

PROGRESS OF CROCODILE CONSERVATION IN TAMIL NADU

INTRODUCTION -

In the state of Tamil Nadu at present only the Indian Marsh or Muffer Crocodile (*Crocodilus palustris*) is found. The Estuarine or Salt water Crocodile (*Crocodilus porosus*) is reported to be extinct since the 1990's the last reported shot in the year 1938 near Tanjore (Forest Dept source). Even the muffer Crocodile is restricted to small isolated areas of the state. With the ban on export of Crocodile skins in the year 1958 by the Govt of India and the repealing of ^{issue of} contracts to kill crocodiles from reservoirs where commercial fishery operation ^{are in force} ~~is continuing~~ the muffer Crocodiles ^{population is stable} ~~were scarce~~. But the greater awareness for Crocodiles came only after the ~~ad. formulation~~ of 1972 Wildlife Protection Act of Govt which ^{listed all Indian} kept Crocodiles in the schedule I, ^{entering a ban on} ~~prohibiting~~ all kinds of trade with Crocodiles and ~~keeping~~ their parts.

~~By 1973~~ In the year 1973 the Madras Snake Park Trust, an organisation ^{promoting knowledge about} snakes and other reptiles was permitted to ^{keep 30 adults and 100 young} ~~keep a certain number of~~ Crocodiles for display ^{conservation purpose} and ~~display~~. In 1974 the M.S.P.T applied ^{and was allowed to collect} for a wild laid Crocodile egg collection permit and was allowed to collect with the condition that for artificial hatching with the condition that 25% of hatched Crocodiles should be released in suitable habitats. This was also allowed for the 1975 season. The M.S.P.T started their ^{Wild laid Crocodile} egg collection work from ~~the~~ ^{the} year 1973 and ~~collected~~ ~~and~~ hatched muffers successfully in their hatchery (Table I). ~~upto 1978~~

The author was also involved in collecting & hatching of wild laid crocodile eggs in Tamil Nadu in the nesting season of 1975.

With the initiation of the Tamil Nadu ^{conservation} Crocodile scheme with central Govt ~~assistance~~ and FAO/UNDP technical assistance the T.N. Forest Dept took over the whole operation from nesting season 1977 and carried out - the ~~work~~ wild laid ^{crocodile} egg collections, artificial hatching and rearing of the hatchlings at different rearing stations all over the state (Table II)

(*)

In 1976

CROCODILE CONSERVATION IN

INTRODUCTION

1976 ~~years~~ ^{years} TAMIL NADU ~~in 1976~~
Mugger egg collection for artificial hatching

The two species of crocodiles found in India, i.e. Salt water
Crocodile (*Crocodylus porosus*) and Mugger (*Crocodylus palustris*), and
~~the unique species Gharial (*G. gangeticus*)~~ were rapidly
declining in number. The unique north Indian species, Gharial
(*Gharialis gangeticus*) was on the verge of extinction. The
reason for this depletion was indiscriminate killing for
hides, ~~and~~ habitat destruction and use of ~~new~~ nylon
gill nets ('set-nets') in the fishing practice. ~~Consequently~~ ^{Consequently}
Govt of India legally banned ~~the~~ such killings with the
introduction of the Wildlife (Protection) Act, 1972. This Act
affords strict protection to all the three species and they
are enlisted in schedule I of the Act. ~~Export~~ Export of
crocodile skin and any part of crocodiles are also prohibited.

In Tamil Nadu except Cauvery most other rivers are
monsoon dependant - and are dry most part of the
year. The existing Mysur population (*Crocodylus palustris*)
of these rivers have adapted to the dammed reservoirs on these
rivers as a dry season habitat. During Feb to April (dry months)
these reservoirs also provide excellent - nesting (egg laying)
ground for these myssur.

~~1976~~

BACKGROUND OF CONSERVATION MEASURES:

Efforts are already in progress in many Indian states to conserve these crocodilian resources with proper management keeping the recommendations of FAO crocodile expert, ~~the~~ (published by FAO (1974)) as the guideline. The ^{accepted} modus operandi is collection of wild laid crocodile eggs, as soon as laid, for safe hatching incubation. Hatched young ones would ~~be~~ also be captive reared, eventually releasing ^{them} in selected protected habitats to form breeding groups. It is expected that these would show good recovery, as a consequence of the high fecundity of crocodilians and the long adult lifespan. Similar effort were also made in Tamil Nadu during Feb to May in the year 1976 and this paper is ~~about~~ ^{the result of} with that...

STATUS OF MUGGER IN TAMIL NADU

Tamil Nadu now has only the ^{Marsh or} Mugger crocodile (*C. palustris*). The coast-dwelling estuarine crocodile (*Crocodilus porosus*) is reported to be extinct in this state, which frequented ^(Smith) in the 1920's & 30's in the Carnap-Govorn estuaries. Like most other states of India the Mugger crocodile population was also fast declining in this state prior to the introduction and adoption of 1972 Wildlife Act. Fortunately the Madras Snake Park Trust had already surveyed the state of its crocodile resources and ~~the~~ in the course of the ^{two} ~~year~~ (1974/75) nesting season.

had ~~for~~ accumulated a fairly good knowledge of the habitats. ~~It~~

The Trust had the permission of the Tamil Nadu forest dept. to collect wild laid crocodile eggs for ~~from~~ 1974 & 1975 egg laying season. The agreement was that 25% of the resultant offspring would be returned back to the wild and the remainder would be retained ~~by~~ ~~as~~ ~~captive~~ by the trust to form a captive breeding stock.]

[Except Cauvery most other rivers of Tamil Nadu are monsoon dependant and dry most part of the year. The existing mugger population in some of these rivers like Ponnaiyar, Amaravati & Bhavani have adapted the dammed reservoirs on these rivers as a dry season habitat. During Feb to April (dry months) these reservoirs also provide excellent nesting (egg laying) ground for ~~the~~ ~~these~~ ~~muggers~~]

1. ~~1976 Egg Collection Programme~~ ~~mugger~~ ~~egg~~ ~~crocodile~~ ~~egg~~ ~~laying~~ ~~season~~
During 1976 ~~egg~~ ~~crocodile~~ ~~egg~~ ~~laying~~ ~~season~~ (TNFD)
from Feb to April, Tamil Nadu forest department made an unique arrangement with the Orissa ~~state~~ ^{state crocodile project} and Madras Snake Park trust (MSPT) for collection of eggs. It was unique in that TNFD in its joint ~~egg~~ ~~collection~~ ~~programme~~ of ~~2~~ ~~artificial~~ ~~hatching~~ ~~of~~ ~~mugger~~ ~~eggs~~ provided ~~for~~ their personnels in protecting the nests at site. MSPT personnels and a research student of Orissa carried out the collection work and MSPT provided the hatching facilities at Madras.

~~the hatching facilities at Madras~~

~~with the initiation of the programme~~

with the initiation of the programme the following major habitats of Tamil Nadu were selected for egg collection

1. Chidambaram (S. Arcot dist)
Vakaramani ~~water~~ Memicul water reservoir, Trichinopoly
2. Killikuda Tank near Grand Arcot (Trichinopoly Dt)
3. Amaravati Dam (Coimbatore Dt)
Amaravati river
4. Hosanakal falls on Cauvery river (Dharmapuri Dt)
5. Bhavani Sagar Dam, Bhavani & Moyar River (Coimbatore Dt)
6. Sathaman Dam on Pennaiyar river (N. Arcot Dt)

These areas hold the present remnants of the once ~~lost~~ strong Mysian population.

~~the~~ ~~habitat~~ ~~of~~ ~~the~~ ~~species~~

MUGGER NEST COLLECTION

Nest: Muggers (*C. palustris*) like Nile crocodile (*Crocodilus niloticus*) and ^{gharial} (*Gavialis gangeticus*) is a hole nester. The nests are dug dug out in the clayey and or damp mud bank of the habitat and eggs are laid in layers and covered again. Unlike Gharial which ~~lays~~ makes its nest in fine sand banks, muggers ~~lay~~ forego their nest in varied type of substrate. In some rocky areas the mother muggers dig or some trial nest hole before the final nest is made whether this is to test the suitability of nesting ground or to deceive the numerous nest predators is not certain.

Nest predators include jacksals, mangroves, monitors and even but man is the most deadly predators since he collects it before other carnivore predators could even find trace of it. ~~At Annavarath & Sathanur habitats in the previous years all the nests were robbed by tribal people.~~

Nests are about 40-50 cm in depth with a narrow mouth and a wide bottom (pitcher shaped in most cases). The top layer of eggs mostly remain about 15-20 cm below the surface.

~~Protection~~ Before the ~~whole~~ actual collection by tribal watchmen and ~~forest~~ appointed personnel of TNFD at the sites prevented the nests from being robbed, or foredated and or being disturbed by grazing cattle. In previous years (1975) it was reported by MSPT that all the nests in some of the sites were robbed by Pollayar tribals who relish the eggs. Appointment of the same tribals to protect the nests made it possible to collect a good number of nests.

Locating and detecting the insignificant-mound at the nest site is rather difficult. But ~~at~~ ^{near} most of the nest sites the spoor marks is easily traced observed and helps in the detection of the nest. A nest may be only a few meters from the water and in some cases a bit far (at Annavarath some nests were collected as far as 50 mts from water).

collection

After locating a nest it was collected in to the incubation box [★] with in 48hrs to a fortnight. The incubation box used here were 60 x 45 x 30 cm in dimension with holes on side walls for aeration made of 2.5 cm thick ~~wood~~ wooden planks. Eggs from each layer were marked on top with an indelible marking pen or pencil and placed in the box ~~marked side up~~ (already filled with a layer of moist ~~nest~~ earth) marked side up. The eggs were 3cm apart from each other. [Collection was carried out either early in the morning or late evening to avoid harsh temperature shock to the early embryos.] Eggs were placed layer wise and it was ensured that the top layer of eggs not remain at least 15 to 20 cm below. The box was filled totally and the lid was screwed tightly. Cracked eggs were either rejected or collected separately.

Incubation box: In established crocodile farms two ~~methods~~ ^{methods} of incubation are adopted for incubation of collected eggs. They are ~~Kaylike~~ ^{Kaylike} hatching box and simulated nest methods. In the first ~~former~~ method a Kaylike box of 3.5cm thick walls, with an internal dimension of 45 x 42 x 25cm and a ^{cut} trap door of 25 x 25 cm is to the top of the box is used. This box is used to hold up to 60 eggs. In the second simulated nest method the collected eggs are planted "with the original nest soil in slightly moistened sand and are located in the middle of a cubic meter of sand kept in place by side walls made of loose unplastered bricks. These sides allow passage of air causing an evaporation cooling effect. Each cubic meter unit can hold a clutch of eggs of a single nest."

Nest-temperature, ambient-temperature, etc were recorded to enable maintenance of like conditions in the ~~hatchery~~ incubation box & hatchery. From Amravati 10 nests from Sathanuv 5 nests from Killikundu one nest and from Chidambaram 3 nest- were collected. (Table I)

TRANSPORT Transport

Collected eggs ~~in~~ ~~the~~ incubation box were transported to the ~~hatchery~~ hatchery at Madras Snake Park Trust. Wherever possible the incubation boxes with eggs were transported by train to prevent the jerks bumps which can never be ruled out in a jeep. Wherever the transport was done by jeep ~~at~~ care was taken to minimise the jerks, shakes etc by cushioning the boxes and slow driving. This care was taken to minimise the risk of damaging the ~~nest~~ developing embryos. Depending on facility the collected eggs were transferred to the hatchery within 10 to 30 days of collection. (Table I).

Hatchery Incubation

~~HATCHERY~~ The hatchery ^{was} a rat and predator proof room of 3mt X 6mt- dimension with a removable roof to control sunlight and with good aeration facilities. The incubation boxes with eggs were kept apart from each other and were not removed from their original position during the whole period of incubation.

A constant temperature of $32^{\circ}\text{C} \pm 2^{\circ}\text{C}$ was maintained allowing sunlight- and sprinkling water

in the incubation boxes.

HATCHING:

After From 10th week of incubation the incubation boxes were checked by ~~light~~ tapping lightly. But it was only after the 13th week on 23rd May 76 grunts were feeble grunts were heard from nest no fine of Amarravati collection. This incubation box was ~~separated~~ removed from the hatching to another room. It is reported that the grunt of one box may initiate other premature embryos of other boxes to emerge. (in most cases)

In nature the mother crocodile, patrolling nearby the nest aids in nest opening and hatching the eggs but in the hatching the top layer of soil from the incubation box ~~was~~ removed and the hatchlings were allowed to emerge from the egg all by themselves. Only in case of weak hatchlings some aid was given. ~~Some nests~~ Ideally, all the eggs of a single clutch usually hatch on the same day but in our case some clutch took as long as one week to complete hatching from the first-day of hatching.

In our case the ~~first~~ ^{first-clutch} hatching started on 23rd May and the last clutch hatched on 18th June (Table).

RESULTS

Of the 16 clutches of eggs collected from Feb 15 to April 15, ~~11 nests hatched (Table)~~ from ~~the~~ Amravati, Sathianur, Killikunder and Chidambaram only 11 clutches hatched (Table I)

Amravati Collection: Only five out of 10 nests collected from here hatched. These five nests that hatched had a total of 162 eggs out of which 78 hatched i.e. a percentage of 48.15.

Sathianur Collection: From the five nests a total of 133 eggs 67 hatched i.e. a percentage of 50%.

Killikunder Collection: The single nest from Killikunder with 21 eggs resulted in 5 hatchlings (23%).

Chidambaram Collection: At Chidambaram 3 nests were located but one was collected which had 46 eggs. This resulted in 21 hatchlings. The other two nests were left at the nesting site (with undertime guards to protect them from predators) to hatch naturally. Thus from two clutches with 77 eggs, 44 hatchlings resulted i.e. 57%. The other, a small clutch of 18 eggs, did not hatch at all though a few dead

half developed embryos were found in the eggs when opened. This nest was barely covered by the mother and the death might be due to lethal temperature (Bustard 1971)

DISCUSSION: From the results it is ~~is~~ observed that ^{with the} ~~the~~ ^{57%} ~~good~~ hatching percentage was achieved with the natural nests at Chidambaram followed by Sathanur collected eggs and

Amaravati 48.15%.

Amaravati site ~~was~~ is the farthest site from the Madras hatchery and the transport of eggs involved ^{transport} ~~travel~~ by Jeep & train

Nest number ~~1, 2, 4, 8 & 10~~ 1, 2, 4, 8 & 10 did not hatch. The first three

nests i.e. 1, 2 & 4 were exposed to rough handling before collection and nest 8 & 10 in the incubation box overturned

during transit by Rail on 26 March. It is thus evident that transport of eggs over long distance affects the

hatching result. ^{and left to}

If the nest ^{can be} is protected well from predators ^{as} hatch at natural site was done in the case of Chidambaram nests or good availability of ^{other} protection

hatching percentage can be achieved but with ^{other} protection

of nest this is not advisable. Good hatching percentage was

also reported at Jaipur Zoo (Prakash 1971). There ~~is~~ the ^{eggs} laid were not removed from the natural nest.

Thus it is clear that undisturbed nest result is good hatching percentage.

Nests collected at an later date stage of embryos development (nest number 3 & 5 of Sathamur) shows a good hatching result.

Incubation period is also shorter in natural nests; about 9-10 weeks whereas in the artificial incubation methods it is about 12-13 weeks.

~~Since the basic purpose of collecting and artificially hatching of wild laid crocodile eggs is to eliminate the high mortality in nature because of predators etc. (which can only be achieved with good hatching percentage) is required to be achieved for a active management programme. The future of these rapidly depleting crocodile species depend on how fast their population is increased.~~

* Newsletter of the Madras Snake Park Trust Vol I No I May 1976
reports that a female a nest of 23 eggs gave a hatching result of 22 hatchlings (95.6%) and the hatching took place at the natural nest site.

The future of the rapidly depleting condition species depend on how fast their populations are increased, ~~and~~ once their populations are increased ~~and~~ active management programmes of which ~~many~~ ^{may start to be fully functional} cropping may be a key factor ^{in the sustained conservation of} ~~(thoughtful use of resources)~~ the species. ~~Thus~~ A good breeding percentage will

ensure a ~~good~~ rapid increase in population which is of utmost importance at this stage. This can be improved upon finding out the faults at this beginning ~~stage~~ ^{years} of possible conservation. ~~It is~~ therefore important to check & recheck the best methods ~~of~~ and evolve a ~~best~~ method to ensure a good breeding percentage which followed by a efficient ^{rearing/ husbandry} condition would guarantee a revival and utilization of these unique resources.

Acknowledgment -

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$$\begin{array}{r}
 77 \quad 44 - 7 \\
 \quad 628 \\
 \quad \underline{440} \\
 \quad 77 \quad 4 \\
 \quad \quad 572 \\
 100
 \end{array}$$

$$\begin{array}{r}
 77 \quad 440 \quad | \quad 57.0 \\
 \quad 385 \\
 \quad \underline{550} \\
 \quad 539 \\
 \quad \underline{110}
 \end{array}$$

TABLE I

Details of 1976 *C. palustris* egg collection and hatching in Tamil Nadu.

| Place from where nests collected | Serial Number of nests collected | Total number of clutch size eggs in the nest | Number of eggs collected | Date of Laying | Date of collection | Date of transfer to hatchery | Date of hatching | No. of incubation days | Total No. hatched | Percentage | Remarks |
|----------------------------------|----------------------------------|--|--------------------------|--------------------|--------------------|------------------------------|------------------|------------------------|-------------------|--------------|--|
| AMARAVATI | 1 | 30 | 30 | 29.2.76 Feb. 29 | 1.3.76 1 | 12 March | did not hatch | - | - | - | Badly handled during collection |
| | 2 | 30 | 30 | 24.2.76 Feb. 24 | 1.3.76 1 | 12 March | did not hatch | - | - | - | Badly handled during collection |
| | 3. | 29 | 29 | 1.3.76 Mar. 1 | 2.3.76 2 | 12 March | 31 May '76 | 291 | 22 | 75.86 | -- |
| | 4. | 30 | 30 | not known | 2.3.76 2 Mar. | 12 March | did not hatch | - | - | - | Badly handled during collection |
| | 5. | 34 | 34 | 16.2.76 Feb. 16 | 2.3.76 2 Mar. | 12 March | 23 May '76 | 97 | 11 | 32.35 | -- |
| | 6. | 35 | 35 | 3.3.76 Mar. 3 | 4.3.76 4 Mar. | 26 March | 31 May '76 | 88 | 17 | 48.57 | -- |
| | 7. | 33 | 33 | 3.3.76 Mar. 3 | 4.3.76 4 Mar. | 26 March | 31 May '76 | 88 | 20 | 60.60 | -- |
| | 8 | 33 | 33 | 3.3.76 Mar. 3 | 4.3.76 4 Mar. | 26 March | did not hatch | - | - | - | Incubation box turned over during transfer |
| | 9. | 31 | 31 | 3.3.76 Mar. 3 | 5.3.76 5 March | 26 March | 4 June '76 | 93 | 8 | 25.8 | -- |
| | 10. | 29 | 29 | 5.3.76 Mar. 5 | 7.3.76 7 March | 26 March | did not hatch | - | - | - | Incubation box turned over during transfer |
| SATHANUR | 1 | 33 | 33 | X | 19 Mar | 16 April | 9 June | X+81 | 8 | 24.2 | -- |
| | 2 | 35 | 35 | X | 19 March | 16 April | 26 May | X+67 | 20 | 57.1 | -- |
| | 3 | 17 | 17 | X | 27 Mar | 16 April | 18 June | X+86 | 13 | 76.4 | -- |
| | 4 | 24 | 24 | X | 30 Mar | 16 April | 9 June | X+71 | 10 | 41.6 | -- |
| | 5. | 30 | 24 | X | 15 April | 16 April | 26 May | X+42 | 16 | 53.3 60.8 | -- |
| KILLIKUDU | 1. | 21 | 21 | X | 9 April | 20 April | 10 June | X+62 | 5 | 23.8 | DDT Spikes on the incubation box |
| CHIDAMBARAM | 1 | 46 | 46 | Mar. 5 | 13 Mar | 13 Mar. | 20 May | 75 | 21 | 45.6 | -- |
| | 2 | 31 | - | Mar. 14 | -- | -- | 19 May | 63 | 23 | 74.1 | -- |
| | 3 | 18 | - | Mar 17 | -- | -- | 19 May | 57 | 4 | - | -- |

30x30
500
900

24 / 1000 / 81
98
40
24
16.

24 / 16
24 / 160
144
2 / 160
144
160