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SEA TURTLES OF SRI LANKAN WATERS

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Turtles are the most ancient surviving reptiles, their origin antedating the extinct dinosaurs and the still living Tuataras of New Zealand.

The Testudinate reptiles (i.e. turtles, tortoises and terrapins) were well established by about 185 to 200 million years ago in the Triassic period of the geologiclal record. They had acquired their present day form and aquatic modifications by the Cretaceous (90 million years ago) and the marine turtles of this period resembled today's species while being contemporary with the dinosaurs.

The marine turtles of today consist of seven species -

1. *Dermochelys coriacea* (Leathery, Leatherback or Trunkback turtle or Luthe);
2. *Chelonia mydas* (Green turtle);
3. *Chelonia depressa* (Flatback turtle);
4. *Caretta caretta* (Loggerhead turtle);
5. *Eretmochelys imbricata* (Hawksbill turtle);
6. *Lepidochelys kempi* (kemp's or Atlantic Ridley);
7. *Lepidochelys olivacea* (Pacific Ridley, Olive Ridley or Olive loggerhead).

Of these seven species, the nesting range of the Kemp's Ridley is restricted to the east coast of America from Massachusetts to Mexico. The nesting ranges of other six species include beaches in one or more countries bordering the Indian Ocean. These six species are, for instance, known to nest in Australia. The Leatherback turtle, Green turtle, Pacific Ridley, Loggerhead and Hawksbill are known to nest in Sri Lanka while the Flatback may visit our waters occasionally.

Nesting records of these turtles in Sri Lanka are mainly from the west and south of the island. This preponderance of records from the west and south is attributable to the high density of human habitation along this coast and the accessibility to wild life observers from Colombo. However, turtles (male and female) frequent a much greater extent of the coastal waters of the island including those of the north. Mating takes place in the sea close to the nesting site.

Turtles come ashore to lay their eggs. In the case of the turtles of the Indian Ocean this usually takes place at night and at high tide. Stormy weather does not appear to hinder egg-laying and may, in fact, help the survival of the eggs by disturbing the sand to the extent that predators would not observe evidence of nesting. This may also be related to the occurrence of a "mass nesting" or "arribada" of about one hundred Olive Ridleys which took place in December 1978 in Sri Lanka just before a cyclone. While mass nestings (of turtles of one species on one beach on one or at most a very few days) are known to take place in other countries, such as India, Mexico and French Guiana, this is not the case in Sri Lanka, as a rule.

Nesting takes place on the beach above the surf line and oviposition (egg-laying) takes place into a 16 inch deep egg chamber dug out by the female turtle at the end of a 15 inch deep hollow termed the "body pit". The average clutch size varies from 50 to over 200 eggs depending on the species and the average weight of each egg from 40 gm. to over 78 gm. The longest incubation period is that of the green turtle and is 6 to 12 weeks with an average of 8 weeks. The period of incubation is inversely dependent on the temperature. For the green turtle, incubation at 27^0C results in hatching in 80 days, while at 30^0C it takes 55 days and at 32^0C 48 days.

Another interesting observation is that the sex ratio of hatchlings of certain species is dependent on the temperature of incubation of the eggs. This dependency of sex on the temperature at which the egg is incubated is, of course, quite different from the situation found in animals, such as mammals, where sex is determined by the chromosomal make-up.

The hatching success may average around 85% in the wild and, while the hatchlings may take several days to work their way up to just below the surface, the final emergence is delayed until nightfall or a shower of rain. On emergence the hatchlings make their way as fast as possible to the ocean in order to escape from birds and other predators, such as certain species of crabs. Light cues appear to be a principal factor in guiding newborn hatc-

hlings to the ocean, although other factors may, also, have an influence.

Even once they reach the sea, hatchlings are still exposed to predators in the form of shark and other fish and birds, such as gulls and terns. In view of the numerous hazards encountered by hatchlings it has been estimated that every one to four adults represent the survivors of a thousand hatchlings.

Little or nothing is known of where hatchlings spend their first year (the "lost year") after leaving their nesting beach in Sri Lanka. During this time most are carnivorous and need to frequent localities where sufficient food is available relatively close to the surface. After leaving their nesting beach, hatchlings are next seen after they have reached 10 to 50 lbs. weight and are, possibly, one year of age.

Voyaging

Turtles are known to perform extensive sea voyages. Numerous tagging experiments have recorded voyages of over 1000 miles. One loggerhead was found to have travelled some 1650 miles in 91 days.

Some of these voyages are undertaken by turtles in order to travel from feeding grounds to nesting beaches. It is now known that turtles return to lay their eggs on the same beach as that on which they themselves originated. It is very unlikely that male and female turtles travel long distances to reach a particular beach relying on chance to bring them to the right place at the same time.

Various hypotheses have been proposed to account for how turtles navigate across the oceans. Some of these hypotheses draw on those proposed for direction - finding by other animals such as bees, migratory birds, and salmon. The direction-finding mechanism would need to operate together with a memory on which extensive data is imprinted. The hypotheses proposed for navigation by turtles include 1) odour and taste gradients, 2) echo sounding of the sea floor, 3) sensing of current flows, 4) sensing of magnetic variations, 5) sensing of the Coriolis force, 6) inertial guidance system and 7) celestial navigation and compass sense. Agreement has not been reached as to whether any one or several of these mechanisms or yet others assist turtles to navigate.

Influence of Man

That the mechanisms and habits which have evolved surrounding the breeding of turtles are highly successful is borne out by the fact that marine turtles have survived for over a hundred million years. It is amazing that *Archelon*, a marine turtle with an eleven foot carapace and which was present over ninety million years ago, closely resembled present day forms.

The advent of man and, more importantly, his activities in recent times have drastically changed this picture. Estimates of the international survival status of the various species of marine turtle are replete with classifications such as "heavily depleted", "limited geographic distribution", "actively threatened with extinction", "rare" and "critically endangered".

Many are the pressures from man on the survival of turtles. Eggs, turtle flesh and calipee (for soup) are taken for consumption, while the Hawksbill is killed for tortoiseshell (although its flesh is, sometimes, poisonous). Pollution of nesting beaches, such as by oil spills, can affect egg-laying (n.b. the Green turtle nests in South Yemen and its numbers may be reduced by the massive oil releases, which occurred during the recent Gulf War). Pollution of seas by junk such as polythene bags can, also, endanger turtles which swallow these in mistake for their normal prey of jelly fish.

Nesting beaches may, also, be utilised for housing construction, hotels, highways, industry etc. In addition to reducing the area available for nesting, and increasing the likelihood of egg predation by man, the lighting of coastal highways etc. may disorientate nesting turtles and hatchlings.

Another threat to turtles is that posed by fishermen's nets. In Sri Lanka fishermen generally fish coastal waters using gill nets at night. These may be nets of 200 to 800 metres used within 15 to 20 km. of the shore or those of 0.8 to 1.5 km. used within 30 to 45 km. The turtles, which are generally night swimming and night nesting in Sri Lanka, become (accidentally) entangled in these nets and are usually slaughtered.

Inadequate studies have been made on depradations of turtles in Sri Lanka. Estimates have suggested that 200 to 500 adult turtles may be slaughtered (both at nesting beaches and from gill nets) and 20,000 eggs plundered per year. This estimate would not include turtles and eggs lost due to natural causes, predators (other than man), pollution etc.

Turtle Conservation

Turtles and their eggs are protected by law in Sri Lanka. This legislation is adequately designed but is, unfortunately, inadequately implemented (as is the case in many countries where such legislation has been enacted).

A conservation effort has in recent years been developed to collect turtle eggs from nesting beaches, transfer them

emergence. Such an effort was first proposed by members of the Wildlife and Nature Protection Society in 1962 and the first hatchery commenced operations in 1970. Turtle conservation activities are also carried out by certain tourist hotels on the coast, in addition to the work of the Department of Wildlife conservation. Several turtle conservation activities have received financial support from the Victor Hasselblad Wildlife Trust (Sri Lanka).

Transferring turtle eggs to a hatchery provides protection during incubation from humans and other predators, such as wild pigs, jackals, dogs, mongooses, monitor lizards and, occasionally, even leopards. During their journey across the beach to the sea, protection is often needed from predators, such as crows, gulls, terns, herons and sea eagles. A turtle hatchery is an enclosed area in which eggs brought from the nesting beaches are re-buried. The egg nests may be discovered on the beach by the operators of the hatchery but the bulk of the eggs are purchased from residents of the area.

The percentage hatching rate in the wild is around 85%, but that in hatcheries is usually about 67% or less, probably due to the disturbance of the egg contents during handling. On emergence the young turtles are placed in a tank of sea water for a few hours until they are released to the ocean. The release involves placing the hatchlings on the beach and letting them make their own way across the sand to the water. This is believed to enable some characteristics of the beach to be imprinted on the hatchling's memory and enable it to recognise the beach when it returns as an adult for breeding purposes.

While these conservation efforts are commendable, it is estimated that the number of hatchlings released so far probably does not approach replacing the adults slaughtered and eggs plundered in the same period. This is particularly so in view of the estimate that only 1 to 4 hatchlings per thousand survive to adulthood. One obstacle to expanding the programmes has been inadequate finances, particularly for purchases of turtle eggs. However, some finances are being generated by charging an admission fee from visitors to the hatcheries. (The admission fee also carries the possibility of the visitor releasing hatchlings to the ocean and, thus, in a small way participating in the activity of the conservation project). These projects need to be expanded and the existing legislation implemented more effectively if a precipitous decline in turtle numbers is to be avoided.

Global Warming

Other factors do, of course, also place stresses on turtle populations. One factor, as mentioned above, is the pollution by flimsy polythene which may choke an adult turtle, while other pollutants may for instance affect prey populations on which turtles feed.

Another factor which may eventually affect turtle populations is the postulated "global warming", which may result as a consequence of the increase of atmospheric carbon dioxide concentrations. While this rise will be very gradual, it has been suggested that due to the eventual melting of the polar ice caps and expansion of the ocean waters, large tracts of low-lying land could go under water. Should this happen it is highly likely that many traditonal nesting beaches of marine turtles will also go under water, thus adding another obstacle to the continued survival of turtles.

Finally, it must, also, be noted that global warming may increase the temperature at which hatching occurs. This, as has been noted above, may alter the male to female ratio of the hatchlings, thus placing further constraints on their breeding.

It is now time that the littoral states of the Indian Ocean devised and implemented a programme for the conservation of marine turtles in the region. If not, we, the inhabitants of the Indian Ocean region, may be responsible for acts of extinction which did not occur over 100 million years.

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