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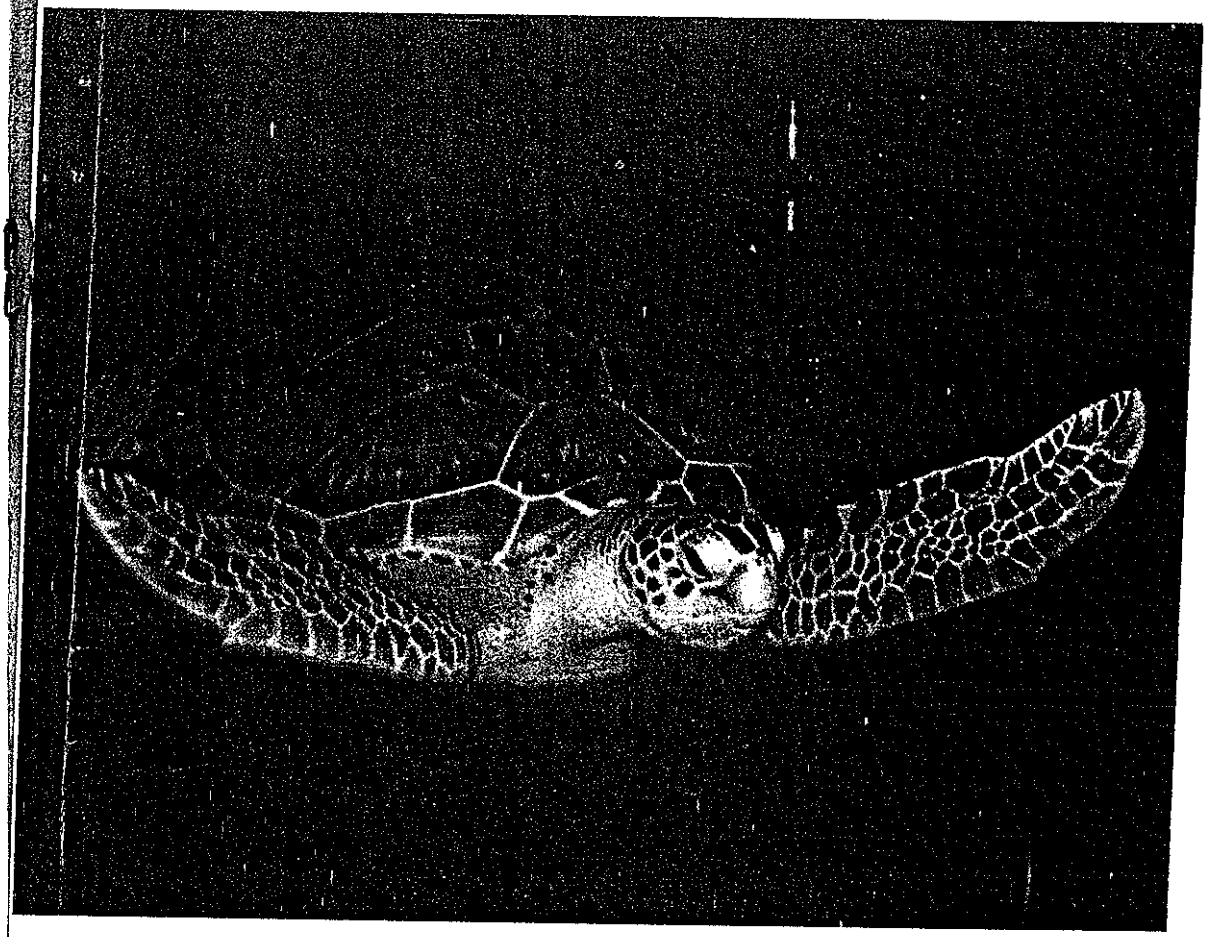

The majestic Green Sea Turtle (Chelonia Mydas) needs help from man in protecting its nesting grounds in a hostile world

Locating and Conserving Sea Turtle Nesting Grounds in the Andamans

Satish Bhaskar

Honourable Mention – The Rolex Awards for Enterprise – 1984

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In order to locate and conserve hitherto unrecorded nesting populations of endangered and threatened sea turtles, I propose to spend eight months alone on the uninhabited island of South Sentinel (approximately Latitude 11°N, Longitude 92° 16′ 36″ East) in the Andaman Islands.

Probably on account of non-availability of fresh ground water, and its remoteness, South Sentinel apparently has been visited only rarely by humans. The island is part of the Indian Union Territory of the Andaman and Nicobar Islands, which is administered from Port Blair by a Lieutenant Governor appointed by the Central Government at New Delhi.

South Sentinel is a flat, roughly circular, coral island, about 6 kilometers in circumference. Lagoons make up about half of its shoreline, with the other half being comprised of rocky or sandy beaches. One of India's loveliest sand beaches occupies about 2 kilometers of the northwest coast, and it is here that sea turtles, particularly the Green turtle, come for nesting and sunning.

Based on surveys carried out by me on nearby islands, it appears likely that one or more other sea turtle species (Hawksbill, Olive Ridley and Leatherback) additionally nest at South Sentinel. Earlier reports by scientists visiting the island were related to stays during February 1973 and March 1974, months which are believed to be lean seasons for nesting Green turtles in the Andamans, based on my studies. I am therefore proposing to spend the period of 1 June 1984 through 31 January 1985 on South Sentinel, to cover the peak nesting season for Green turtles, and to incorporate the nesting seasons for any other sea turtle species visiting the island.

All necessary equipment, provisions and medical supplies will be carried to the island at the start by hired motor launch from Port Blair, to make the expedition self-supporting. Some freshwater will also be carried, but most will be collected from the rains, as both monsoons — the southwest and the northeast — will occur during the study period. Two tents are being taken to provide accommodation and shelter for equipment and records. No contact with humans, including members of the friendly Onge tribe who inhabit Little

Andaman Island about 25 kilometers distant from South Sentinel, is anticipated over the course of the 8 month expedition. Official permission to stay on the island will be obtained in advance from the Central Government.

The Green turtle *(Chelonia mydas)* is considered by many as the most valuable of all reptiles, and is known all over the world as the 'soup turtle' Its shell is a dirty green and its fat a light green, accounting for its popular name.

Six of the world's seven surviving sea turtle species, including all five known from Indian waters, are listed in the International Union for the Conservation of Nature and Natural Resources' Red Data Book for threatened and endangered species. The study at South Sentinel will be aimed primarily at the conservation of sea turtles on this island, and will provide further information on the basis of which the island could be set aside as a sanctuary for these reptiles.

Since September 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 up to 6 years and a fine of a minimum of Rupees 500 (about U.S. $60).

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. Apart from the colonization of nesting beaches by man and the hunting of adult turtles for meat, this constitutes the greatest threat to the future existence of the sea turtles

Natural predators include Monitor lizards which can and do excavate sea turtle eggs, often fighting among themselves for the right to the spoils. Wild pigs may be another predatory enemy. Hatchlings are preyed upon by ghost crabs, rats and, in all likelihood, hermit crabs.

In order to provide information to support the recommendation to make South Sentinel a preserve, the data to be collected will include:

1) The species and numbers of sea turtles nesting on the island each night

2) Those species predatory on turtle eggs and young, and the degrees of predation.

3) Observations on nesting, re-nesting intervals, clutch sizes, hatching times and temperatures, courting and mating habits, weights and sizes of nesting females, hatchlings and eggs, and nesting habits.

The survey method will be similar to that used by me in earlier studies of sea turtles in the Andaman and Nicobar Islands. The sandy beach coastline is first surveyed on foot for evidence of turtle tracks, nests, excavations, shells, carcasses, and skeletal remains or egg shells. Sightings of turtles at sea, on land while nesting, or when emerging from nests as hatchlings are recorded. Clutches of turtle eggs are located by digging, and data on these are noted under the following categories: number of eggs in a clutch, track width, depth of topmost and deepest eggs, sand temperature at nest level, size of eggs (using vernier calipers), evidence of predation on eggs, and the nesting habitat (eggs are carefully replaced in a manually excavated 'nest' after data are collected). Additionally, turtle carapaces or carcasses found on shore are measured for carapace curved length and curved width, and skulls for head width

As many nesting turtles as possible will be tagged in order to obtain data on migration routes. If nesting numbers warrant, as is considered to be likely, follow-up studies of shorter duration will be undertaken in later years, in the

hope of revealing re-migration intervals and growth and recruitment rates.

Other data of natural history interest will be collected. Special attention will be focused on the Coconut crab, which has been the subject of the only in-depth study at South Sentinel so far. The occurrence of the Estuarine crocodile *(Crocodylus porosus)*, to date unreported from South Sentinel, will be looked into also.

After the study, a detailed report and list of recommendations pertaining to the conservation of the sea turtles at South Sentinel will be prepared and sent out to the IUCN, the Indian Government and to other organizations concerned with conservation.

Photographs and art not credited below were submitted by the entrants

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Present status of some endangered animals in Nicobar Islands

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During a six-month survey and study programme of sea-turtles on the southern group of Nicobar islands sponsored by the Madras Crocodile Bank, the senior author had an opportunity to visit Tillanchong, Meroe, Menchal, Pillomiloo, Trak, Terois, Little and Great Nicobar Islands, during November 1991 to April 1992 and observe the present status of some endangered species of animals in the wild. Some of these animals were also observed on the Nicobar Islands during recent faunal explorations of the Zoological Survey of India. They included four species of sea-turtles, salt-water crocodile, reticulated python, water monitor lizard, megapode, pigeon, swiftlet, crab-eating macaque, wild pig, dugong and coconut crab. Results of these studies are briefly reported in this article.

The leather-back turtle : During the nesting season, 692 excavations made by this turtle were encountered on 8 beaches of the Great - Nicobar Island, constituting the most important nesting areas of this species in the Nicobars. These excavations occurred mainly on four beaches at the mouths of Alexandria river (294), Galathea river (158), Dagmar river (101) and Renhong creek (86). Elesewhere in the Nicobars, the only major nesting beaches for this turtle occurred on Little-Nicobar and Katchal (Bhaskar, 1979), where their present status needs a further study. The removal of beach sand for construction purposes in the settlement areas on Great Nicobar has practically eliminated many nesting habitats on the island. Settlers on this Island consume the turtle and its eggs at every opportunity. The Nicobarese who are exempt from the provisions of the Wildlife (Protection) Act consume all turtle species and their eggs, excepting the leather-back, which has considerably helped the turtle in maintaining its population at a comfortable position. The presence of Forest Department Staff and the Madras Crocodile Bank personnel at these nesting sites rendered these turtles and their eggs safe from human beings. But, the feral and domestic dogs took a heavy toll of eggs and their hatchlings. However, the Forest Department is presently making earnest efforts to control the dogs here. On other beaches, the pigs and water-monitor lizards were predating on the eggs and their hatchlings. Spoilage also occurred due to tidal action and the infiltration of roots of the littoral vegetation as *Ipomea* and *Pandanus*.

The Olive-ridley turtle : During this breeding season, 228 nests of this species were encountered at Great Nicobar on three beaches at Galathea mouth (109), Dagmar mouth (195) and Alexandria mouth (24).

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Our tagging study revealed that 50% of the females nested twice during the season, while the remaining nest only once. This gave a population estimate of 153 nestings for this turtle on Great Nicobar for this season. The nesting population appeared to decline considerably during the past 13 years. This decline may safely be attributed to the increased human presence along coastal areas and the increase in the population of feral and domestic dogs and pigs. The nests of this turtle occurred comparatively at shallow depths at 30 cm below surface in sand beaches, making them easy victims of humans and predatory animals. The nests of this turtle were also seen on the beaches of Meroe and Little Nicobar Islands. Unlike other turtles, leather-back and olive-ridley turtles nest on the same beaches as seen on Great Nicobar and Menchal Islands.

The Hawksbill turtle : Nesting made by this turtle is so dispersed, both spatially and temporally, that it was practically impossible to arrive at any exact estimates of the population (Misra, 1990). Its nesting sites have been located at Indira Point and Saphed Balu on Great Nicobar as well as Meroe, Trak, Treis and Tillanchong, which are quite suitable for this purpose. Pending the identification of the peak nesting season, the present survey can only permit to state that the nesting turtles have considerably declined over the past 10 years, apparently due to the over-exploitation of turtles and their eggs by man, coupled with the predatory activities of domestic and feral dogs and pigs on the Great Nicobar beaches. This turtle generally prefers to nest on small and well isolated islands.

The Green turtle : The nesting populations of this turtle remains to be studied during the South-West monsoon, which is believed to be the peak nesting season for this species. The nesting areas for this turtle in Nicobars include the undisturbed parts of Meroe, Trak, Treis, Tillanchong, Little Nicobar and the Indira Point on Great Nicobar, as a good number of excavations were encountered at several places on these islands. The skeletal remains of this turtle were also seen strewn on these beaches, indicating their over-exploitation for flesh, oil, shell, etc. Presently as this turtle is being rarely encountered, it is to be considered the worst affected of the four sea sea turtles on these islands due to over-exploitation of eggs and audits.

The salt-water crocodile : Only one species of the crocodile *Crocodilus porosus* has so far been reported to occur in the Nicobars. But, the Nicobarese on Nancowry Island claimed the existence of two species in the area, showing colour variation of body. The subject requires a detailed investigation by specialists on the group. However, there is considerable evidence to show that the crocodile population has been steadily declining in numbers on on these islands in recent decades due to increasing poaching actvities of man for its valuable skin, which is in great demand both in national and International markets. Our observation at several prospective areas on these islands showed that the crocodiles and their juveniles were being rerely encountered. However, numerous crocodile tracks were observed along the southern part of Galathea river on Great Nicobar and on Tillanchong along brackish water creeks,indicating their presence on these islands in good numbers. But, thess areas need adequate protection from potential poachers and egg collectors.

The reticulated python: This is the largest and heaviest of Indian snakes commonly reported on Great Nicobar Island among the Nicobars. The snake has already been over-exploited by the settlers and others for its flesh and valuable skin, reducing its present status on the island to an endangered species. It is now rarely seen on the island, largely grown specimens becoming increasingly rare year after year. In the circumstances, unless adequate precautions are taken in time, this snake will be lost to us in no time in this region. Its presence at the present is largely restricted to thick forest areas on the island harbouring freshwater resources along Galathea, Alexandra and Dagmar rivers and their environs.

The water monitor lizard: This endemic sub-species *Varanus salvator andamanensis*, is frequently encountered on Great Nicobar, Nancowry, Katchal, Kamorta and Tillanchong Islands. As the lizard is amphibious and quite fond of fish and eggs of sea turtles, crocodiles, birds, etc., prefers to inhabit thick jungles along coastal areas on these islands. Its population has considerably declined in recent years as it was badly hunted by tribals and settlers for its flesh and valuable skin. As the lizard is easily caught with the help of hunting dogs, its position became extremely vulnerable at all the inhabited areas. With the result, at present fully grown adults are being rarely encountered on these islands.

The Nicobar megapode: Two sub-species of the megapode *Megapodius freycinet abbotti* and *M. f nicobariensis*, are known to occur in the Nicobar Islands (Tikader, 1984)). Our observation on the coasts of Great-Nicobar for the past one decade showed that the population of this bird has considerably declined in recent years. The megapode eggs are largely collected by Shompens and Nicobarese for their regular consumption. However, the excessive physical work involved in excavating the eggs from the mound-nests deters many egg collectors, who generally prefer to hunt turtle eggs on sea beaches. We collected 5-16 eggs from five nests near Pulo Babi, Pulo-Pakka and Pulo Bet Villages with 10 developed embryos, indicating a 3-month nesting season. The Nicobarese generally capture the megapodes when a couple approaches a mound for incubating their eggs. At Meroe, we saw two megapodes being shot dead by the Nicobarese. We also sighted the megapode nests on the North-West coast of Little Nicobar, indicating the presence of the bird on the island in considerable abundance. Megopodes also occurred on Tillanchong, Kamorta, Nancowry, Menchal and Teres Islands in small numbers. On Great and Little Nicobar Islands, the nests also occurred in the interior far away from the shore. The small Nicobarese population on Little Nicobar helped to maintain a rich wildlife on the island, including the megapode. But on the east coast of Great Nicobar, the megapode habitat has been very much disturbed and the bird population has practically been wiped out due to over-exploitation by settlers and others.

The Nicobar pigeon: The sub-species *Caloenas nicobarica nicobarica* being largely endemic to Nicobar Islands, was sighted during our surveys on all the major islands of this archipelago. Presently, its population has very much declined on the densely inhabited islands as Car Nicobar, Teressa, Kamorta and Nancowry islands, while its position is quite comfortable on Great Nicobar, Little Nicobar, Katchal and Tillanchong islands, where the bird was frequently seen by us in pairs or in groups feeding on the ground on seeds and wild berries.

The swiftlet : Popularly known as Hawabill in these islands, this endemic sub-species *Callocalia esculenta affinis* is less common in the Nicobars than in Andamans. During our intensive survey, with great difficulty we could encounter 33 examples of this bird on Great Nicobar (12), Little Nicobar (3), Nancowry (6), Katchal (8) and Kamorta (4) islands. The jelly-like nests made out of saliva for laying eggs are mostly located on steep rocky and wooden surfaces along coastal areas. As these nests are quite edible for making delicious soups and are of considerable economic value, no visible nest was spared by the local people. This wanton destruction of nests has seriously affected the reproduction and population of this bird. Due to these reasons, the swiftlet became quite rare in these islands in recent years, reducing its present status to an endangered position.

The crab-eating macaque : At present, this macaque is encountered only on Great Nicobar, Little Nicobar and Katchal islands in the Andaman - Nicobar archipelago. The sub-species is mostly gregarious in habits and often moves in troupes, raiding forest or agricultural produce in settlement areas. On Katchal and Great Nicobar islands, the macaque is killed by the local peopele, as it was causing considerable damage to their crops, plantations, fruits and vegetables. Due to the arboreal habit of this primate, hiding in thick forest foliage, it was not possible for us to ascertain its exact population density on these islands. However, the frequent sightings of this macaque in troupes of 5 to 20 at several localities, suggest that position of the macaque for present is quite comfortable on these islands.

The Nicobr wild pig : This endemic pig formed an important source of protein food for aborigInal tribals and settlers on Nicobar islands. Like the macaque, the pig also moves in small herds, often causing considerable damage to agricultural crops in settlement areas. It is largely hunted by local people with the help of hunting dogs. As the pig also hides in bushes and thick forest vegetation, it proved difficult for us to estimate its actual population density on these islands. However, we observed its pug-marks at several places and witnessed their catches by local people in stray numbers on Great Nicobar, Little Nicobar, Kamorta, Katchal and Nancowry islands. Information collected from local people revaled that population of the pig is certainly on the steady decline in recent years with the increase in the hunting.

The dugong : Although the sea-cow *Dugong dugon* was known to occur in stray numbers since long in the coastal waters around Nicobar Islands, no intensive survey has yet been made to ascertain its exact population density in these islands (Rao, 1990). As elsewhere, dugong was largely hunted by the local tribals and settlers for its delicious flesh, fat, oil and skin. As a result, its population has practically been wiped out at several places around these islands, while it is still surviving and struggling for its existence in a few pockets. According to the version of the local people, it is sighted at present in single or paired individuals only around Great and Little Nicobar Islands, which offer several sheltered bays for its comfortable colonization. Fishermen settled on the east coast of Great Nicobar were rarely netting the dugong now-a-days in their shore-seine operations. During our surveys, we could sight this mammal in Chengappa, Campbell and Galathea bays on the Great Nicobar Island.

The Coconut crab : The occurrence of this crab in the Bay Islands in recent years has been reported only from South Sentinal and the adjacent North Brother Islands, (Davis and Altevogt, 1976) and Great Nicobar (Daniel and Premkumar, 1968),which support rich coconut groves. During these surveys we encountered 7 crabs on the North-South road on east coast and around villages on the south - west coast on Great Nicobar, confirming its present occurrence on the island. It is also commonly reported by the Nicobarese on Meroe and Menchal Islands The islands of Trak, Teres, Tillanchong, Pillomiloo, Little Nicobar and Car Nicobar also supported stray populations of the crab. Thus, it is now certain that this crab is more widely distributed in the Nicobar group islands than previously supposed But its population is quite vulnerable to human exploitation. Presently its position appears to be comfortable only on Little Nicobar and Manchal islands in the Nicobars.

Conservation measures : Despite our great concern to conserve the threatened populations of wildlife on these islands, several species are only on the decline and struggling for their very survival, Presently the wildlife is better conserved on uninhabited and least inhabited areas on these islands. For this reason, the sea turtles were also forced to abandon their traditional nesting sites on disturbed coastal belts as happened on Car Nicobar and Teressa Islands In the circumstances, effective conservation measures are to be undertaken to protect the remaining populations of these endangered species The Wildlife (Protection) Act should therefore be extended to all these dwindling species and the law is to be earnestly enforced. All poaching activities in protected areas are to be arrested and deterrent punishment imposed in all cases of violation. Even the tribals who are being provided with rations should not be permitted to hunt the endangered species of animals, particularly those included under Schedule I of the Wildlife Act The use of fire arms by all in hunting these wild species is to be prohibited. Education on the significance of wildlife and its protection shall be imparted to all the tribals on these islands, to make the conservation programme a real success.

The following measures are to be undertaken particulary for conservation of the declining populations of sea turtles on these Islands With the recent gazette notification of two national parks in the Great Nicobar Biosphere Reserve, the potential nesting beaches shall be protected from removal of sand for construction purposes. The nesting and hatching seasons of sea turtles are to be carefully monitored by wildlife protection staff. Tho dogs and pigs should not be permitted on these beaches, during nesting and hatching periods. The accumulation of vegetable debris and the growth of *Ipomea* and *Pandanus* shall not be permitted on nesting sites. Adaquate protection should be given to the nesting sites to prevent tidal inundation, salt saturation and beach erosion. These beaches should not be utlised for recreational purposes to avoid trampling and damaging the eggs The domestic cattle also should not be permitted to stray on these beaches for the same reasons.

ACKNOWLEDEMENTS

We are greatful to the Madras Crocodile Bank for initiating and supporting the turtle project on Nicobar Islands and the Director, Zoological Survey of India, for facilities to

survey the islands. Thanks are also due to the Andaman and Nicobar Forest Department and other individuals for the help rendered during the survey.

REFERENCES

Bhaskar, S. 1979, Sea turtle survey in the Andamans and Nicobars. *Hamadryad*, 4 (3) : 1-26.

Davis, T. A. and R. Altevogt. 1976, Giant turtles and robber crabs of the South Sentinel. *Yojana*, 20 (14) : 75-79.

Daniel, A. and V. K. Premkumar, 1968. The coconut crab, *Birgus latro* (Crustacea, Peguridae) on Great Nicobar Island. *J. Bombay nat. Hist. Soc.*, 64 : 574-580.

Misra, A. 1990. Olive-ridley turtle : breeding and behaviour. *Tiger Paper*, 8 : 29-32.

Rao, G. C. 1990. Present status of the sea-cow, *Dugong dugon* (Muller) in Bay Islands. *J. Andaman Sci. Assoc.*, 6 (2) : 185-189.

Tikader, B. K. 1984. *Birds of Andaman & Nicobar Islands*. Zoological Survey of India, Calcutta, 167 pp.

vidence indicates otherwise." Source: *Species* (Newsletter of the IUCN Species Survival Commission), No. 18, June 1992.

ACTION PLAN FOR SEA TURTLES IN THE ANDAMAN AND NICOBAR ISLANDS, INDIA

The Andaman and Nicobar Islands host the largest nesting populations of two of the four ea turtle species that nest in India -- the leatherback turtle Dermochelys coriacea and the awksbill turtle Eretmochelys imbricata. Between 1978 and 1992, surveys and studies by the Iadras Crocodile Bank, WWF-India, and the Andaman and Nicobar Forest Department have own that both species nest here in numbers that contribute significantly to the world pool for ach species, but that several populations have declined or are threatened by human activities. esting beaches used by multiple species (generally 2-4) are common in the islands and provide nique natural laboratories for study, conservation and management. Studies at the prime esting sites of the olive ridley Lepidochelys olivacea in the islands will also be invaluable in the onservation and management of the world's largest nesting population of sea turtles, that at ahirmatha in Orissa.

Urgently needed are:

Precise determination of nesting seasons for hawksbill and green turtles.

Surveys of five islands off the northwest coast of North Andaman, islands that are potential nesting sites and feeding grounds for hawksbills, to be urgently gazetted as a hawksbill sanctuary.

Recurrent yearly nest counts for each of the four species during their respective nesting seasons at their known nesting grounds, over 90% of which have been discovered. The prime objective is to monitor population fluctuations.

Intensive studies and tagging at the main nesting beaches for each species, to reveal turtle migration routes and information vital to turtle management and conservation.

Detection and evaluation of feeding grounds in the islands and tagging of turtles in these marine habitats, for similar ends.

Formulation of a Management Plan.

The project duration is to cover five years initially and two years continued survey, onitoring and implementation. A minimum of four investigators will be required, each to be pported by at least one qualified assistant. Directly involved should be the Andaman and icobar Forest Department (which may partially fund the project), which should be, as executor all management plans for turtles, the recipient of detailed reports and recommendations ising from the project. The survey work taken up last year and ongoing is being carried out lely by one investigator due to lack of funds.

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RENESTING INTERVALS OF THE HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATA*) ON SOUTH REEF ISLAND, ANDAMAN ISLANDS, INDIA

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(with two text-figures)

ABSTRACT.- Data on 106 renesting intervals involving a total of 56 hawksbill sea turtles (*Eretmochelys imbricata*) on South Reef Island, Andamans, India were analyzed. Renesting intervals ranged from 12-17 days, averaging 14.06 days, and show a standard deviation of 1.17 days. The most frequent renesting interval was 14 days (35.8 per cent of total). Fifty instances of multiple renesting involving 32 of the 56 hawksbills were encountered. In 90 per cent of these instances, the variation in renesting of individual turtles were either 0 or 1 day. The maximum number of renesting within a season was six.

KEY WORDS.- *Eretmochelys imbricata*, renesting interval, multiple renesting, South Reef, Andaman Islands, India.

INTRODUCTION

Uninhabited South Reef Island, one of 94 islands designated as a Wildlife Sanctuary in India's Andaman and Nicobar Islands, is 450 m long and 90 m wide at its broadest part. It is fringed by an unbroken coral reef on all sides except off its north-eastern corner where the reef is patchy. The island is forested, and extreme spring tides frequently invade the forest edges. A dynamic cycle of erosion and deposition of the coast by the sea occurs, and is linked to the two monsoons, the Southwest (June to September) and the Northeast (October to November).

The island is among three of the most favoured sites by nesting hawksbills sea turtles (*Eretmochelys imbricata*) in the Andaman and Nicobars, with up to eight females coming ashore during a single night, although the average number during the peak nesting season is two per night. Green turtles (*Chelonia mydas*) nest is smaller numbers. Despite the existence of nesting beaches used by hawksbills on neighbouring islands, the closest of which is Interview Island (ca. 2 km distant), evidence from renesting encounters suggests that the hawksbills which nest on South Reef exhibit strong nest site fidelity.

Other than a species of *Rattus*, no vertebrate land animal prey on turtle hatchlings on South Reef, and turtles rarely encounter disturbance while nesting. Humans occasionally camp on the island, most often during the fair season (December to May).

MATERIAL AND METHODS

Each year from 1992 to 1995, a small camp manned by one or two investigators was set up on South Reef during the main hawksbill nesting season. During 1992, 1993, 1994 and 1995, the duration of the camps were, respectively, three months- 12 September to 12 December), two and quarter months- 14 September to 22 November, three and quarter months- 27 June to 9 September and 16 November to 7 December, and two months- 14 June to 18 August (Bhaskar, 1993; 1994a; 1994b; 1995; 1996).

Nesting hawksbills were tagged during these isolated periods with a minimum of disturbance: shaded flashlights were used sparingly. A single hurricane lantern, placed within a carton in order to shade and direct the light downwards, was used at the camp, which was itself concealed behind beach vegetation, primarily *Scavola taccada*. Some nesters, however, may have been disturbed by the offshore activities of local shark fishermen and of Burmese divers intent on collecting commercially valuable marine invertebrates.

Sweeps of the 1 km perimeter of the island were undertaken at about 100 minute intervals commencing at 1915 hours and ending at about 0300 hours, after which hawksbills rarely came

ashore. Tagging was delayed until oviposition commenced. Nesting turtles encountered at any stage subsequent to oviposition were allowed to complete the nest, then overturned while returning to the sea, tagged and righted again. Only one in five turtles tagged required to be overturned. Renesting intervals were rounded off to the nearest day.

Two types of tags were used. The first is a corrosion-resistant metal wore carried on a red plastic tag serially numbered AN1, AN2, etc. The second is a metallic corrosion-resistant cattle ear tag, serially numbered CA707, CA708, etc., and the inscriptions: RETURN ANPWS GPO BOX 636 CANBERRA AUST 2601, or numbered 006X, 007X, etc., carrying the inscription: RETURN WILDLIFE BOX 155 NORTH QUAY 4002 QLD AUSTRALIA.

All tags were inserted through the first and/or second and/or third large scale of the trailing edge of the left fore flipper closest to the turtle's body. Double or multiple tagging was employed in cases where tags were thought to have failed to lock securely. Turtles encountered renesting were found to have never lost tags.

RESULTS

Of 106 renesting intervals recorded for 56 hawksbills, 14 days was the most frequent (35.8 per cent or more than one-third of the total). About four of five (79.2 per cent) renesting intervals fell within the range 13-15 days and 98.1 per cent within the interval of 12-16 days. The range was therefore 12-17 days. Renesting intervals averaged 14.06 days and showed a standard deviation of 1.17 days.

Only three of 286 nestings documented occurred during daylight. A hawksbill that stranded at 1545 hours on 1 October, 1992 and nested was never encountered again on South Reef; another female that nested by daylight was missed by the investigator; a third stranded at 1845 hours on 18 July, 1995, nested, and was seen stranding twice again, at intervals of 15 days 7.5 hours and 15 days 17.5 hours, nesting on both occasions. Thirty-two females were each encountered on three or more occasions, giving a total of 50 renesting intervals. For each turtle, the variation in renesting interval

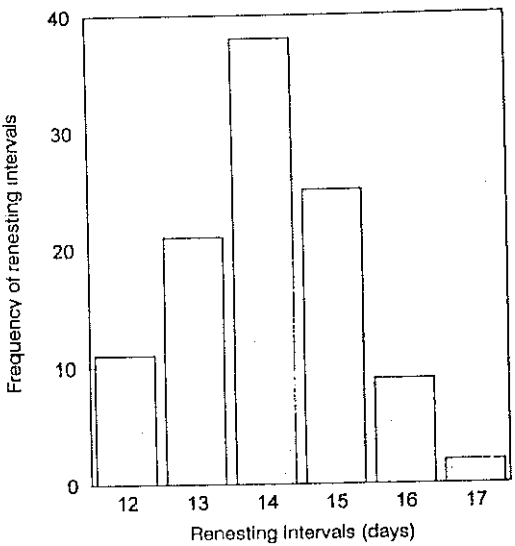

FIGURE 1: Frequency of renesting intervals in hawksbills on South Reef Island

TABLE 1: Year-wise and cumulative frequencies of renesting intervals for hawksbills on South Reef Island. Abbreviations: RI = renesting interval; f = frequency; n = sample size.

RI (days)	Frequency of renesting interval									
	1992 (n = 15)		1993 (n = 35)		1994 (n = 31)		1995 (n = 25)		Overall (n = 106)	
	f	%	f	%	f	%	f	%	f	%
12	1	6.7	6	17.1	1	3.2	3	12.0	11	10.4
13	5	33.3	11	31.4	3	9.7	2	8.0	21	19.8
14	3	20.0	9	25.6	15	48.4	11	44.0	38	35.8
15	4	26.7	7	20.0	9	29.0	5	20.0	25	23.6
16	1	6.7	2	5.7	3	9.7	3	12.0	9	8.5
17	1	6.7	0	0.0	0	0.0	1	4.0	2	1.9

TABLE 2: Illustration of method used in calculating variation in renesting interval (days) for individual hawksbills on South Reef Island. Abbreviation: RI = renesting interval; SI = serial number of turtle.

SI	RI	Variation in RI
A	14, 14	0
B	12, 13, 14	1, 1
C	12, 13, 13	1, 0
D	12, 15	3
E	16, 15, 15	1, 0
F	14, 14, 13	0, 1
G	13, 13, 14, 14, 14	1, 1, 0, 0
H	12, 13, 17	1, 3

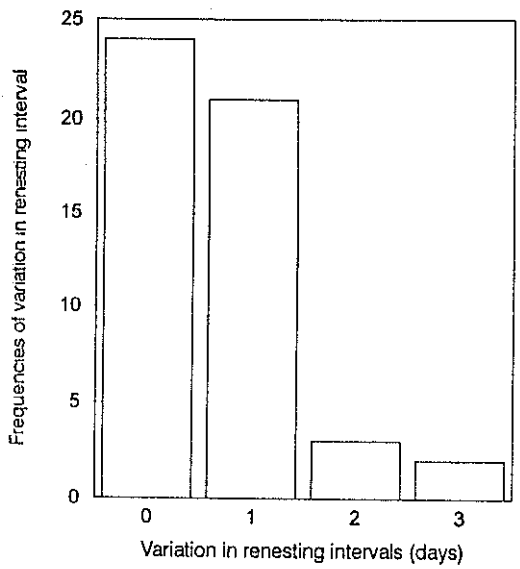

FIGURE 2: Frequencies of variation in renesting interval for mulitple renesting hawksbills on South Reef Island.

TABLE 4: Frequencies of variation in renesting interval (days) for multiple renesting hawksbills on South Reef Island, excluding the 1992 data. Abbreviations: RI = renesting interval (days); n = sample size.

Variation in RI	Frequency of variation in RI	
	Cumulative figures for 1993, 1994 and 1995	%
0	23	52.3
1	18	40.9
2	2	4.5
3	1	2.3

was calculated as in the following examples provided in Table 2.

Using this method, the average variation in the 50 multiple renesting intervals was 0.66 days with a range of zero to three days, standard deviation 0.77 days and a mode of zero days. Ninety per cent of the renesting intervals varied by either zero days (48 per cent) or one day (42 per cent).

The maximum number of times an individual hawksbill was seen nesting was six, at intervals of 13, 13, 14, 14 and 14 days, spanning 68 days. Many hawksbills were encountered only once while nesting. In no year did the study period cover the entire nesting season for the species, and several instances of nesting were missed by the investigators even during the study period.

DISCUSSION

A knowledge of renesting intervals, together with renesting frequencies will reveal the length of time during which a nesting sea turtle is susceptible to predation at or near a nesting beach, or to drowning in fishing nets. It will also facilitate the

TABLE 3: Frequencies of variation in renesting interval for multiple renesting hawksbills on South Reef Island. Abbreviations: RI = renesting interval (days); n = sample size.

Variation in RI	Frequency of variation in RI					
	1992 (n = 6)	1993 (n = 14)	1994 (n = 18)	1995 (n = 12)	Overall (n = 50)	%
0	1	5	11	7	24	48
1	3	8	6	4	21	42
2	1	0	1	1	3	6
3	1	1	0	0	2	4

tagging of nesters by limiting the number of nights of search needed.

While the published information mention that renesting interval of the hawksbill is 15-19 days (Carr and Stancyk, 1975; Diamond, 1976; McKeown, 1977; see also Hirth, 1980; Groombridge and Wright, 1982: 191, for a review), and one worker has even reported a mean of 24 5 days (Vaughan, 1981), the present study gave the range of 12-17 days. The difference obviously relates to geographically distinct populations. It is also possible that the low level of human-engendered disturbance to nesting turtles on and around South Reef Island resulted in the prevalence of near-natural renesting interval, as observed in this study

However, disturbance may not have been negligible during the first year of the study (1992), when a parallel study on sea kraits (*Laticauda* spp) necessitated more frequent use of a flashlight on the nesting beach at South Reef With the data from 1992 deleted, a variation of zero days in renesting interval occurred in over half (52.3 per cent) of the 44 instances of multiple nesting by the hawksbills recorded, and was either zero or one day in 93 2 per cent of these instances

ACKNOWLEDGEMENTS

This project was initiated and funded by the Centre for Island Ecology/Andaman and Nicobar Islands Environmental Team, a division of Madras Crocodile Bank Trust and the Royal Netherlands Embassy. I thank the Andaman and Nicobar Forest Department for issuing me permits and for providing transport and logisitc support. Romaine Andrews oversaw the preparation of several reports, including this paper. Harry Andrews obtained the necessary turtle tags. For help received during various phases of the project, I also thank Divisional Forest Officers at Mayabunder, Saw Bonny and Mark Bastian and their staff

LITERATURE CITED

BHASKAR, S 1993 Andaman and Nicobar Sea Turtle Project Phase II Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

BHASKAR, S 1994a Andaman and Nicobar Sea Turtle Project Phase IV Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

BHASKAR, S. 1994b Andaman and Nicobar Sea Turtle Project. Phase VI Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department

BHASKAR, S. 1995 Andaman and Nicobar Sea Turtle Project Phase VI A. Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department

BHASKAR, S 1996. Andaman and Nicobar Sea Turtle Project. Phase VIII Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department

CARR A & S STANCYK 1975 Observations on the ecology and survival outlook of the hawksbill turtle *Biol Conserv* 8: 161-172.

DIAMOND A. W 1976. Breeding biology and conservation of hawksbill turtles, *Eretmochelys imbricata* L., on Cousin Island, Seychelles. *Biol. Conserv.* 9: 199-215.

GROOMBRIDGE, B & L. WRIGHT. 1982. The IUCN Amphibia-Reptilia Red Data Book Part I Testudines, Crocodilia, Rhynchocephalia IUCN, Gland

HIRTH, H F 1980 Some aspects of the nesting behavior and reproductive biology of sea turtles *American Zool* 20: 507-523

McKEOWN, A. 1977 Marine turtles of the Solomon Islands Ministry of Natural Resources, Fisheries Division, Honiara

VAUGHAN, P 1981 Marine turtles: a review of their status and management in the Solomon Islands Ministry of Natural Resources, Fisheries Division. Honiara

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RENESTING INTERVALS OF THE HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATA*) ON SOUTH REEF ISLAND, ANDAMAN ISLANDS, INDIA

Satish Bhaskar

Centre for Herpetology, Madras Crocodile Bank Trust, Post Bag 4, Mamallapuram, Tamil Nadu 603 104 India.
(with two text-figures)

ABSTRACT.- Data on 106 renesting intervals involving a total of 56 hawksbill sea turtles (*Eretmochelys imbricata*) on South Reef Island, Andamans, India were analyzed. Renesting intervals ranged from 12-17 days, averaging 14.06 days, and show a standard deviation of 1.17 days. The most frequent renesting interval was 14 days (35.8 per cent of total). Fifty instances of multiple renesting involving 32 of the 56 hawksbills were encountered. In 90 per cent of these instances, the variation in renesting of individual turtles were either 0 or 1 day. The maximum number of renesting within a season was six.

KEY WORDS.- *Eretmochelys imbricata*, **renesting interval, multiple renesting, South Reef, Andaman Islands, India.**

INTRODUCTION

Uninhabited South Reef Island, one of 94 islands designated as a Wildlife Sanctuary in India's Andaman and Nicobar Islands, is 450 m long and 90 m wide at its broadest part. It is fringed by an unbroken coral reef on all sides except off its north-eastern corner where the reef is patchy. The island is forested, and extreme spring tides frequently invade the forest edges. A dynamic cycle of erosion and deposition of the coast by the sea occurs, and is linked to the two monsoons, the Southwest (June to September) and the Northeast (October to November).

The island is among three of the most favoured sites by nesting hawksbills sea turtles (*Eretmochelys imbricata*) in the Andaman and Nicobars, with up to eight females coming ashore during a single night, although the average number during the peak nesting season is two per night. Green turtles (*Chelonia mydas*) nest is smaller numbers. Despite the existence of nesting beaches used by hawksbills on neighbouring islands, the closest of which is Interview Island (ca. 2 km distant), evidence from renesting encounters suggests that the hawksbills which nest on South Reef exhibit strong nest site fidelity.

Other than a species of *Rattus*, no vertebrate land animal prey on turtle hatchlings on South Reef, and turtles rarely encounter disturbance while nesting. Humans occasionally camp on the island, most often during the fair season (December to May).

MATERIAL AND METHODS

Each year from 1992 to 1995, a small camp manned by one or two investigators was set up on South Reef during the main hawksbill nesting season. During 1992, 1993, 1994 and 1995, the duration of the camps were, respectively, three months- 12 September to 12 December), two and quarter months- 14 September to 22 November, three and quarter months- 27 June to 9 September and 16 November to 7 December, and two months- 14 June to 18 August (Bhaskar, 1993; 1994a; 1994b; 1995; 1996).

Nesting hawksbills were tagged during these isolated periods with a minimum of disturbance: shaded flashlights were used sparingly. A single hurricane lantern, placed within a carton in order to shade and direct the light downwards, was used at the camp, which was itself concealed behind beach vegetation, primarily *Scavola taccada*. Some nesters, however, may have been disturbed by the offshore activities of local shark fishermen and of Burmese divers intent on collecting commercially valuable marine invertebrates.

Sweeps of the 1 km perimeter of the island were undertaken at about 100 minute intervals commencing at 1915 hours and ending at about 0300 hours, after which hawksbills rarely came

ashore. Tagging was delayed until oviposition commenced. Nesting turtles encountered at any stage subsequent to oviposition were allowed to complete the nest, then overturned while returning to the sea, tagged and righted again. Only one in five turtles tagged required to be overturned. Renesting intervals were rounded off to the nearest day.

Two types of tags were used. The first is a corrosion-resistant metal wore carried on a red plastic tag serially numbered AN1, AN2, etc. The second is a metallic corrosion-resistant cattle-ear tag, serially numbered CA707, CA708, etc., and the inscriptions: RETURN ANPWS GPO BOX 636 CANBERRA AUST 2601, or numbered 006X, 007X, etc., carrying the inscription: RETURN WILDLIFE BOX 155 NORTH QUAY 4002 QLD AUSTRALIA.

All tags were inserted through the first and/or second and/or third large scale of the trailing edge of the left fore flipper closest to the turtle's body. Double or multiple tagging was employed in cases where tags were thought to have failed to lock securely. Turtles encountered renesting were found to have never lost tags.

RESULTS

Of 106 renesting intervals recorded for 56 hawksbills, 14 days was the most frequent (35.8 per cent or more than one-third of the total). About four of five (79.2 per cent) renesting intervals fell within the range 13-15 days and 98.1 per cent within the interval of 12-16 days. The range was therefore 12-17 days. Renesting intervals averaged 14.06 days and showed a standard deviation of 1.17 days.

Only three of 286 nestings documented occurred during daylight. A hawksbill that stranded at 1545 hours on 1 October, 1992 and nested was never encountered again on South Reef; another female that nested by daylight was missed by the investigator; a third stranded at 1845 hours on 18 July, 1995, nested, and was seen stranding twice again, at intervals of 15 days 7.5 hours and 15 days 17.5 hours, nesting on both occasions. Thirty-two females were each encountered on three or more occasions, giving a total of 50 renesting intervals For each turtle, the variation in renesting interval

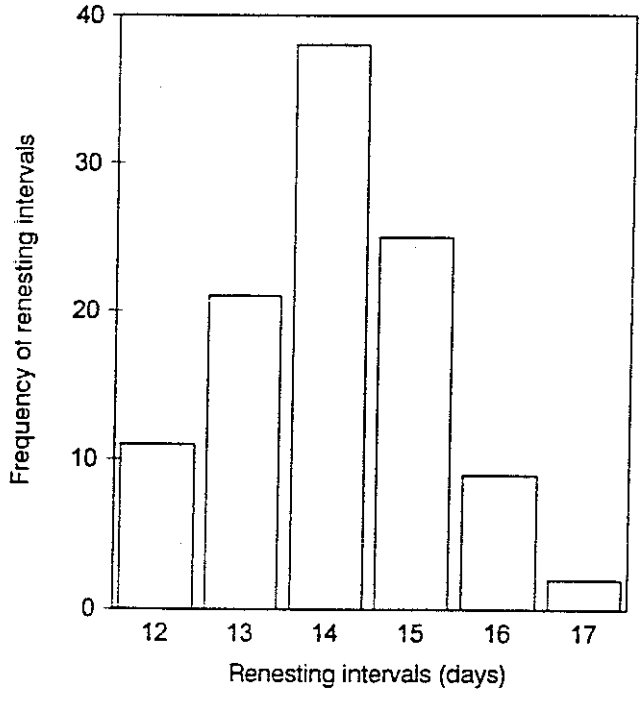

FIGURE 1: Frequency of renesting intervals in hawksbills on South Reef Island.

TABLE 1: Year-wise and cumulative frequencies of renesting intervals for hawksbills on South Reef Island. Abbreviations: RI = renesting interval; f = frequency; n = sample size.

RI (days)	Frequency of renesting interval									
	1992 (n = 15)		1993 (n = 35)		1994 (n = 31)		1995 (n = 25)		Overall (n = 106)	
	f	%	f	%	f	%	f	%	f	%
12	1	6.7	6	17.1	1	3.2	3	12.0	11	10.4
13	5	33.3	11	31.4	3	9.7	2	8.0	21	19.8
14	3	20.0	9	25.6	15	48.4	11	44.0	38	35.8
15	4	26.7	7	20.0	9	29.0	5	20.0	25	23.6
16	1	6.7	2	5.7	3	9.7	3	12.0	9	8.5
17	1	6.7	0	0.0	0	0.0	1	4.0	2	1.9

TABLE 2: Illustration of method used in calculating variation in renesting interval (days) for individual hawksbills on South Reef Island. Abbreviation: RI = renesting interval; Sl = serial number of turtle.

Sl	RI	Variation in RI
A	14, 14	0
B	12, 13, 14	1, 1
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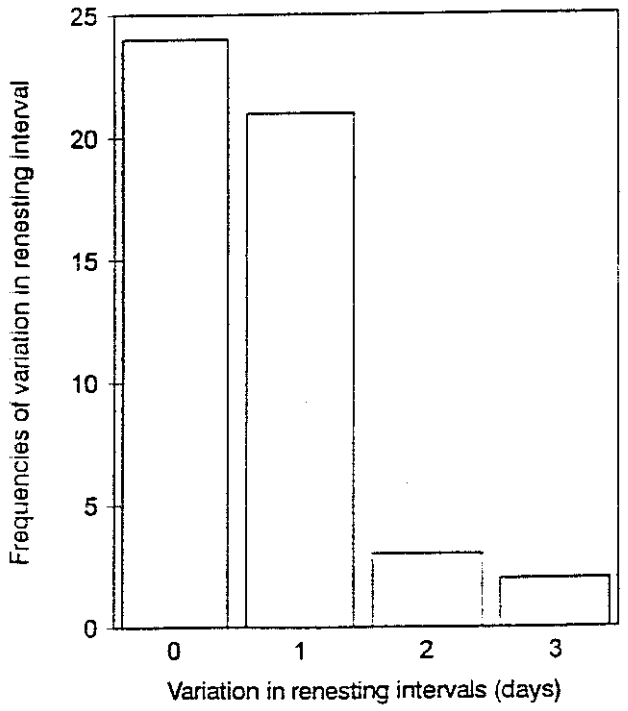

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However, disturbance may not have been negligible during the first year of the study (1992), when a parallel study on sea kraits (*Laticauda* spp.) necessitated more frequent use of a flashlight on the nesting beach at South Reef. With the data from 1992 deleted, a variation of zero days in renesting interval occurred in over half (52.3 per cent) of the 44 instances of multiple nesting by the hawksbills recorded, and was either zero or one day in 93.2 per cent of these instances.

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LITERATURE CITED

BHASKAR, S. 1993. Andaman and Nicobar Sea Turtle Project. Phase II. Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

BHASKAR, S. 1994a. Andaman and Nicobar Sea Turtle Project. Phase IV. Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

BHASKAR, S. 1994b. Andaman and Nicobar Sea Turtle Project. Phase VI. Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

BHASKAR, S. 1995. Andaman and Nicobar Sea Turtle Project. Phase VI A. Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

BHASKAR, S. 1996. Andaman and Nicobar Sea Turtle Project. Phase VIII. Report submitted to the Centre for Herpetology and the Andaman and Nicobar Forest Department.

CARR, A. & S. STANCYK. 1975. Observations on the ecology and survival outlook of the hawksbill turtle. *Biol. Conserv.* 8: 161-172.

DIAMOND, A. W. 1976. Breeding biology and conservation of hawksbill turtles, *Eretmochelys imbricata* L., on Cousin Island, Seychelles. *Biol Conserv.* 9: 199-215.

GROOMBRIDGE, B. & L. WRIGHT. 1982. The IUCN Amphibia-Reptilia Red Data Book. Part I. Testudines, Crocodilia, Rhynchocephalia. IUCN, Gland.

HIRTH, H. F. 1980. Some aspects of the nesting behavior and reproductive biology of sea turtles. *American Zool.* 20: 507-523.

McKEOWN, A. 1977. Marine turtles of the Solomon Islands. Ministry of Natural Resources, Fisheries Division, Honiara.

VAUGHAN, P. 1981. Marine turtles: a review of their status and management in the Solomon Islands. Ministry of Natural Resources, Fisheries Division, Honiara.

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THE MANNAR ISLANDS

BY

S. BHASKAR

I arrived in Mandapam Camp in early March, 1977 to join a Central Marine Fisheries Research Institute survey team covering the islands just off the Ramanathapuram District Coast in the Gulf of Mannar. The team, which had just surveyed four islands in the Gulf of Mannar close to Tuticorin, included -

(1) Mr. Rajapandian, in charge of the party.
(2) Mr. Bastian Fernandes, the turtle specialist, whose main task was to map the islands.
(3) Mr. Rajan, to catalogue all the flora and any incidental fauna on the islands.
(4) Mr. Ramdas, a Scuba diver, to report on the marine aspects of the islands.

Later that day, the CMFRI motor launch, "CHIPPI", arrived after a 6 hour journey from Tuticorin, carrying Soosai Francis and another driver who constituted the launch crew. On this survey, no scuba equipment was used, only snorkelling gear and a glass bottomed bucket, carried in a 5 - man fibreglass shell (boat) the "OYSTER" which was lashed to the "CHIPPI".

Sea Turtles:

Bastian says that all 5 species of sea turtles are known to exist in the area, but that Dermochelys (Leatherback is very rare.

Turtles	Status	Local Name (s)
Green	Common	Peramai; Perumdulai (south of Tuticorin)
Ridley	Common	Ateamai; Sithamai (in Rameshwaram)
Hawksbill	Not uncommon	Alungamai, Panginiamai
Loggerhead	Scarce	Kilimmai
Leatherback	Very rare	Tholamai, Baku (?) vari amai or Thoni amai (in Kilakarai area alone)

There may be some confusion caused by one local name being applicable to more than one species, in some areas. Bastian says that nesting on the mainland is not prolific, and that only Ridleys have been confirmed to nest in the area. The turtle specialist at Mandapam camp Mr. Mudaliar Pillai had reared two

Ridleys from the egg stage - these are now on display at the CMFRI aquarium. They are fed on molluska.

Krusadai Island, 3rd March '77. The 8 of us left for Krusadai, a forty minute run by motor launch, at 6.30 a.m. Krusadai is one of the four islands in the immediate vicinity of Pamban on Rameshwaram island - the others being Pullivasal. Pulli and Shingle - Protected by the Govt., Krusadai, the largest of the group is about a mile in length and half a mile in width. Shingle, the smallest is about half a mile in diameter. Krusadai and Pullivasal are separated by a channel about 4ft deep and 150 metres wide. By wading in a detour over submerged sandbanks, one can cross from one island to the other in water 2ft deep at low tide. Likewise, Pullivasal and Pulli are separated by a shallow channel only 25 metres wide. Shingle island is a bit more isolated, and is about 15 min. from Krusadai by motor launch.

Most of the islands in the Gulf of Mannar have live coral reefs encircling them partly or fully; the widths of these coral fringes tend to be greater on the seaward side than on the mainland side, where I saw stretches only upto 25 metres broad.

Very shallow reefs consisting mainly of coral stone, (i.e. coral that has been compacted into stone over the ages) ranging from sea level to a few feet deep often form a barrier to the approach of boats of any respectable size. These barriers sometimes extend upto 600 metres from the shores of the islands on the calm mainland side, and extend upto 2 miles or more on the choppier seaward side. The Gulf of Mannar between the islands and the mainland is generally calmer than the Palk Bay, which is more prone to violent seas.

One often sees halfbeaks (Hemiramphis gaimardii), slim fish about 8" long, skittering above the sea surface as the approaching motor launch scares them off. They cannot quite fly like the sea flying fishes do. At Krusadai, one finds a narrow beach about 10 m. broad consisting of sand and shingle. The nearby vegetation consists of shrubs and bushes usually casuarina and Prosopis are common though mangroves like Avicenia occur in some stretches. Coconuts, Calotropis and Phoenix palms are on Krusadai and on some of the larger islands like Hare Islands. Most of the islands have a population of partridges, minor other birds;

south of Krusadai.

A green turtle carapace lay on the beach. Nesting of turtles on the islands does not occur frequently - possible reasons may include the narrowness of the sandy beaches, the presence of the reefs, and the disturbance created by fishing launches and sail-powered fishing craft. The only species confirmed to nest on the islands is Lepidochelys (Ridleys).

Some stretches of Krusadai (and other islands) are totally devoid of beach; vegetation grows right upto the waters edge and one has to wade in the shallow water in order to circumvent it. Two species of mangroves are to be found. Mud flats occur in Krusadai and on other islands where calm bays thrust deep into the islands.

A stretch of intertidal area between Pullivasal and Pulli is covered in mud 2-3ft deep over an area of half a square mile. In these places, a wader sinks upto his thighs in mud and often feels the hard, weathered surfaces of coral stone or dead coral under his soles. Plenty of sea cucumbers in the mud flats - the two common species being Holothuria atax and H. scabra. H. atra is commercially valuable (each specimen fetching about 40p), for this beche-de-mer is used in the manufacture of the trepang soup which is relished in S.E. Asian countries.

On Krusadai, one finds an animal called "Indian sea grapes" washed ashore. They occur in clusters attached by tapering stalks to bits of dead coral or rocks. Resembling grapes in size, they are green and turgid with a fluid resembling sea water.

Shingle Island We went to Shingle where in the absence of a boat jetty (Krusadai is at present the only island in the Gulf of Mannar to boast of one) we beached "Chippi" on a sloping shore of sand and shingle. The beach on the seaward side of Shingle is full with dead cowries and cones. A 30ft high obelisk made of bricks, constructed in the 19th century is present on this island as well as on many other islands and on the mainland. These are used as landmarks by seafarers.

On the return to MDPC, Soosai the helmsman said he saw a dugong - we were too late to see it before it dived under. Shingle has a smaller variety of land flora and fauna than Krusadai, one reason being that it is smaller. No coconuts or any ~~x~~ other large trees

Pulli Island, 4th March '77. Skipping Pullivasal temporarily, we visited the adjacent island of Pulli (also called Poomarichan). Approaching Pulli we had to drop anchor about 200m from its shore, since the "Chippi" drew 4ft of water and shallow coral reefs and stones were visible as maroon patches in the deeper green areas. We rowed across in the "OYSTER". Saw my first marginella shells here. These resemble cowries and occur on other islands as well. Mangrove swamps and mud flats made progress on foot around the island a slow, arduous thing. A lone boy, having come by sailboat, collected small gastropods from the mud (which often was thighdeep) to make into necklaces.

A crazily tilted obelisk is on the south side of Pulli. Small live ceriths (Cerithidia fluviatalis) swarming on the mud flats. Many edible clams of the species Cardium fluvum, distinguished by having massive valves considering their small (2") size. A flock of about 70 gulls (3 species of which occur in the area) on a mud flat.

On my swim back to the boat I found coral growing in greater profusion in 10ft depth than in deeper or shallower water. There were staghorn corals (Acropora) and Madreporanians. Species of Acropora seemed to be more abundant of the islands than of the mainland where the usual variety is Madrepora (massive, spherical shapes) and Favia (starcoral). The crew of the "Chippi" collected 7 species of coral in their diving forays here. Here, the live coral fringe was only 10 metres wide. The giant sea anemone, Stoichactus, which retracts into the sand on being physically disturbed, occurs on Pulli and elsewhere in shallow water and even on intertidal sand beaches. Its nematocysts (stinging cells) did not hurt my fingers when I touched it, but eyes and nose get inflamed on contact with the fingers after touching the animal. A dolphin was swimming about 50ft from me. Sounder says that porpoises (small whales) are much rarer than dolphins here. On the seaward side of Pulli, heavy seas were breaking on submerged reefs 300 metres away from shore, the intervening stretch of shallow sea being very calm. Many kinds of sponges grow on the waters surrounding the islands (as well as on the mainland). I was jackal tracks on Pulli, jackals must have swum from the mainland (a kilometre away from Krusadai at its nearest, at Kundugal Point). Mr. Mahadevan, one of India's poineer scuba

drivers and an ex-Research Asst. at the Krusadai Marine Bilogical Station (the only permanent station on any of the islands) said that he had actually observed a jackal swimming over from Krusadai to Kundugal Point in the 50's. Jackals could therefore easily make it from Krusadai to Pullivasal and thence to Pulli. The next island, manaali Putti is however too far away, about 5 kms. We returned to MDPC early, at 1 pm. Red and white Trochus shells (T.radatus) and turbo (Turbo intercostalis) are common off most islands and T.pustulosa East of Hare Island. Among a pile of commercially valuable sea weed which had been harvested by a fishermen of Pulli, I found a living money cowri (Cypraea moneta). Button shells (Umbonium Vestiarium) occur literally by the thousands on some beaches on Hare Island and elsewhere. They live aninch or two below intertidal sand and have to be dug out. Donax scortum also is abundant, being one of the relatively few species I saw common to the Madras coast and the Gulf of Mannar. The 3" long gastropod , Potamida paluatris sometimes share the mud flat habitat of its tiny relative Cerithidia fluviatalis. Cypraea arabica Cypraea onyx, C. serpentis and other cowries are to be found living upside down under flat rocks in shallow seawater. I saw two kinds of periwinkle - Littorina scabra on the Krusadai boat jetty, and Planaxis sulcatus on most of the islands where mangroves occur; also the dog-whelk, (Thaisrudolphi)

Talairiyu Island:On Talairiyu tivu I found a single dead specimen of a flawless, intricately carved rock shell, Muresa ramosus, about 3½" long. An occasional ear shell (Haliotis) can be found under rocks on the islands, also black and white nerites (Narita chamaleon) Tiny pheasant shells (Phasianella sp.) are often washed ashore, empty. The gastropod Bulia ambulla, with a hole at its apex is also found washed ashore, minus the soft parts. Occasionally tun shells (Toma Dolium) Olive shells (Oliva gibbosaa) and star shells (Astraea semicostata) can be found. The pink coloured Anaana plicata is also found washed ashore and on Hare Island, I saw an empty Nautilus laying on the shore. Limpetus do not seem to be common on the islands and the only one I saw was under the obelisk at Pulli. I collected one tiny chiton at Appa island. The gastropod (Angilla scanhella) occure in two colours - milky white and orange.

Putti Island, 5th March '77. Went to the small (½ sq mile) island

of Manali Putti (or Putti island) which is connected to the large island of Manali at low tide by a 200m stretch of mud flat 100m broad. The "Chippi" was forced to anchor 600m away from Putti's shoreline, and we had to abandon the "Oyster" also a hundred metres further in. The remaining distance we waded through knee deep mud and sea water, cutting our feet on sharp rocks.

On Putti, we saw a woman with a diving mask emerging from the sea after collecting mollusks to be made into necklaces. She had collected 1/4 "padi" od molluska, which earn her Rs.5/-, about an hours work. She dives to 10ft, she said, in search of sea weeds and seashells. A large pile of seaweeds on the shore sells at the rate of Rs.5000/- per ton she said. The woman, her husband and 5 small children had arrived on Putti 14 days back, carrying freshwater in 3 large plastic jerrycans, and a makeshift tent. They planned to depart when their freshwater supply ran out, which would be in another 10 days, she said. The husband had gone to the mainland in the sailboat in order to sell a load of the seaweed and shells, they had collected. Such remporary residents, more usually fishermen, are to be found on many of the islands in the Gulf of Mannar. The woman showed me large cowries of 4 species that she had collected and buried in the sand to let the flesh decay away. They fetch about 0.40p each.

Freshwater seems to be non existent on all islands except Hare Island and Nallatanni Tivu, which are the only islands privately owned. On Krusadai, the ground water is a bit brackish, but quite drinkable when one gets used to it - surveys on the other islands might locate water of equal or better potability.

On Putti I found a large sea slug with tubercles on its back. Brahminy kites, stilts, and flocks of cormorants (among other birds) exist on Putti.

Manali Island. Next we walked across to Manali. Here four fishermen campers were cooking fish locally caught. Three sting ray carcasses lay drying in the sun. The fishermen has also collected and pile of edible beans which grow wild on Manali. We found the plastron of a small Ridley and the carapace of a larger one. A small obelisk exists here. The blue floats of a few Protuguese men-o-war (Physalia) lay stranded on the beach on the mainland side, which is bordered by mangrove vegetation. These mangroves growing on the waters edge forced us to wade in shallow sea water. No coconut trees on Manali. Returned to MEPC early. Mr. Mahadevan

arrived from Tuticorin to join us for the rest of the survey.

6th March '77: Went to Hare island, about 1½2 hours run from MDPC. Being a private island, permission to survey it had already been obtained by the CMFRI from the owner, a Mandapam Marikar, to whose ancestor the island had been gifted by a Raja of Ramnad. The island, the largest one I saw on this survey, is about 5 miles long and averages ½ mile in width, though in some places it is only 100 yards wide. Hare island has a resident population of about 50 people. Besides fishing, this community raises cattle and also has some land under cultivation. Cocoanuts and other palms grow on the island, also a variety of trees bearing edible grape-sized fruits. The seaward side of Hare Island is sandy, though one can see breakers spilling on reefs about a mile away. The mainland side is predominantly composed of mud and mangrove swamps. Here also, lush growths of seagrasses exist, rivalling the undersea meadows of MDPC. The marine fauna of Hare Island seems to be less disturbed and exploited than that of the other islands because fishermen from other areas are not allowed to ply their nets near Hare. Mud flats are extensive on the northeast and southwest ends of the island. Though I did not see any, monkeys are said to exist on Hare island. Islanders walked through mud flats using a 5ft staff as a probe, for detecting quicksand, I was told. The shells of Cardium flavum, naturally very thick, are even thicker here. The disjointed skeleton of a whale (possibly a Blue Whale) lay on the beach. I couldn't lift even one rib of it.

At Hare Island, a beautiful nudibranch (similar to seaslugs) called Onchidium exists. It is about 4" long, with bright orange feathery breathing organs. These are extended only when the creature is undisturbed. Another nudibranch from Hare island, brown with purple breathing organs, stained the bottleful of sea water in which it had been kept a bright purple when it was bitten by a large red hermit crab in a tun shell.

A seaside colony of coelenterates closely resembling jelly fish but oriented upside down, had occupied a calm bay near a mud flat. We watched as the "bells" of these creatures pumped sea water rhythmically.

A Ridley carapace, a Green turtle carapace and a Hawksbill carcass lay at different spots on the island. Unfortunately, I missed seeing a dugong feeding for an hour in shallow water a mere 50ft from the anchored "Chippi". The entire survey party saw it and Mr. Mahadevan said that this was the first time in his 25 years service that he had observed a dugong feeding in its natural habitat.

Partridges are present on Hare Island. Potamides palustris is common on its western end. The mud flats here are a paradise for ibises, stilts and cormorants, among other birds. Hermit crabs skitter about in shrubbery wearing protective turbo shells. They seem to have almost forsaken the sea. Bits of floating wood washed ashore had goose barnacles (Lepas) colonising them. I saw rock branacles (Balanus) only on Appa island. On the return journey to MDPC, we saw a Ridley turtle swimming on the choppy sea surface.

Pullivasal Islands. 7th March '77. We visited Pullivasal. There being no safe approach to this island, we anchored off Pulli and waded across Pulli to Pullivasal in 3ft of water. Later in the day, at high tide, this 20 metre broad strait was 4½ feet deep and gave me a soaking when I crossed it on my way back.

A brown tentacled sea anemone grew in shallow water. As on Shingle Island, we found the shells of sea urchins washed ashore. Also of heart urchins and an occasional sand dollar. A red worm about 4" long burrows in the sandy soil onmany islands including Pullivasal.

About 5 women were wading in the seaward reef, looking for seaweed ("pasi" in Tamil). The protected status of the island did not deter them.

Bastian saw a Ridley carapace and a fresh Green turtle carcass. The mainland side of Pullivasal is overgrown with mangroves and covered in deep mud, which makes progress slow and tiresome.

Swimming back to the launch, I saw a beautiful coral city off Pulli populated by colourful fishes. Live coral can be distinguished (after being brought to the surface) from dead coral by its characteristic smell and by the fact that unlike dead coral, it exudes a sticky mucous like secretion. Mr Mahadevan says that water clarity in the Gulf of Mannar is usually good

from November to February and in June and July.

Mr. Nagappan Nair, the OIC at CMFRI Tuticorin, and a pioneer scuba diver himself, arrived that night and took charge of the survey party.

8th March '77. Visited Mulli, Valai and Talairiyu tivu. Mulli was the smallest island I visited, being about 350 metres in diameter, and having sparse vegetation. It is about 2 hours from MDPC by motor launch. Water clarity here was the best I had seen on this trip, verticalvisibility being about 20ft. A narrow intertidal reef about 25m broad, similar to the one at Pullivasal, projects radially outwards for ½ a kilometre on the seaward side of Mulli.

Marine life is abundant near the tip of this reef - molluscs, coelenterates, annelids, crabs, etc., all occur in profusion here. We saw a waterspout (a mild tornado) which approached to within a mile of Mulli. Swirling sea spray marked the spot where the dark funnel, clearly visible , connected the sea and the dark clouds about 10,000ft overhead. The funnel was visible for an hour after which it gradually dissipated. Waterspouts seen to be common in the Gulf of Mannar, only a few days later, I saw another at MDPC from a distance. Mr. Mahadevan knows of two fishermen being killed by a waterspout, and Bastian says that a boat was lifted 8ft and capsized, on another occasion.

Valai Island. We next went to Valai island which is also small about a third of a mile in diameter. Valai and Talairiyu tivu (the 2nd largest island I visited) are connected by the usual intertidal strip of sand and mud, about 300m long here. On Valai island, fishermen using shore seine nets had cought seer fish (Scomberomorus commerson) rainbow sardines and other species of fish, including small sharks and rays. A boy barried squid eggs, about a kilo in weight; the baby squids eyes were visible through the outer membranes. Talairiyu tivu had about 50 fishermen, who had arrived in 5 sailboats, working their nets around it. Its seaward side was totally devoid of beach and we had to wade or out across the island on land if the water got too deep for wading. we saw a dead Ridley here. Diving near the east tip of Talairiyu, a substantial current worried me a bit. The bottom was sand and dead coral with occasional patches of sea grass. On the return journey to MDPC, I saw two dugongs onthe sea surface. On the

They dived when our launch approached to within 50ft of them, giving a fairly clear view of them.

Appa Island, 9th March '77. Went to Appa Islands which is in fact two islands connected by an isthmus, 400m long and 200m wide, consisting of sand and mud. Appa I is small and sandy, while Appa II is larger and is primarily made of coral stone. Unlike all the other islands which are low lying, Appa II is in places 40ft above sea level. The coral stone, which is compacted into a single solid mass, has small weathered channels crissorossing it, making it painful for a barefoot walker.

Appa was the second island (the first Shingle) on which we were able to beach the "Chippi", the fringing reefs occuring only intermittently. Fishermen on Appa II presented me with large specimens of spider conches (Lambis digitata) and a large Strombus shell with a bright red hermit crab in it.

On Appa II, clicking sounds made by crabs and shrimps among the loose intertidal rocks are to hb heard continuously. Appa II is a haven for water birds. Sheep have been introduced here as on some other islands like Talairiyu and Hare. I heard partridges on Appa I. Found two 6" annelid worms buried in mud in the bar connecting Appa I and Appa II.

Next we went to "Poovarasan", a ½ acre "island" of sandwhich is completely submerged at high tide, about a mile west of Appa. Diving here, I collected a striated brown cone shell (Conus) and also saw a number of the dangerous scorpion fish family eyeing me boldly from the sandy bottom 6ft below. Balayamunai and Anaipar islands were visible in the distance. Since Appa and Poovarasan are directly off Kilakarai on the mainland, we went to Kilakarai and thence by jeep to MDPC, having left the "Chippi" in Kilakarai harbour, so that it would be quicker to reach Balayamunai and Anaipur the nest day. At Kilakarai, the CMFRI obtained permission from the owner of Nallatani tivu to survey his island later.

Balayamunai and Anaipar Island, 10th March '77. Balayamunai and Anaipar are both quite small islands about ½ mile inlength each. Balayamunai is 30 min. run from Kilakarai and again we landed the "CHIPPI" on beach sand.

Next to this spot, a clam shallow bay exists - the diving here is wonderful- the water being clear, warm, of just the right

depth (about 5ft) and swarming with coral gardens and colourful fish.

Not many trees on Balayamunai, mainly shrubs. A fisherman in a sailboat had landed, besides the usual kinds of fish, three 5ft long moray eels still alive of chequered black and white patterns (these are of the commonest kind in the area, Muraena punctata). On being questioned, the fisherman said that they were not for the table; he had caught them since they were vidious creatures, the sea and everyone else would be better offs without them! The morays had amazingly smooth and slippery skins.

Fifteen minutes later, we were at Anaipar island. An inter-tidal coral stone reef exists here also, projecting 200 metres out to sea on the seaward side of Anaipar. Spider conches were to be found in the sandy sea bed bordering Anaipar. Mr. Rajapandian found a large Pteroceros shell which he gave to me. Diving near where the "Chippi" was anchored, I was surprised to see its propeller only about a foot clear of the sea bed. A tiny but colourful chrimp with spots on it shelters in the folds of the Stoichactus enema. W

We returned by launch to Kilakarai and jeeped back to MDPC. This was the end of the island trips for me, since the CMFRI intended covering the two remaining islands, Nallatanni and Upputanni much later using Tuticorin as base.

11th March '77. The survey team departed for Tuticorin.

SUMMARY: There are 15 islands in the Gulf of Mannar and a few sandy shoals. I visited 9 islands. Most were small, within the size range 50 to 500 acres. Only Hare and Talayariyu islands were larger. Fresh water was only to be found on Hare Island and Krusadai Island (besides Nallatanni tivu which I didn't visit), though drinkable, brackish ground water may be found on other islands. Besides Hare and Nallatanni Islands, none have permanent residents on them. Fishermen do however camp for periods ranging upto two months on the islands. On many islands, mainland cattle have been introduced - their impact on the flora and fauna of the islands have yet to be assessed. Live coral exists off all the islands. Because the islands are small and localised, it would not take a major upheavel (man-made or natural) to wipe out the coral which is, in any case, not abundant, at

least on the mainland side of the islands. Mangrove swamps, mud flats and coral stone beaches exist on several islands.

Because of their size, Talayriyu and Hare islands would seem to be the most suitable islands to establish any tourism complexes in future. Ground water has to be surveyed on Talayriyu island. Hare island is, at present, privately owned. Indiscriminate exploitation of coral both live and dead for commercial purposes has to be put to an immediate stop, since live coral areas will in future inevitably become centres of tourism, besides providing unique ecological niches to other marine flora and fauna and eventually may support a controlled curio industry. Dead coral also supports much marine life. Navigational approaches to all islands have to be charted.

The theoretically protected islands of Krusadai, Shingle, Pulli and Pullivasal are at present being exploited by fishermen and sea weed collectors; we found fishermen's campfires on Shingle. The protection laws must be enforced, if these islands are to remain a biologists' paradise.

Mr. S. Bhaskar
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Postcript: Toward the end of Mr. Bhaskar's trip Zai Whitaker and myself visited the Mandapam area and three of the islands. We spent two days snorkelling (skin.diving) with Mr. Bhaskar who is an experienced diver. We were deeply impressed with the magnificent coral formations even close off shore on the Palk Bay side. Bdt. Evidence of the destruction caused by the coral extractors and shell collectors was unfortunately only too obvious. As in rain forests where millions of years of evolution and hundreds of years of growth are destroyed in hours of timber felling, our few fragile coralreefs are being decimated for the cement and carbide industries.

We received a telegram from Mr. Bhaskar shortly after our return that a dugong (India's rarest marine mammal) had been captured and was penned at Tuticorin. We informed the Assistant Director, Wild life but it was too late, the dugong had been chopped up and sold on the spot. A carefully planned and managed tourism/conservation marine national park will hopefully be a step toward protecting this important area and rarities like the ponderous dugong.

R. Whitaker
Director
Madras Snake Park Trust, Madras-600 022

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SEA TURTLE RESOURCES IN THE ANDAMANS[1]

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INTRODUCTION

Of the 7 existing species of sea turtles found in the oceans of the world, 4 occur in the Andaman Sea ; they include four of five existing genera of sea turtles. All four are presently known to nest in the Andamans Among them is the largest and rarest of sea turtles, the leatherback turtle This turtle has been listed in the International Union for the Conservation of Nature (IUCN) Red Data Book for species immediately threatened with extinction. All Indian sea turtles are totally protected by law, having come under Schedule I of the Indian Wildlife (Protection) Act in 1977.

The presently known status of Indian sea turtles is summarized below :

Zoological Name	English Name	Status in Indian seas	World wide status
Lepidochelys olivacea	Olive Ridley Turtle	Very common	Not uncommon but declining rapidly
Chelonia mydas	Green Turtle	Common	Common but declining rapidly
Eretmochelys imbricata	Hawksbill Turtle	Not Common	Exterminated over most of their original range
Dermochelys coriacea	Leatherback Turtle	Common only in the Andamans	Uncommon

Sea turtle meat and eggs constitute an important food source in many countries. Turtle soup prepared from cartilaginous tissue called calipee s widely relished The horny laminae on the shell of the hawksbill turtle are converted into highly priced curios. Turtle fat is used as a remedy for a variety of ailments and as caulking for boats. The hide is converted into shoes. If nesting occurs in sufficient concentrations, sea turtles could promote tourism. Carefully supervised 'turtle watching nights' (i.e the organized observation of sea turtles as they come ashore and nest) have become popular tourist attractions in Australia and Malaysia. Aesthetic reasons apart, the uses cited above make it well worthwhile for us to protect and preserve sea turtles, whose populations have taken a downward plunge ever since man and dogs commenced colonizing their remote nesting areas, collecting their eggs, 'turning' them on land and netting, spearing and hooking them indiscriminately at sea. Dogs scent and excavate turtle eggs with disheartening efficiency. Turtle nesting beaches have literally been trucked away for construction purposes, as has occurred, for example, on the Betapur coast in Middle Andaman.

The Snake Park is currently carrying out a sea turtle survey in the Andamans and offshore islands. So far Great Andaman and Little Andaman have been surveyed

SEA TURTLE SURVEY FINDINGS IN LITTLE ANDAMAN

The Island was surveyed from 29th December '78 to 5th January '79 by the Madras Snake Park Field Officer. Data were collected in two ways : (1) Walking the seashores of the island in order to locate turtle

[1] Invited Paper.

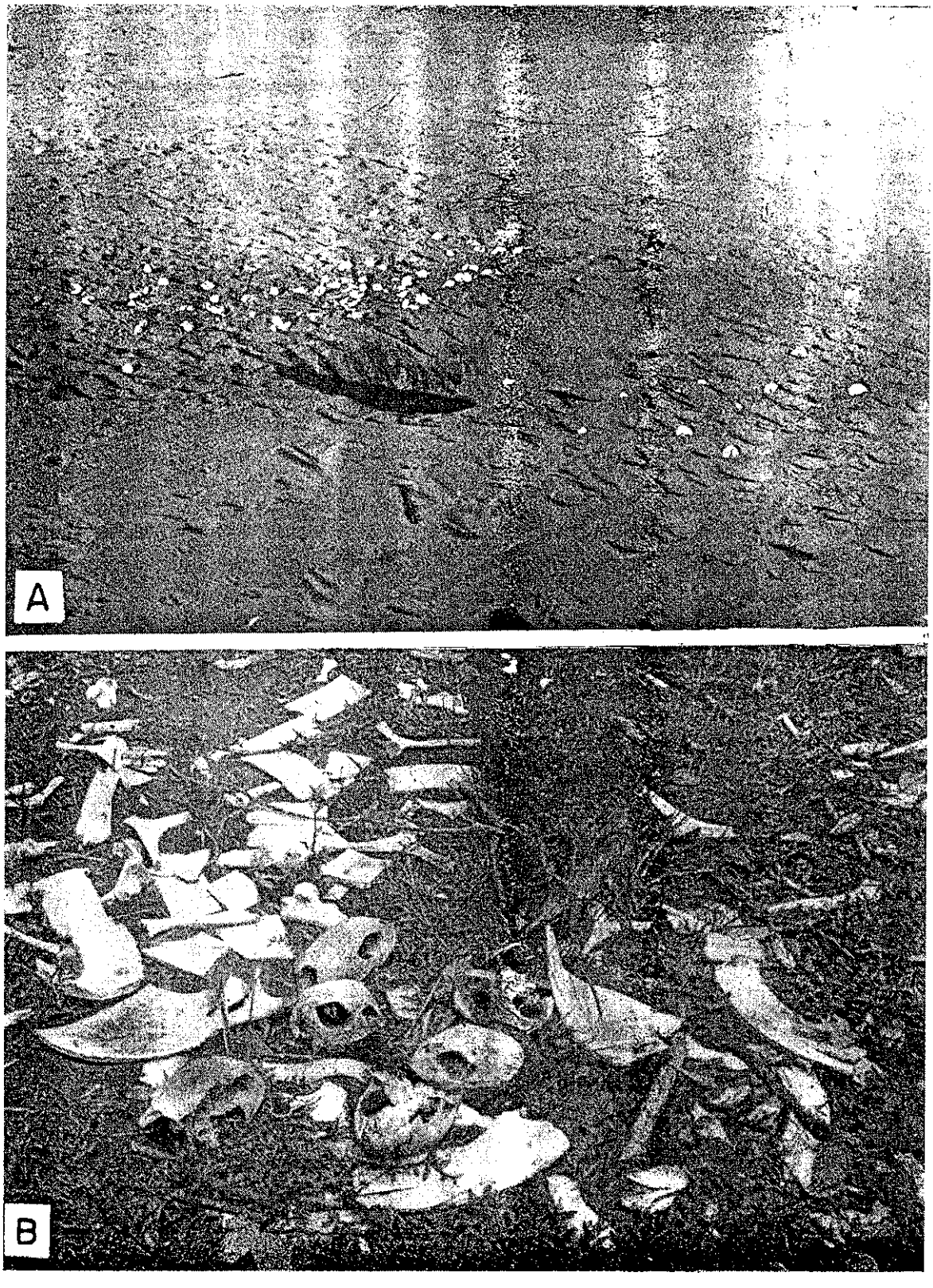

Plate I A Sea turtle eggs are dug up and eaten by dogs, pigs monitor lizards and man. B Skulls and bones of green sea turtles caught for meat near Wandoor South Andaman (Photos by S Bhaskar)

Plate II The eggs of hawksbill are the smallest of sea turtle eggs in the Andamans. (Photo by S Bhaskar)

nests, excavations, tracks, carcasses, skeletal remains and egg shells and (2) interviewing settlers and Onges who fish and hunt for a livelihood

Most excavations of four species were found on Little Andaman, with leatherback nests prepondering The breakup was as follows :

Species	*No. of excavations*
Leatherback	82
Olive Ridley	4
Green	3
Hawksbill	1

While nests of the Ridley, Green and Hawksbill turtles are often encountered on the coasts of mainland India and on offshore islands, the last confirmed account of a leatherback nesting dates back to 1928 at Quilon, Kerala where no nesting has occurred since, on account of predation by man on eggs and adult turtles

Of the 82 leatherback excavations (meaning 82 nests, in all probability) about 15 had been made during or immediately prior to the week of the survey i e. around late December '78 and early January '79

On the night of 31st December a leatherback turtle was observed as it nested at West Bay, Little Andaman. This is the first occasion in 50 years that leatherback nesting has been observed and recorded on Indian soil

Leatherbacks grow to 2 5 m in length and over 1000 kg in weight. The individual observed in Little Andaman measured almost 2 m in length and left a track 180 cm in breadth as it crawled up the beach sand Large leatherbacks leave tracks reminiscent of those made by a tractor well over 2 m broad The eggs (white in colour, encased in a flexible parchment textured outer skin) are laid and buried 60 to 75 cm below ground level in moist sand (temperature roughly 25°C) usually on broad sandy beaches at or above the spring hightide line. Roughly 100 eggs are laid, most of them with a diameter of 51 mm, larger than those of other sea turtle species that occur in India The area excavated by the nesting turtle may measure 15 m by 3 m (the surveyor carefully reburied all eggs after measurements had been taken and data collected)

In spite of the leatherback turtle's impressive open-sea swimming ability and its far-ranging habits (the species is found in all but the coldest seas), only three large nesting concentrations are known to exist, to date : at Trengganu (Malaysia), Surinam and Costa Rica

It would be rash to assume, in the absence of more detailed investigation, an aggregation of comparable magnitude in Little Andaman However, this pos ibility cannot be ruled out in view of the fact that the duration of the nesting season, its peak period and intensity have yet to be ascertained.

' Natural ' predation on turtle eggs by monitor lizards and, possibly, by wild boar and civet cats exceeds 80% of the clutches laid, as was evident from the numerous occasions raided nests (with empty turtle-egg shells strewn about) were encountered (Pl I, A) Monitor lizards were observed as they excavated turtle nests on four occasions. Wild pig and civet tracks were often found around turtle nests Presumably this degree of natural predation has kept the leatherback population in a state of dynamic equilibrium—a situation which could easily be upset by the encroachment of man (and, inevitably, dogs) on turtle nesting beaches. This has evidently occurred at Hut Bay where fishermen state that nesting has dwindled and almost ceased over the past decade. The presence of only one leatherback excavation in Hut Bay during the survey period, in spite of the availability there of otherwise suitable nesting habitat, reinforces this belief Today, ne ting preponderates on the virtually undisturbed West Bay. South Bay which is visited occasionally by fishermen, predictably harbours a smaller nesting population.

Of vital importance for the continued survival of the unique Little Andaman leatherback population is the need to protect the beaches at West Bay and South Bay from all human intrusion, at least until these areas can be effectively and regularly patrolled by law enforcers Under no circumstance should dogs be allowed to be brought to these areas.

The traditional hunting of turtles by Onges, may, however, have no adverse effect on the turtle population because of the antiquity of this interaction and the small scale on which it occurs at present. Onges spear sea turtles for consumption using a hand-propelled wooden harpoon with a detachable metal spike head. The green turtle is the species usually hunted The imminent construction of a motorable road from Hut Bay to the vicinity of Jackson Creek will greatly jeopardize the existence of the West Bay nesting population Crocodiles, reputed to occur in numbers in the area will be similarly threatened.

Follow-up surveys are necessary in order to collect more accurate and quantitative data regarding sea turtle nesting seasons, nesting populations and their fluctuation, sea migration routes, egg laying frequency, biology etc , with a view to conserving this resource.

Sea Turtles in the South Andaman Islands

Areas surveyed

1. The coasts of the main island of South Andaman barring those along the Jarawa Tribal Reserve
2. The Rutland Island coast excluding its eastern face
3. The 12 small islands that form the Labyrinth group which lies off Wandoor, South Andaman.
4. The Twins, two islands situated approximately due west of Wood-Mason Bay, Rutland Island.

Period of survey : 7 October to 4 November '78.

Prior to the Government ban in October'77 on the killing of sea turtles and on the collection of their eggs, turtles were actively hunted by fishing communities from the small townships of Maymyo and Wandoor (Pl I, B)

Wandoor became the largest 'turtle depot' and butchering centre in South Andaman, where sea turtles that had been speared using hand-propelled harpoons or, less frequently, caught in nets or while nesting were brought and carved up before transportation to Port Blair where the meat fetched Rs. 3-5 per kg. Turtle eggs were consumed locally and occasionally sold for 5 paise a piece

The turtle species usually killed for meat was (and to some extent still is) the green turtle (*Chelonia mydas*), as was evident from the presence of 34 *C. mydas* skulls at Wandoor in September 78, a year after the ban. Juveniles as well as adults were taken. The skull width ranged from 9¼ to 13 cm and averaged 11½ cm.

Local estimates of the catch before October '77 range from 5 to 20 turtles during fishing days, the number of which is curtailed mainly by the prevalence of the south-west monsoon. Fishermen of Bengali origin who are reputedly experienced in the use of sails and adept at wielding harpoons state that the heaviest nesting occurs during August but do not state the species involved. At least 3 other species occur in the Andaman sea—the hawksbill (*Eretmochelys imbricata*), Ridley (*Lepidochelys olivacea*) and the leatherback (*Dermochelys coriacea*).

Hawksbills in South Andaman nest well into October (at least)—23 sets of fresh hawksbill tracks were found on the Twins, known locally as Kachua Tikeri (turtle Island). The Twins were the most remote of the areas surveyed but even so fishermen occasionally undertake the 3 to 7 hour journey from Wandoor and other coastal hamlets expressly to collect turtles and their eggs. Evidence of this was the presence of a stripped carcass of a green on the Eastern Twin island and many turtle egg shells strewn nearby.

Fishermen hesitate to use nets in the shark infested waters around the Twins. On a broad, kilometre-long sandy beach on Rutland Island directly opposite the Twins, both sets of green turtle tracks visible had been made by a turtle lacking the left fore-flipper—in all likelihood the result of a shark attack. The time elapsed between the laying of the two clutches probably represented an inter-nesting interval for the turtle, roughly a fortnight. Another green nest site visible nearby but with tracks obliterated may have been excavated during a still earlier nesting venture by the same turtle. If so, she must have first come ashore to nest about mid-September. This evidence is of course too meagre to delineate the green's nesting season in the Andamans.

Also on the same beach was a fresh hawksbill nest and 5 leatherback egg shells scattered over a 75 m front. Of these 5, 2 were intact and unbroken and, though discolored and desiccated, retained their roughly spherical shape, thus facilitating a rough measurement of their diameters. One of these contained the remains of a hatchling's carapace. The fact that the other did not, makes it likely that the eggs came from different clutches (75 m of sand carpeted by sparse vegetation and separating the two eggs reinforces this possibility). The two intact eggs exclude predation and the likely explanation for their presence on the sand surface is that they were uprooted inadvertantly by another nesting turtle of the same or different species. If correct, these presumptions lead one to the exciting possibility that the beach was, sometime during the previous few months, a reasonably heavily nested area used probably by leatherback, because these large turtles dig deeper body pits and egg chambers than other species do and are therefore more likely to accidentally excavate other nests. Though suitable as a leatherback nesting site (being sandy and remote), this beach which lies immediately south of Wood-Mason Bay offered no other signs of digging activity by leatherbacks; but the excavations could have been obliterated during the south-west monsoon months (the beach faces west). About 5 km away were two leatherback nest sites excavated about 2 months earlier, i.e. in July or August, on a little disturbed beach on Rutland's southern coast.

About midway between the beaches mentioned were 6 sets of fresh hawksbill tracks on a 1 km wide front. This narrow beach is remote and fringed by tall panda-

nus There was evidence of 5 nests Of these, three had lately been robbed by monitor lizard (*Varanus salvator*). Unlike dogs and jackals, monitors leave behind few, if any, egg shells The surveyor's visit surprised a 0 75 m monitor as it rested on a turtle nest after eating all the eggs It was sluggish in making its getaway after the heavy meal There were abundant monitor tracks on Rutland's beaches and on the larger Islands of the Labyrinth group, especially on Tarmugli and Redskin, where nesting occurs, as also on Boat Island

Wild pigs inhabit Rutland Island but no evidence of predation by them on turtle eggs was found The relatively heavy nesting on the Twins is at least partly attributed to the absence of monitors there.

Data relating to the green and Ridley turtles are each from a single nest ; the hawksbill figures are average values from 4 clutches (Pl. II). The leatherback egg diameter is the average of 2 dry but intact eggs found on a Rutland beach This is the first definitive evidence of leatherbacks nesting in the Andamans.

The representative figures suggest trends to aid in distinguishing between eggs of the four species The overlap in egg size of the hawksbill and Ridley eggs prevent size alone being a criterion for distinguishing between eggs of the two species Clutch size may overlap between any two of the species and is therefore even less distinctive.

TABLE I. *Egg size of sea turtles from South Andaman*

Species	No. of eggs per clutch	Egg size, mm (Max. dimension obtainable)	Range in egg size, mm
Hawksbill	139 (range-96-177)	34 3 (avg. of 8 eggs)	33.0-37.8
Ridley	119	36 6 (avg. of 4 eggs)	36.2-36 9
Green	93	41.8 (avg. of 2 eggs)	41 4-42 1
Leatherback	?	50 (avg. of 2 dried eggs)	49-51 (dried eggs)

Sea turtle nesting also occurs on about 20 small, narrow debris-strewn coves on the rocky eastern coast of South Andaman island from Shoal Bay to Burmanalla, but the density of nesting is low, at least during the survey period. A *Lepidochelys* nest was found in late October on a narrow sandy cove 1½ km north of Madhuban. There was also a fresh Ridley nest site and two older nest sites about 2½ km north of Madhuban. One of these had been raided by humans The reported penalties for possession of turtle eggs (Rs. 5 per egg) and for the killing of turtles (Rs. 50) will serve as effective deterrents if the turtle protection laws are enforced rigidly.

Data on the egg size of the 4 species from South Andaman is given in Table 1

RECOMMENDATIONS

1 One of the authors (S Bhaskar) has made the first observation of leatherbacks nesting on the islands. *D coriacea* is a rare turtle and its nesting beaches such as those on Little Andaman and Rutland should be identified and strictly protected.

2. Adequate wildlife staff and strict enforcement of the Wildlife (Protection) Act of 1972 would go a long way toward ensuring the survival of sea turtles in the Andamans

3. Since turtles are an important protein resource mariculture possibilities should be investigated.

4. The fact that turtles are protected should be publicized in the islands