saw many painted skulls of turtles inside a Nicobarese hut at Trinkat island.

Hawksbill Laminae

The horny laminae on the shells of hawksbills, if thick enough, are moulded in the Nicobars into a variety of trinkets--finger- and ear-rings, bangles, combs and belts. Pieces of silver are imbedded into "tortoise shell" finger-rings.

These products are not exported, however, and probably do not constitute a drain on the turtle resource by themselves. Bonington (1931) states that tortoise shell was mentioned in the Government records pertaining to the Nicobars only in two years, once with 64 pieces and another time 25 pieces. He adds "undoubtedly tortoise shell is exported (probably to Burma and Penang -- S.B.) which is not declared".

In the Andamans, tortoise-shell curios were not on sale during the survey period, unlike in recent years.

Feeding Areas Located

As the pre-1977 frequency of Green turtle catches indicated, the area extending from the Labyrinth islands southward to Rutland and the McPherson Strait appears to support a feeding population of sea turtles. It seems likely that Green turtles also feed in the environs of the North Andaman coast though this is yet to be substantiated. Data for other species were not forthcoming, though it seems likely that the Leatherbacks that nest in the Andaman and Nicobar Islands migrate elsewhere to feed.

The waters around the northern islands of the Ritchie Archipelago appear to be favoured feeding grounds for Hawksbills (including juveniles) and for other unidentified species, as was evident from the frequency with which turtles were sighted thereabouts.

The sea near the rocky South Andaman coast east of Brookshabad is reported to be frequented by turtles that feed there. Many other feeding areas are likely to have been overlooked as little underwater observation was attempted.

Vegetation on Shores where

Turtles Nest

The following species border sandy shores in the Islands:

- | | |
|-----------------------------------|-----------------------------------|
| 1. <u>Scaevola taccada</u> | 5. <u>Pemphis acidula</u> |
| 2. <u>Barringtonia speciosa</u> | 6. <u>Sporocoea pescaprae</u> |
| 3. <u>Pandanus sp.</u> | 7. <u>Casuarina equisetifolia</u> |
| 4. <u>Messerschmidia argentea</u> | |

Coconut trees and grasses also border sandy coasts in many regions.

V. Rao of the Botanical Survey of India helpfully identified the flora.

Green turtle 31 sun-bleached skulls of Green turtles speared near Wandoor ranged from $9\frac{1}{4}$ cm to 13 cm in width, and average $11\frac{1}{2}$ cm. A male speared at Camorta had a head width of $13\frac{1}{2}$ and measured 97 cm in carapace curved length (CCL) and 86 cm in carapace curved width (CCW).

Other shells from Camorta and Trinkat measured:

CCL	108	104	100	94	93	81	$73\frac{1}{2}$	49
cm								
CCW	94	98	$87\frac{1}{2}$	85	$86\frac{1}{2}$	77	71	44

E.H. Man, referring to the Green turtle in the Andamans in 1883 states that an average sized animal weighs roughly 35 to 45kg. Hawksbills, he states, weigh considerably less. The heaviest Green turtle which came under his notice weighed about 400 lbs.

Hawksbill Only four Hawksbill shells (no adults) were measured. Two of these, of carapace curved lengths 31 and 32 cm belonged to Hawksbills that were being reared in captivity in Nicobarese homes. The largest of the four was a female with a head width of $7\frac{1}{2}$ cm.

CCL	52	32	31	21
cm				
CCW	41	$27\frac{1}{2}$	27	$18\frac{1}{2}$

Hatchlings A Hawks bill hatchling found dead in a nest at Pygmalion Point, Great Nicobar (incidentally the southern most land point in India) was measured, as also a Leatherback hatchling in the process of emergence, near the Alexandria river, Great Nicobar.

Hawksbill hatchling: Carapace straight length = 39.3 mm
Carapace straight width = 28.9mm

Leatherback hatchling: Carapace curved length = 55 mm
Carapace curved width = 47.5 mm

Leatherback On the only occasion when a nesting female was seen (at Little Andaman), the carapace straight length measured 155 cm. The turtle made tracks 186 cm in width. Tracks made by other Leatherbacks suggested that the turtle seen nesting was below the size of average nesting Leatherbacks in the Andaman and Nicobar islands. (See appendix II)

Olive Ridley The carcass of a female olive Ridley that had nested on 17 Jan 79 was found at Karmatang in Middle Andaman. Its measurements:

CCL = 69cm
CCW = 70cm
Head width = 12cm

Predation

Natural Predators: Direct evidence of predation on turtles (as could be obtained, for example, from an examination of the stomach contents of sharks and other predatory fishes) was not actively sought for. In three instances, tracks made by nesting turtles presented an unsymmetrical pattern indicating loss of foreflippers. The animals involved were a Green turtle on Kutland and a Leatherback each at Katchal and Little Andaman. As is the case elsewhere in the world, it may be presumed that the ubiquitous presence of sharks and other predatory fish in the Islands constitutes an important factor in the net predation on turtles.

Predation on hatchlings is commonplace. On one of three occasions when tracks made by hatchlings were located evidence of predation by ghost crabs (*Ocypode* sp.) and rats was found. In all (6)

likelihood, hatchlings are also preyed upon by hermit crabs (*Coenobita* sp.) which are abundant on many islands.

On the Twin Islands, the nesting beaches are overrun at night by a large species of land crab which probably preys on the hatchlings though evidence of this was unobtainable. These crabs have proliferated on the Twins probably because of the absence thereof large predators such as civet cats (*Paradoxurus tytleri*), wild pigs (*Sus andamanensis*) and monitor lizards (*Varanus salvator*). On Rutland Island which lies only about 2 km away and where the larger predators exist, the crabs were not to be found.

The Nicobar Serpent Eagle (*Hamatorinis-cheela*) is likely to number among the bird predators of hatchlings especially on Great Nicobar Island. This species was seen on two occasions to snatch up octopi from a fringing reef at low water near the village of Pulo Babi on Great Nicobar.

Monitor lizards (*Varanus Salvator*) were surprised on about five occasions as they excavated turtle eggs (including those of the Leatherback, buried about 70 cm deep) on Rutland, Little Andaman and Katchal. Monitors also prey on Green turtle eggs at South Sentinel (Davis and Altevogt, 1976). On Little Andaman they probably excavate more than 80% of the nests, as was evident from the number of raided nests, with scattered eggshells, that were found on the West Bay nesting beach. Competition here among monitors appears to be fierce. Three fresh carcasses of monitors were found near the surf. All had grievous injuries, with the belly skin ripped open in each instance.

Wild pigs often excavate sand on turtle nesting beaches evidently in search of molluscs and crustaceans. The larger individuals are capable of scooping out quite a deep crater--this puts turtle eggs within their reach. First-hand evidence of predation by wild pig was, however, not obtained.

It is yet to be confirmed whether or not the civet cats of South Andaman prey on turtle eggs and hatchlings. It appears likely that they do--a civet cat on Rutland was found searching for morsels on an exposed reef fringing a Hawksbill nesting beach, at low tide.

The tracks of a half-grown estuarine crocodile (*Crocodylus porosus*) lay superimposed on those of a nesting Leatherback at Katchal. Predation on sea turtles by *C. Pososus* is reported from the Palau islands in Micronesia (Pritchard, 77).

While methodical crocodile counts were not attempted during the survey, a total of 8 crocodiles, ranging in length from 73 cm (for a 750 gm individual measured on 26th January 79) to at least 251 cm were observed near sandy shores on Great Nicobar (3), Katchal (3), Trinkat and Little Andaman (1 each). Tracks of 26 more crocodiles were found leading from brackish pools to the sea across sandy beaches on Katchal (11), Nancowry (8), Great Nicobar (3), and on Little Andaman, Trinkat Camorta and Car Nicobar (1 each). The largest individual left a hind footprint 21 cm long at East Bay, Katchal. The majority appeared to have been "displaced" juveniles, probably incapable of preying on any but young sea turtles.

Extra-natural predation The only period in the life-cycle of turtles when man is disinterested in them extends from roughly 10 days after the eggs are laid--the developing embryos render the eggs unpalatable--upto the time when juvenile turtles may be seen and harpooned two or more years later.

Domestic animals namely dogs and pigs prey on eggs and hatchlings. Dogs may harass nesting turtles. Evidence of egg predation by humans or dogs was found on every major nesting beach except at West Bay, Little Andaman, where monitor lizards are the main predators. As with wild pigs, domestic ones dig deep furrows over large areas of sandy beach. On some narrow Pandanus and Scaevola fringed beaches in the Nicobars, there remains hardly a square metre of beach left unexcavated by pigs, especially near human settlements. Nesting is never prolific in such areas.

Nesting areas threatened by human habitation

Four of the important nesting areas mentioned above--Rutland, the Twin Islands, Little Andaman and Great Nicobar Island--are immediately threatened by the scheduled "opening up" of the areas for human colonization and by the construction of metalled roads that facilitate easy accessibility to the nesting beaches. The allotment by the Administration of land for private ownership on Rutland is imminent or has already begun. Hitherto, the only permanent human presence on the island occurred on the northern side where the Andaman Timber Industries was engaged in felling wood. The nesting beaches are on the island's southern and south-western coasts and will inevitably suffer if steps for their immediate protection are not taken.

The colonization of Rutland will place the Twin Islands, about 2 km away, within easy reach of rowboats--the present 3-6 hour by sailboats and rowboats from South Andaman will be cut to about 45 minutes. Powered fishing boats will soon come into vogue. Even if the Twins are declared as wildlife preserves before the nesting turtles disappear, it seems likely that the activities of boats in the channel separating the Twins from Rutland will disturb the breeding population of turtles in the vicinity.

On Little Andaman, the nesting population of Leatherbacks at West Bay is at present quite undisturbed on account of the relative inaccessibility of the nesting beach from the human settlements on the island's eastern coast. The West Bay nesting beach is about 2½ days' walk from the Hut Bay settlement. A metalled road across the island (the ancient home of Onge tribals) from Hut Bay to Jackson Creek just north of West Bay is planned. During and following the construction of the road, poachers will have to be actively discouraged if the West Bay nesters and the crocodiles at Jackson Creek are to survive.

The presently smaller nesting colony at South Bay has already begun to feel the impact of Man's activities. Turtles reportedly nested frequently a decade ago at Hut Bay where, as always, the establishment of a large human settlement has reduced nesting occurrences almost to zero.

A similar situation exists on Great Nicobar Island. The important nesting beaches near the mouths of the Dagmar and Alexandria Rivers have recently been placed within easy reach of egg poachers by the construction of a 42 km overland metalled road from the settlement at Campbell Bay on the east coast to the two-hut Nicobarese hamlet of Hopen Heat on the west coast. The construction of a projected metalled road from Campbell Bay to the lighthouse at the island's southern end may jeopardise the turtles nesting near Pygmalion Point.

The trucking away of beach sand for construction purposes summarily eliminates nesting by turtles in some areas eg. on parts of the Betapur coast.

Nesting seasons

North to south, the Andaman and Nicobar Islands extend over a distance of almost 800 km. (comprising latitudes between 6° 40'N and 13° 40'N). This may result in a substantial difference in climate between the northern-most and southern most land in the group. It is possible, therefore, that nesting seasons for each of the sea turtle species that occurs may not coincide throughout the range.

Leatherbacks apparently nest primarily during the months of December, January, February and March. Nests were found from early November to early April.

Many Hawksbill nests were found in October, but individual nests were found throughout the eight month survey period ending in May. Daily nesting is reported to occur on the Twins in August, but the species involved is uncertain.

Green turtle nests were found in numbers suggesting low nesting intensity from October to May. It appears likely that Green turtles nest in greater numbers during the southwest monsoon (May to September). Reports of substantial year-round nesting on some islands (e.g. uninhabited South Reef Island) cannot be discounted. Acharji (1950) states that the chief egg-laying period is between July and November. Davis and Altevogt found Green turtles nesting on South Sentinel island during visits in February 1973 and March 1974.

The Olive Ridley can tentatively be assigned a nesting season parallel to that on the Indian mainland's Coromandel coast, (December to March) which stretches roughly over the same degrees of latitude. This season coincides largely with that of the Leatherback.

Track characteristics

Tracks made by nesting Leatherbacks and Green turtles are distinctive for two reasons:

- (a) These species (as also the Loggerhead, Caretta caretta, which is apparently absent from the Islands) drag themselves about the nesting beach using all four flippers in unison, an action which leaves a symmetrical set of tracks. Hawksbills and Ridges, on the other hand, usually "walk" in the standard reptilian way i.e. they move diagonal limbs alone in unison, thereby leaving staggered flipper per-imprints on either side of the midline of the track.
- (b) Leatherback tracks are among the broadest of any animal in the world and are therefore easily recognizable. 25 tracks of nesting females found on Middle Andaman, Little Andaman, Katchal and Great Nicobar ranged from 172 cm to 249 cm in width and averaged 194 cm.

Nesting Green turtle tracks did not, as a rule, overlap in width with those of Olive Ridges and Hawksbills--the latter are usually smaller--and never with those of Leatherbacks, which are larger. Four tracks made by Green turtles on Rutland, Great Nicobar, Little Andaman and Middle Andaman ranged from 91 cm to 112 cm in width and averaged 98 cm.

It appears to be difficult to distinguish Ridley from Hawksbill tracks for their widths overlap. It is possible that the Hawksbill is a weaker swimmer than the Ridley; this may result in the "stride lengths" of Hawksbills on land being the smaller of the two, though this requires further investigation. Three Hawksbill track-widths ranged from 68 cm to 80 cm (average 75 cm) and 5 Ridley tracks from 77 cm to 88 cm (average 83 cm). Species identification of some of these tracks was doubtful.

Egg sizes

Full-sized Leatherback eggs from two clutches ranged in maximum diameter from 48.8 mm to 51mm. Green turtle eggs from two clutches were smaller, ranging from 41.4 mm to 43.3 mm. Olive Ridley and Hawksbill eggs were smaller still; eggs from 15 clutches measured 33.0 mm to 40.2 mm, with Olive Ridley eggs usually being the larger of the two.

Clutch sizes

The minimum and maximum recorded during the survey were 45 eggs (for a Green turtle) and 177 eggs (for a Hawksbill). A probably unnatural nest of an Olive Ridley contained only 10 eggs. Leatherbacks invariably laid numerous undersized eggs, though occasionally other species did so too. Hawksbills, on an average, laid the maximum number of eggs.

Depth of eggs

Leatherback eggs were buried upto depths reaching 76 cm. Green turtles made slightly shallower egg chambers. The eggs of the Olive Ridley and the Hawksbill were found at depths ranging from 30 cm to 50 cm, closer to the surface than those of the Green turtle.

Nesting habitat

Leatherbacks appeared to prefer broad, low beaches that were just awash at spring high tide, for nesting. The beaches were usually situated near the mouths of rivers or creeks and possessed deep water sea approaches, though reefs often broke the surface a quarter-mile or more offshore. Hawksbills appear to favour narrow beaches fringed by Pandanus or Scaevola on the landward side relatively narrow and shallow reefs on the seaward side.

Nest excavations

Leatherbacks, after having nested, left behind unevenly ploughed areas about 2½ to 3 m broad and about 5 to 15 m long. No prominent craters remained. Leatherbacks differ in this respect from Green turtles which often leave one or two large craters (if two, they are confluent).

A typical Green turtle excavation measured 3 m along its long axis. Two confluent craters of unequal size were present. The larger crater measured 175 cm in diameter and 32 cm in depth.

Olive Ridley and Hawksbill nesting sites may be identified by the presence of a roughly ellipsoidal patch of disturbed sand measuring approximately 1m x 1½ or 2 m. Hawksbill nest sites were usually found to be more uneven in appearance than those of the Ridley.

The Twin Islands

20th October '78 Our party left Wandoor by sailboat for the uninhabited Twin Islands at 1.30 pm, reaching the Western Twin 5 hours later. My two fisherman companions and I were obliged to row about half the distance after the wind had ceased.

One can walk entirely around the coast of Twin West in about 15 minutes. Potable water apparently does not exist below the island's forest-covered soil; a shallow make-shift well exists on Twin East. (Which is the larger of the two islands) and yields water which is unsafe to drink.

On Twin West, eight fresh sets of turtle tracks were found, all on the island's eastern shore which is the only sandy stretch. The beach is narrow, about 3/4 km long and is fringed by Scaevola taccada bushes. All the turtle tracks appeared to have been those of Hawksbills. My fisherman companion almost stepped on a sea snake (Laticauda colubrina) that came ashore at 7.30 PM.

October 21 Rowed across to Twin East, about 200 m. away. The sandy beach here is even narrower than that at Twin West but is longer--it extends for about 1 km from the north west coast of the island, along the east coast almost to the southern shore. 24 Hawksbill diggings were seen, 15 sets of tracks visible. As at Twin West, all had probably been made during the period of the recent spring tides. Marine life-laden reefs which are exposed at low tide fringe both the islands and may possibly present an obstacle to turtles attempting to nest at this time.

Turtle eggshells and the remains of a Green turtle killed less than a month earlier were present on Twin East.

A few of the nests had been made inside the vegetation line under Barringtonia speciosa trees where the dead-leaf overlain soil was harder and of a brown colour, in contrast to the white of the calcareous beach sand where most of the nests had been made, immediately seaward of the vegetation. No monitor lizard tracks were encountered on either of the Twins but large land crabs were abundant--these probably constitute a serious threat to emerged hatchlings but not, apparently, to the eggs. No other large animal was found on the Twins.

A single Hawksbill nested on Twin East on the night of 21-22 October when the neap tide was high. A juvenile turtle (species undetermined) was observed in the sea between the Twins as it basked or floated immobile at the water surface at about 8 AM.

The nesting beach at West Bay, Little Andaman

The beach is about 8 km long and situated roughly 1/2 days' walk from the lighthouse construction site. A total of 82 Leatherback excavations were found on this beach, indicating the presence of more than 70 nests, for a small percentage (less than 10% of the excavations) may be made without eggs being laid within, as is true of Leatherback nests in Sarawak, Malaysia.

Though the beach is about 40 m broad in most places, much of its width is inundated by high spring tides which wash over the high beach platform (berm). This results in the intermittent inundation of some of the nest sites causing a possible reduction in the percentage of nests that hatch, due to high chlorine concentration in the sand. A shallow creek separates the beach into two unequal portions. On Great Nicobar Island where the Dagmar and Alexandria rivers do so. The beach on the northern portion of West Bay is backed by a sloping 3 m high embankment which some of the Leatherbacks had climbed in order to nest. Most of the nesting however takes place at or near the base of the embankment.

Two sun-bleached Green turtle skulls hung on posts within a deserted Onge hut south of the nesting beach. A few Hawksbill, Ridley and Green Turtle nests were also present on the beach. Bonington (1931) states that turtle eggs were to be found on long stretches of sandy beaches on Little Andaman and were often seen in the (Onge tribal) huts hanging up in nets.

Nesting of a Leatherback At 9.55 PM on 31 Dec '78 a Leatherback was observed as it camouflaged its nest site apparently after having nested. Nearby vegetation consisted of Scaevola bushes and Pandanus. The turtle was evidently quite oblivious to the writer's close proximity and to being touched on the carapace. Track width 180 cm. Carapace straight length 155 cm. Temperature of sand at nest level (arbitrarily taken to be 65 cm below ground level) was 24.5°C. The sand had a very fine texture and was moist - aeration of the eggs would therefore not be good, and the low temperature would result in a greater number of days being required for the eggs to hatch than if the temperature were higher - probably about 70-80 days (a rough estimate). The turtle had crossed the 40 m broad sandy berm and had picked a spot favoured by nesting Leatherbacks as the density of nest excavations there proved. High tide occurred at 10.12 PM. The moon's phase was one day past new, the night dark though starry and cloudless. It had drizzled earlier at 7 PM. There was no wind.

The turtle used its foreflippers simultaneously to throw sand backwards, usually making about 4 sweeps with each flipper before pausing to rest. It intermittently raised its head to breathe noisily. The rear flippers were also used in alternation to flick sand, with the foreflippers braced. All 4 flippers also swept sand backwards occasionally moving the turtle a few inches forward each time. The turtle had white (or yellow) spots on its carapace. The knobs on the ridges of the carapace were more pronounced on the mid-dorsal ridge.

The turtle re-entered the sea at 10.20 PM. On its seaward crawl the writer stood 1/2 m away blocking its path but the turtle barely veered sideways, making it necessary to step aside. The turtle once made a sound not unlike a grunt while exhaling after a tiring series of flipper strokes, while crawling. The tail left a furrow which bisected the tracks. The excavated area measured about 3 x 15 m. No large craters had been left behind.

The two-day old tracks of a Leatherback were found on a 2 m high embankment. The turtle had climbed a metre high sandy ledge on a 45° slope, in the process bringing down a good deal of sand. The rest had been raided lately and flies had settled on the exposed eggshells. The track width was 215 cm. The turtle lacked the left foreflipper; possibly it had been removed by a shark. Much of the elevated part of the embankment had been grubbed up by wild pigs--these were seen nearby on 8 occasions. Some of the craters they made were about the size of non-nesting craters that Ridley turtles make.

Adjacent to a Leatherback nest were the fresh tracks of a saltwater crocodile. These led from the brackish lagoon that backs the West Bay nesting beach, over the sand and into the sea. That same night the crocodile crawled back to the lagoon. Both sets of tracks had been made prior to high tide i.e. before 10 PM on 31 December '78.

Sea Turtle kill by Onge tribals A hunting party of Onges, had set up camp by the seashore. The Onges were not present; A green turtle had been freshly roasted over a fire and carved up. Many portions had been carefully wrapped among the leaves of a Crinum asiaticum plant which grew nearby, and placed over the still-warm embers of the fire. A few choice parts portions of what appeared to be liver and flippers - had been roasted (the liver incompletely so) and placed on an elevated grating made of sticks below which another fire had been made. The turtle's carapace was found nearby. Its outer aspect was charred black. A monitor lizard prowled about the site and entered the hollow space below the empty carapace.

Bonington, writing in 1931, states that turtles were much appreciated as presents, among the Onges. An Onge I met south of Dugong Creek on Little Andaman was engaged in hollowing out a tree to be made into a canoe and fitted with an outrigger. The dugout would be shaped so as to include a prow on which the hunter would stand poised while harpooning turtle and fish. Another Onge was engaged in fashioning a sapling into a 3 m long harpoon. A detachable iron spike 5 cm in length tied to a nylon line would serve as the spearhead.

E.H. Man (1883) has described the turtle hunting methods employed by the Great Andamanese tribals, whom the Administration is presently attempting to retrieve from vanishing-point--24 survive today.

Seagrass

Sea grasses were found growing along shallow stretches of the sea at Sout Bay, Little Andaman. Green turtles probably graze on this. The occurrence of sea grass pastures in deeper waters was not investigated. Dugongs are known from the area but appear to be so scarce that the extent of competition over seagrass that they provide to Green turtles must be negligible.

Great Nicobar Island

The main human settlement exists at Campbell Bay on the eastern coast. Two metalled roads lead away from Campbell Bay--one to the south, up to the Galathea river 35 kms away and the other westwards over mountain ridges to the coastal hamlet of Hopon Heat about 42 kms away. Each of these roads form a potential threat to the turtle-nesting beaches near their terminuses. Great Nicobar island was the most important of all nesting areas located during the survey.

Forty-six Leatherback excavations were visible on the beach south of the Alexandria river and about 30 more were present north of it. The beach was not dissimilar in configuration to the important Leatherback nesting beach at West Bay, Little Andaman. A sandy deep water approach onto a 75 m broad berm exists there. Turtles nest near Pandanus vegetation which lines the shore. 32 excavations of another species (either the Ridley or the Hawksbill or both) were also present. In only one instance was the track visible. This had been made by one of the smaller species. The majority of nests had been made apparently a few (1 to 4) months earlier.

About 80 Leatherback excavations were present on a 3km long sandy beach extending on either side of the mouth of the Dagmar river in Casuarina Bay. Most of these had been made on the northern side of the river-mouth. Many of the nests, as those near the Alexandria river were washed over by spring high tides. They appeared as indistinct undulations in the sand. Many others, without doubt, had been totally obliterated.

The Great Nicobar coast north of this beach was not surveyed.

Only a single turtle track (made by a Ridley or a Hawksbill) was found near the mouth of the Dagmar River. 39 egg shells were also found. The eggs had evidently been slit open ~~xx jx, xxx~~ and by humans and consumed. Dogs had also preyed on many nests near the Dagmar river. No tracks of monitors were present on Great Nicobar's western coast, probably because the turtles' main nesting season was over.

At the Galathea river, about 40 km by road south of Campbell Bay, there exists a 1 km long sandy beach which x

straddles both sides of the rivermouth. Substantial nesting by 3 species-Leatherbacks, Greens and Hidleys (or Hawksbills) occur there.

Exploitation of nests appears to be heavy as many old nest markers (upright sticks) were found on the beach, and no eggs.

The shore at Pygmalion Point is fringed by a coral reef and the sandy beach is narrow, bordered mainly by Scaevola and Pandanus. The writer was informed by the lighthouse staff that turtles nest there all the year round. Four fresh nest excavations, probably those of Hawksbills, were found.

On the island's western coast north of Pygmalion Point, sandy beaches bordered by Scaevola, Pandanus and Messerschmidia continue for a few kilometers until rocky areas occur. The beach is not frequented by humans except for occasional Nicobarese fishermen. However, the construction of a projected road from the Galathea to Pygmalion Point will endanger the turtles nesting there.

A large Green turtle had come ashore on the night of 6-7 April '79 on a narrow sloping beach. Overnight rain might have triggered stranding by the turtle. Green turtles on such occasions wander extensively over beaches and return to sea without laying. This had occurred in the present instance. The turtle had crawled 100 m along the shore before returning to sea. A day or two prior to this a Green turtle (probably the same one), track width 112 cm, came ashore at a different location and had dug 3 large craters among Scaevola bushes. A Green turtle had nested earlier still (tracks had been obliterated).

A half kilometer sandy beach exists near a one-hut Nicobarese village called Saphed Balu (white sands). Three Leatherback nests were found there. Tracks in one instance were only about a day old, made on 6-7 April. Two more Leatherback excavations were present on narrow sloping sandy beaches nearby.

A Hawksbill nested on 4-5 April '79 at Pygmalion Point.

Representative nesting data relating to the four common Andaman and Nicobar species

1. Leather back

Location of nest: On a 30 m broad "high beach platform" 1 km north of the Alexandria River, Great Nicobar Islands, 4 m seaward of a 60 cm high embankment carpeted by Imoorea pescaprae, landward of which grew Scaevola taccada and Casuarina equisetifolia. Nest may have been washed over by the highest spring tides.

Description of excavated area: A uneven ploughed-up patch of sand, level on the average, measuring 3m x 8 m. The largest Leatherback excavations encountered measured 3 m x 15 m.

Description of beach: The sea approach was sandy, with no fringing reefs though submerged rocks may have been present offshore. Sand off-white in colour and fine-textured.

Date of nesting: Unknown. Probably end January or early Feb '79.

Date emergence of first batch of hatchlings onto sand surface: The night of 31 March-1 April '79

Depth of deepest eggs and egg shells : 76 cm below ground level

No. of eggs laid : 102

No. of full-sized eggs : 79

No. of eggs that hatched (found by counting egg shells). 59

No. of normal-sized unhatched eggs: 20. Of these, 16 had apparently failed to develop and 4 contained well developed, living embryos. Most of the 16 undeveloped eggs were badly discoloured (unlike the others). Vegetation (roots or fungus?) grew on their surfaces.

Diameters of the 4 eggs containing well-developed embryos : 48.8, 49.1, 49.8, and 50.1 mm

Number of undersized (yolkless) eggs: 43

Size range of undersized eggs:	No. of eggs	9	15	19
	Rough diameter	More than 20mm	10-20 mm	Less than 10mm

Average diameter of the largest undersized egg : 34 mm

No. of hatchlings that emerged onto sand surface: 20

Land predation: Two hatchlings had been killed by crabs and one by a rat, as tracks indicated. The carcass of the rats victim was found among Casuarina bushes 6 m away. This hatchling had been dragged away at the site of emergence itself. Its brain and part of the corselet had been attacked and eaten. The other two had been dragged away while crawling climbed over an obstacle (a 16 mm diameter branchlet on the sand) in the process.

No. of hatchlings found under sand at site of emergence: 31

These were present at various levels. 24 of them formed a group which appeared to be ready for emergence and were released at sea after having been revived in a container of seawater. The longest it took for a hatchling to begin crawling actively after being unearthed was about 5 minutes. Most started to do so within a minute. 6 hatchlings whose yolk-sacs had not diminished appreciably in size (they were situated externally) were replaced in a chamber dug by the surveyor on the beach. No trace was found of eight remaining hatchlings other than their empty eggshells. They had probably been carried away by predators while on the sand surface and the evidence of their tracks obliterated somehow. Among the hatchlings was one with a deformed carapace and another with a deformed plastron.

Track width of hatchlings: 11 1/2 to 12 1/2 cm (average, 12 cm)

Site of emergence: Visible as a cup-shaped depression 25 cm in diameter and 4 cm deep, in the sand surface. The hatchlings' tracks fanned out towards the sea distant 25 m from the depression, and subtended an angle of 15-20°.

Hatchling measurements: (randomly selected individual)

CCL	5.5 cm
CCW	4.75 cm
Total (straight) length including length of head	8.5 cm
Weight roughly	40 gm

A small opening in the plastron for the attachment of the yolk-sac (which had been absorbed) was present.

Sand Temperature 65 cm below ground level: 28.8°C, measured on 1 April, the date of emergence of the first hatchlings. As a comparison, the sand temperature at the same depth near a leatherback nest on West Bay, Little Andaman, measured on the date of nesting, 1 January '79, was 24.5°C. (15)

2. Hawksbill

Location of nest: On a narrow sloping Pandanus-fringed beach 300 m east of the lighthouse at Pygmalion Point. The beach is fronted by a fringing reef about 50 m broad which is exposed at low tide. The nest may have been washed over by the highest spring tides.

Description of excavated area: Nesting Hawksbills often left a Ridley-like, uneven, level-on-the average patch of sand roughly of dimensions 1 m x 1/2 m. In the present instance, however, the excavation had been obliterated.

Date of nesting: Unknown. Probably early February '79.

Date of emergence of hatchlings onto sand surface: About 4 April '79. Unlike the Leatherback hatchlings, the Hawksbill hatchlings appeared to have emerged onto the sand surface in a single batch, as the massed tracks suggested.

Depth of deepest eggshells: 50 cm

Apparent number of eggs laid: 130

Number of eggs that hatched: 126

Number of spoiled eggs: 3

No. of eggs containing developed embryos: One. (this was almost fully developed when the egg was opened on 6 April '79).

No. of hatchlings found dead in the nest: One.

Measurements of the dead hatchling: Carapace straight length
39.3 mm
Carapace straight width
28.9 mm

Lepidosis of the dead hatchling: Marginals 11+11
Vertebrales 5
Laterals 4+ 4
Nuchal 1
Supra caudals 1+ 1

A small opening in the plastron for the attachment of the yolk-sac was present.

Predation on land: No evidence was found.

Track widths: These were not measurable but were decidedly smaller than those of the Leatherback hatchlings.

Nest temperature: Not measured. Sand temperature near a Hawksbill nest at Trinkat measured on 25 January '79 was 25°C.

3. Green turtle

Location of nest: On the sandy coast at Betapur No.3, Middle Andaman. Much flotsam littered the beach which was about 40 m broad at midtide and which straddled the mouth of a tidal creek.

Description of nest-excavation: Two confluent craters were present. The one excavated last, of diameter 175 cm and depth 32 cm, was the larger of the two.

Position of egg chamber: 59 to 75 cm below ground level, at a distance of 3.8 m from the outer border of the larger crater.

Distance from treeline (*Nipa fruticans*) to nest: 9 m. A brackish creek intervened.

Distance between side walls of the egg chamber: 25 cm

No. of eggs: 55 (this appeared to be below average)

Diameter of an egg randomly selected: 42.8 mm.

Description of eggs: Four of the eggs had a thin shell as was indicated by a pinkish tinge in their colour. The remaining eggs were white. All were quite turgid, indicating that they had absorbed moisture from the sand after having been laid. One egg was opened. The embryo was about 10 mm long, globose eyes dark and prominent, suggesting that the eggs had been laid roughly 12 days earlier.

Approximate date of nesting: 7 November '78.

Tracks of the nesting female: These had been obliterated by wind.

4. Olive Ridley

Location of nest: About 1 km north of the Hut Bay settlement at Little Andaman. The turtle had climbed a $\frac{1}{2}$ m high sandy escarpment washed over at spring high tide and had nested on top without proceeding landward any further, possibly because the beach, waterlogged a few inches below ground level, sloped gently to a brackish pool inland. Village dogs frequent the beach.

Description of nest excavation: A disturbed patch of sand flattened in appearance, almost level with the surrounding sand and measuring about 1 m x $\frac{1}{2}$ m.

Date of nesting: The night of 2-3 January '79.

Number of eggs: 51 "normal" eggs. This is well below the average number that Olive Ridelays lay. There were also, quite untypically, a large number of abnormal eggs and shelly material that the turtle had extruded. These included many "stringed", undersized and warped eggs and also a pair connected to each other so as to appear dumb-bell shaped.

Average diameter of the "normal" eggs: About 39 mm.

Dimensions of the largest abnormal egg: 52.4 x 43.9 mm
(ellipsoidal)

Depth of topmost eggs: 32 cm below ground level

Sand temperature at nest depth (taken as 35 cm): 26°C.

Recommendations

1. Turtle protection laws should be rigidly enforced everywhere in the Andaman and Nicobar Islands.
2. The Leather back nesting beaches at (a) West Bay, Little Andaman, and (b) at the mouths of the Dagmar and Alexandria rivers in Great Nicobar require intensive patrolling to thwart poaching during the main nesting season, December-February. Sight-seeing tours organised and strictly monitored by officials could be arranged following detailed investigation of the nesting turtles by scientists and conservationsists.
3. The Twin Islands should be declared as a protected sanctuary for nesting turtles.
4. Detailed surveys are to be speedily undertaken in the areas not covered by the present survey in order to identify un-

discovered by the present survey in order to identify nesting colonies. The areas to be surveyed include North Andaman and the southern Nicobars in addition to the islands listed on page 4.

5. Detailed studies of nesting turtles, tagging and conservation projects such as the collection and hatchling of wild eggs in artificial nests and the release of the young at sea must be undertaken at any or all of the areas listed under "Important nesting areas located" and at nesting beaches that may be identified in future.
6. Dogs and domestic pigs should not be allowed to stray onto turtle nesting beaches.
7. Sea turtles are a valuable wildlife resource and an important item of food to tribals such as the Onges of Little Andaman, the Great Andamanese, the Nicobarese and probably the Jarawa of Middle and South Andaman. In the short period of heavy human colonization of the Islands (since the 1950's) turtle populations have already noticeably suffered and will continue to decline unless the wildlife wing tackles the problem with the necessary staff and facilities.

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Species	Date of Nesting	Location of Nest	No. of Eggs	Egg Dia (mm)		Track Width (cm)	Depth of eggs (cm)		Nest Level Temp. (°C)	Data Gathered on
				Large Egg	Small Egg		Topmost	Deepest		
HT	Mid-Oct	W. Twin E. Coast	96	35.0,	33.7	68	-	-	-	20 Oct 78
HT	20 Oct	E. Twin N. Coast	162	36.4,	35.1	-	-	-	-	21 Oct 78
HT	21 Oct	E. Twin NE. Coast	177	-	33.1	-	-	-	-	22 Oct 78
HT	21 Oct	Rutland W. Coast	121	33.9,	33.0	-	-	-	-	22 Oct 78
HT or RT	Mid Oct	S. Andaman 2 Km N of Mirchidera	119	36.9,	36.2	-	-	-	-	2 Nov 78
HT or RT	14 Nov	Betapur No.3	102	37.0,	34.9	99	-	-	-	15 Nov 78
HT	19 Nov	Betapur No.3	102	38.5,	36.4	66	-	-	-	20 Nov 78
HT	25 Jan	Trinkat E. Coast	168	35.6		78	30,-	25		26 Jan 78
HT	Early Feb	Great Nicobar S. Coast	130	-	-	-	- 50	-	-	6 Apr 79
RT	17 Oct	Betapur No.3	91	40.2,	39.0	77	- 38	-	-	18 Oct 78
RT	Late Dec	Hut Bay, Little Andaman	51 ⁺	40	38	-	32,-	26		4 Jan 79
RT	Late Jan	Katchal S. Coast	95	39		88	31, 40	27.8		8 Feb 79
GT	Mid Oct	Rutland W. Coast	93	41.4		88*	-	-	-	22 Oct 78
GT	Early Nov	Betapur No.3	45	43.3,	41.7	-	-	-	-	15 Nov 78
LT	End Dec	W. Bay, Little And.	43 ⁺	51	48	81	- 73	-	-	31 Dec 78
LT	31 Dec	W. Bay Little And.	-	-	-	180	-	-	24.5	1 Jan 79
LT	Early Feb	Gt. Nicobar W. Coast	79 ⁺	50.1,	48.8	-	-	76	28.8	1 Apr 79

The figure excludes undersized, yolkless eggs.

To this must be added about 8 cm, the missing span of a foreflipper.