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SUMMARY

A brief visit was made to 3 sea turtle hatcheries in Mangalore, Kundapur and Bhatkal between 20 and 24 March 1987. The only species of sea turtle known to nest is the Olive Ridley, *Lepidochelys olivacea*. No massed nesting ("Arribada") is known from the west coast of India, as it ~~does~~^{occurs} on the east coast of the country. In Karnataka, eggs have been collected as early as 13 June and as late as 4 April, showing that the nesting season is protracted. Comparable to the east coast, the season begins and ends earlier in the south. As is normal for the species throughout its range, the average number of eggs per nest is about 110, and hatching success varies from 20 to 94 %. Eggs and hatchlings are normal for the species, except that hatchlings show remarkably large amounts of white coloration on the plastron - a feature normally associated with the Green Turtle. This indicates that there may be a distinct population of Olive Ridley Turtles from Karnataka or the west coast.

There is great variation in the actual techniques employed in each hatchery, with differences in the: 1) record keeping efficiency, detail and reliability; 2) number of eggs handled; 3) relationship between the hatchery project and local inhabitants; and 4) priorities in nest protection and long term operation of the programme.

RECOMMENDATIONS

It is of the greatest importance that reliable records be kept, because management practices, policies and decisions will be distorted by false and inaccurate records. To facilitate general comparisons and state-wide policies and decisions, it is essential that there be standardization of records and procedures between various installations. This is not to underplay the necessity of modifications to meet with local constraints and conditions, but it is imperative that there be easy means of comparing and relating different parts of the same programme.

The ultimate goal is to enhance the turtle populations, and this objective should not be clouded by temporary goals such as "number of eggs purchased per year". By far the most effective - both financially and biologically - way to manage the turtle stocks is by providing adequate conditions to the animals for breeding and feeding. Because modern biology and wildlife management techniques cannot provide many critical details on how to manage turtles, it is best to provide support for the natural situation - such as in-situ protection of nests. With our present lack of basic information, manipulation should be kept to a minimum.

Another consideration which will directly effect the true success of any sea turtle conservation programme is that of time and stability of the programme. These are long-lived animals requiring a decade or more to reach maturity. The results of conservation practices will not become clear after a long term commitment. Short-term solutions will only serve as window-dressing. It is essential that the full support and participation of the local population be involved in the programme; official involvement should ultimately serve only for guidance.

INTRODUCTION

At the invitation of the Chief Wildlife Warden of the Karnataka Forest Department, an evaluation survey of the state sea turtle hatcheries was conducted. Three sites, one in each of the three southern coastal divisions, were visited between 20 and 24 March 1987 in collaboration with the local Forest Department official(s), and a preliminary analysis of each site is given in this report.

The survey was made possible by the kind assistance of Mr. M. K. Appayya, Chief Wildlife Warden; Mr. M. Reddy, D. F. O., Mangalore; Mr. Sahai, D. F. O., Kundapur; and Mr. Vasant G. Kulkarni, R. F. O., Bhatkal.

It was said that during the 1985-1986 season a total of nine hatcheries were being run by the Forest Department, but that during the present season (1986-1987) only three were in operation. However, there was some confusion among staff members as to how many hatcheries were in operation, so we only visited the three sites generally known to have hatcheries.

RESULTS

Bengare Sand Spit Hatchery

The first visit was made to Bengare Sand Spit Sea Turtle Hatchery, in Mangalore Division, Dakshin Kannad District, on the 20th of March 1987, accompanied by the Range Forest Officer who is directly in charge of the installation.

Coastal Habitat:

The coastal habitat at Bengare Sand Spit was characterized as a flat terrestrial platform. Nearly 100% of the supralittoral beach was planted with *Casuarina*. The littoral as well as the supralittoral areas were covered with silicacious sands (terrestrial) which were

brilliant white, but also there were frequent patches of black (ferrous ?) grains.

The most common native vegetation present in the gaps of Casuarina plantation was *Eimbristylis* spp., and *Ipomoea hilaba*. Along the beach crest zone, just at the edge of the vegetation, were commonly tracks of small predators (mongooses or cats ?), rodents, crabs and birds. There were vast mounds and layers of chitinous tubes on the beach platform, indicating that there is a massive population of some shallow water invertebrate (? worm) in the nearshore waters.

There are houses and boats on the beach in the ~~near~~ vicinity of the hatchery. This, coupled with the density of Casuarina planting, results in the nesting habitat being very reduced in area and of low nesting potential.

In the nearshore waters along the beach, as close as 100 m to the beach, were well over 100 motorized stern trawlers cutting back and forth across the shallow water. It is clear that the coastal zone in this area, from essentially the beach to several km offshore, is very heavily (over)fished.

Hatchery Installation:

A weathered sign along the access road announces the presence of the hatchery. In the midst of a young Casuarina plantation, about 2 m inland of the beach crest, is a wire cage about 6 x 6 x 2 m. Being of iron, it is rusting, and it has been painted recently with green paint, which is spattered on the sand inside the cage (thus contaminating the hatchery substrate). The base of the cage is not always in contact with - much less buried by - the sand, and crabs and possibly also other animals can slip in under the wire. Dogs were patrolling outside the cage during our visit.

There were twigs stuck into the sand at 13 places, suggesting the presence of 13 transplanted nests. We were informed that the Bengare

hatchery is responsible for the coastal area from Panabar (Port) to Ullal, a distance of some 10 km. The Forest Department pays 45 p per egg (while the market value is at least 50 p). It should be noted that legally there is a complete ban on digging up, selling or buying turtle eggs.

No species identification was made as no specimens were available, but given the fact that *Lepidochelys olivacea* is known to breed in Karnataka (see below), it is assumed that most (if not all) of the eggs from

this species.

A notebook kept by a local watchman, who was formerly a fisherman, contained the following information.

Date Eggs Collected (or Received)	No. of Eggs	Date "Hatched" [emerged]	No. Hatchlings Released	Incubation Time (days)	Hatch %
10 Nov 1986	75*	3 Jan 1987	70	54	93.3
29 Nov 1986	200*	23 Jan 1987	178	55	89.0
8 Dec 1986	200 **				
13 Dec 1986	225 **	6 Feb 1987	209	55	92.9
25 Dec 1986	300	18 Feb 1987	275	55	91.7
26 Dec 1986	225	19 Feb 1987	185	55	86.7
28 Dec 1986	112	22 Feb 1987	96	56	85.7
2 Feb 1987	275*				

* Eggs obtained from the beach; otherwise, it is not recorded if the eggs are from the market or beach.

** nest identification lost.

These data might be taken as evidence that:

1. clutch size varies from 75 to 300, averaging 201.5 eggs/nest.
2. incubation period varies from 54 to 56 days, averaging 55 days.
3. hatching success varies from 85.7 to 93.3 %, averaging 89.9 %

However, based on long term, rigorous studies of marine turtles in other areas, several points must be considered.

1. The average clutch size in *Lepidochelys olivacea* is about 110 eggs; 150 is unusual and 170 is rare; there is no reliable record of clutches of 200 (or more) eggs in this species.
2. "Incubation Period" also shows considerable variation in nature and may vary from 45 to 70 days, depending on climatic and other conditions.
3. Hatching percent - even in the best of conditions - is highly variable and may range from 0 to sometimes 100 %. When eggs are transplanted from natural nests to a hatchery, there is regularly a noticeable decrease in hatchability - often hatcheries with rigorously kept records show results of 50 % hatching. When eggs from markets or egg sellers are used, hatching percent drops even further because of repeated trauma to the fragile embryo.

In conclusion, the records from Bengare are incredible in indicating:

1. clutch size twice the average.
2. absence of natural variation in "incubation period".
3. absence of natural variation in hatching success, and hatching percentage that is twice as successful as in scientifically established hatcheries with the best possible conditions.

Interviews:

Interviews were carried out with the watchman and a local elder, Shri Banga Puttran, indicated below as "A)" and "B)", respectively.

A) "Krishna Aame" (Black Turtle)

- is dark in colour;

- best nesting area is from sand spit point northwards
for 2 to 3 km;

- nests most commonly during new moon, full moon and in conditions when there is a ring around the moon.

"Iswar Aame" (God Turtle)

- has 3 lines on the shell (like the 3-lined mark which devotees of Shiva put on their foreheads;
- has red, orange and black colours;
- is only caught in nets, does not come to the coast;
- can be found 30 miles from the coast.

B) "Krishna Aame"

- is large and red in colour;
- has a ridge on the shell;
- does not come to shore to nest;
- those who eat this turtle do not live.

"Kardalu Aame"

- is smaller and more convex than Krishna Aame;
- they lay 200 to 300 eggs per nest;
- when he was young (60 years ago) 10 to 15 turtles used to nest nightly in this area.

Both informants stated that dead turtles do not, except on rare occasions, appear on the beaches here.

If Kardalu Aame is the species which nests, then it is evidently *Lepidochelys olivacea*. It appears that Krishna Aame may also be used for this species, but the name also applies to another species which - from the brief descriptions given - might be *Caretta caretta* or *Demochelys coriacea*. The identity of Iswar Aame is unknown.

The intensity of trawling activity immediately in front of the fishing beach suggests that there must be incidental capture of sea turtles, and that the numbers caught must be sizeable. In other parts of India and the world there would be dozens, if not hundreds, of turtles on the beach during the nesting season. If this is not opening, it suggests that the trawlermen are finding some way to dispose with the turtles, perhaps by including them in their landings. This point needs to be investigated with great delicacy if reliable information is to be obtained.

Thrasi Hatchery

The second hatchery, at Thrasi Village, Marvanthe Range, Kundapur Taluk, Dakshin Kannad District, was visited on 23 March 1987 together with the RFO who is in charge of the work.

Coastal Habitat:

The beach immediately to the south of the hatchery shows an open supralittoral platform with scattered cover of *Eandanus* sp. and coarse epiphytic grass. The coastal highway is 10 to 50 m inland of the beach crest, essentially forming an inland boundary to the beach platform. The length of the natural beach is less than 1 km. (Shore), and along the shore to the north are (basaltic ?) rock outcrops. The Thrasi beach, having open spaces and vestiges of indigenous vegetation, provides excellent nesting potential.

Hatchery Installation:

The site in use was inland of the road, 30 m from the beach crest, on an area of sand and compact red lateritic soil which is within a *Acacia* plantation. A net covers the hatchery, which is 2 x 5 x 0.9 m. About 6 nest markers were inside the net. On the seaward side of the road are two wire mesh cages, each 10 x 6 x 2 m; they have been

painted with a black paint, some of which has fallen onto the sand. These cages were not in use.

The coastal area served by this hatchery was said to be 5 or 6 km to either side of it. Eggs are purchased from casual labourers at Rs 75 per batch, regardless of the number of eggs. In comparison, the market price is said to be 25 to 30 p per egg [that is Rs 33 for a nest of 110 eggs]; however, turtle eggs are said not to be sold as freely as they were formerly.

A nest inside the hatchery was said to have hatched out the 21st of March, and said to have contained 130 eggs and been laid on 29th January. On examination the nest was found to have the following:

- total depth of 38 cm;
- 38 unhatched eggs, 21 egg shells of hatched eggs, and 2 eggs with hatchlings of which one was dead and one alive;
- ten intact eggs were weighed and measured, yielding weights of 29.5 to 39.0 grams and diameters of 38.6 to 42.0 mm;
- of the unhatched eggs, 4 were "nearly fresh" with no signs of development, 28 had "red fungus" and no signs of development, and 6 had dead embryos in various stages of development, some of which had fungus.

Ten hatchling *Lepidochelys olivacea* were being kept in a basin of water in the hatchery. These were measured and observed. Two were found dead - the water temperature in the basin around midday was 35.2 C, which is likely to be related to the deaths. Weights varied from 17.5 to 20.5 grams and straight carapace lengths ranged from 42.7 to 45.4 mm. There was, as is usual in this species, tremendous variation in the scutes of the carapace. Most notable was the presence of large amounts of white in the plastron scutes; this is unknown in other populations of this turtle.

Egg collection records for each of the 3 seasons for which data were available are summarized below.

Season	Date		Total "Nests"	No. Eggs/"Nest"		Hatching %	
	First	Last		Minimum	Maximum	Minimum	Maximum
1984-85	18 Dec	10 Feb	6	83	122	20	94
1985-86	13 June	5 Feb	24	94	133	.	.
1986-87	22 July	30 Jan	59	60	159	.	.

These data were well organized in tabular form and the values show the degree of variation that is normal in clutch size, hatching success, etc. What is remarkable is that eggs are available from mid June until mid February, for a period of 8 months. This protracted nesting season is not known to occur with *L. olivacea* in India, although it does occur in Mexico and Costa Rica.

Two captive *L. olivacea* are kept in a cylindrical cement tank about 1 m in diameter. They are said to be fed 2 kg of squid, or fish, per day. According to the records, these animals are from eggs that were laid on 13 July and hatched on 17 September 1985. At the time of the visit their curved carapace lengths were 44.0 and 43.5 cm. The smaller of the two had an abscess on the plastron the likes of which has never been seen before by the writer: it was about 15 x 10 cm across and 3 cm deep. It was apparently exacerbated by the crowded conditions in the tank and the continual scraping of the venter on the cement.

Under normal captive-rearing conditions, as recorded in various studies both in India and elsewhere, it takes several years to reach the sizes seen in these animals, which were reported to be only 18 months old. The rearing conditions in Thrasi appear to be yielding a captive growth rate 2 or 3 times that found elsewhere. Alternatively, there may have been confusion in the date of hatching and the animals could be older than is thought. The matter warrants investigation.

Jali Hatchery

The final visit was made on 24 March to the Jali Hatchery at the village of the same name in Bhatkal Range, Honavar Division, Uttara Kannad District. The RFO, Mr. Vasant Kukarni, accompanied us; previously he had described the hatchery programme under his charge, which began in 1984. In order to encourage the coastal inhabitants to cooperate, the Forest Department staff popularized the situation with marine turtles and the need for conservation measures; they also informed fishermen that their reduced catches were related to the present reduced stock of sea turtles and that increasing the turtles would help their fish catches.

Over the four-year period the programme has gradually evolved to utilize *in situ* protection of turtle nests whenever possible, and transplantation to a hatchery is now only done when necessary to ensure the safety of the eggs. To achieve this, the full support of the public is encouraged, and a reward of Rs 50 is given for information about the location of recent nests. Hatchery personnel determine, after visiting the site, whether to set up a transportable metal enclosure or to transplant the eggs to the hatchery.

The ultimate goal of the programme, we were told, is to be selfmotivating and selfguiding, for Forest Department staff are continually being transferred so the only way to have stability is by encouraging full cooperation and participation of local residents. It was decided after unsuccessful attempts at keeping hatchlings for 6 months, or for a few weeks, that it is best to release the animals immediately into the sea.

Mr. Kukarni asked a number of important questions about sea turtle biology and conservation and exhibited considerable familiarity with the subject.

Coastal Habitat:

A gentle intertidal slope rises from what appears to be a vast area of shallow water with numerous rock outcrops and two vegetated islands each of several ha in area. The slope from the high water mark to the beach crest is about 15 m in width and rises at an angle of 10° to 15°. The high beach is vegetated with indigenous strand plants such as *Eragrostis* sp., *Ipomoea biloba* and a coarse halophytic grass. This zone is rarely more than 10 m wide, for a road and houses are 10 to 20 m from the beach crest. Nesting habitat is good, but reduced by the amount of human buildings and activities, as well as the many dogs present.

Hatchery Installation:

A wire cage 6 x 6 x 2 m is immediately in front of the hatchery manager's house. It is being painted with coal tar. There were 4 neatly numbered nest markers inside the hatchery, showing the locations of transplanted nests. Wire cages about 0.8 x 0.8 x 2 m were nearby and available for *in situ* protection of nests. Formerly lighter and cheaper transportable enclosures were used.

At the house of the hatchery manager were 5 plastic tubs with sea water and said to have 163 hatchlings from two nests that had hatched on 11 March and 24 March. Twenty hatchling *Lepidochelys olivacea* were observed for scale conditions (as the nests had been mixed the hatchlings were of unknown ages, so there was no use in measuring a sample). Usual to this species, there was great variation in the number of scales on the carapace as well as other body parts. Another 117 hatchlings were examined for coloration of the plastron, and one was found dead. As at Thrasi, there was a large amount of white on the scutes of the plastron; this appears to be characteristic of this species in Karnataka.

Records of egg collection are summarized below.

Season	Date		Total "Nests"	No. Eggs/"Nest"		Hatching %	
	First	Last		Minimum	Maximum	Minimum	Maximum
1984-85	[data not available]						
1985-86	18 Aug	4 April	44	120	175	.	.
1986-87	2 Aug	6 Feb	25	85	150	.	.

These data were well organized in tabular form and the values show the normal degree of variation in hatching percent. However, the number of eggs per nest shows an incredible regularity: 55 % of the 1985-86 "nests" were reported to have had exactly 130 eggs.

As with the hatchery at Thrasi, the nesting season is protracted, with eggs available from early August until early April, again a period of about 8 months. It is notable that the season in the north of the state is 2 months behind that 40 km to the south. A similar phenomenon occurs with the nesting of *Lepidochelys olivacea* on the eastern coast of India.

Additional Hatcheries

In addition to these three functional hatcheries it was learned that during the 1985-86 season there had been sea turtle hatcheries at Baindur, in Kundapur Division, Dakshin Kannad District. In Uttar Kannad District there had been hatcheries at Gangavali Beach, Hiregutti Range; Holangadde and Kade Beaches of Kumta Range; and Hadipur and Kasarkod Beaches of Honavar Range. No details^s of these^h activities were available.