CROCODILE CONSERVATION IN INDIA - SUPPLEMENTARY ROLE OF ZOOS THROUGH CAPTIVE BREEDING

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Cautioned by Daniel (1969), Mishra (1969), Biswas (1970) and Krishnan (1971) on the declining status of the three species of Indian Crocodiles, they were listed in the schedule I of the Indian Wildlife (Protection) Act 1972. Intensive surveys by Whitaker (1973) and FAO (1974) determined the endangered status of gharial (Gavialis gangeticus), salt water crocodile (Crocodylus porosus) and depleted status of mugger (Crocodylus palustris). The survey also pointed out loss of habitat, killing of adult crocodiles, robbing of nests and high rate of mortality at egg and hatchling stage to be the major threat to the continued survival of Indian crocodilians.

The National Crocodile Conservation Project was launched in April 1975 with the objective of "reintroducing" the three Indian crocodilians in protected areas in their former distributional limits. Pilot project centres in Orissa (Tikarpada and Dangmal) and Uttar Pradesh (Kukrail and Katreniaghat) adopted the "head start" strategy of collecting wildlaid crocodile eggs for artificial hatching and rearing; thereby producing a surplus stock by

minimising natural nest predation and hatchling mortality. The surplus stock thus created were reintroduced in suitable protected areas of conservation values. The technique was named **"rear and release technique"** by the project. Assisted by the Government of India and technical advice from the FAO, eleven States and one Union Territory of India initiated similar programmes. Today there are 39 such crocodile rearing centres producing release size crocodiles (Fig 1). Over 6000 crocodilians have so far been released in to the protected areas and in many of these locations, they have been breeding successfully (Fig 2).

A. ROLE OF ZOOS IN THE CROCODILE PROJECT

While the crocodile rearing centres are "ex-situ" conservation sites with the objective of producing "reintroduction stock" mainly dependant on the collection of wild eggs, it was felt that zoos could supplement the project through captive breeding and in the long run takeover the role of major provider of release stock.

In 1976, the crocodile project made an inventory of crocodiles in captivity at various Indian Zoos. The mugger crocodile Crocodylus palustris was the species that most zoos had in their exhibit section. Jaipur, Ahmadabad, Baroda, Delhi zoos and the Madras Snake Park & Crocodile Bank were the only zoos breeding mugger in captivity. Several zoos had gharials either of one sex only or juveniles. The salt water crocodile in zoos was restricted to Nandankanan Biological Park, Madras Snake Park and Ahmadabad

zoos with individuals too small to breed.

The composition of stock in captivity was not the only problem for breeding. The very nature of having them with the only objective of an exhibit meant an inadequate enclosure with improper land to water ratio, lack of basking and nesting areas and improper diet not conducive for breeding.

The project identified Nandankanan Biological Park in Orissa as the location for pilot captive breeding project of crocodiles. Orissa is the only state where all the three species of Indian crocodiles occur naturally (The IUCN policy statement strongly recommends locations of captive breeding facilities within the species' natural distributional limits). Breeding enclosure for gharial, mugger and salt water crocodile were designed taking into account of the basic requirements of the species. Findings of field research by biologists of the project also helped in this - such as providing nesting materials for the salt water crocodiles, sand dunes for gharial, mini territories for hierchial victimised males and proper diet for breeding stock approximating the natural diet.

The project decided to use only the available captive stock of various zoos in the programme. It was considered against the ethics of conservation to capture any wild individuals from an already depleted population for the purpose of captive breeding.

B. ZOO CO-OPERATION IN CROCODILE BREEDING.

(i) Gharial

Many zoos co-operated in this project. The prestigious gharial captive breeding project is a perfect example of International Co-operation. Trivendrum zoo gave away their adult female gharial for the Nandankanan Biological Park project. The Frankfurt zoo loaned their adult male gharial in 1978. The adult male from Frankfurt was first housed in a make shift breeding pool here at the Hyderabad zoo but the female gharial at Hyderabad being sub-adults and unresponsive, was sent back to Nandankanan in 1979. In 1980, the first successful breeding of gharial took place in Nandankanan. Today, at least seven females are successfully breeding at Nandankanan. Other zoos holding sub-adult and juvenile gharials vastly improved their exhibit enclosures and converted them to breeding-cum-exhibit enclosures. Now gharial is breeding at Mysore, Bannerghata, Madras, Kukrail (Lucknow) and Tikerpada in Orissa (Table 1&2).

(ii) Salt water Crocodile

A major problem of breeding salt water crocodile in captivity was the lack of breeding size males. The Madras Crocodile Bank collected several individuals from the Ahmadabad zoo and Singapore zoo to form a breeding group and successfully bred them in 1982.

In 1979, a straying wild adult male salt water crocodile was captured at the Krishna river estuary in Andhra Pradesh which was

shifted to a specifically designed breeding enclosure at Vizag with females from Orissa and Andaman. These have now formed into an extremely successful breeding group.

Meanwhile, the salt water crocodile stock at various captive breeding centres were growing in size and reaching the age of sexual maturity. The simulated hatcheries of all captive rearing centres were using an incubation temperature regime of 32 $\pm$ 2°C which resulted in a lopsided sex ratio of too many females (In crocodiles and most reptiles, the incubation temperature determines the sex). With exchange of stock between centres, now the salt water crocodile is also breeding at the satellite captive breeding centres of state projects at Dangmal in Orissa, Bhagbatapur in West Bengal and Kukrail in Uttar Pradesh (Table).

(iii) Mugger

Well conceived breeding enclosures were designed for mugger at Madras Crocodile Bank, Nandankanan, Gandhinagar and most of the state crocodile rearing centres. This adaptive crocodilian, which starts breeding at an age of 6-7 years is now breeding in about 20 zoological parks and in almost all captive rearing centres (Table1&2)).

C. ZOO HELD STOCKS FOR PILOT REINTRODUCTION PROJECT

While captive rearing centres of State Crocodile Projects were busy in producing release size stocks and adult captive stocks of

zoological parks were being tried to form compatible breeding groups, the juvenile stocks in zoos were being considered for "pilot reintroduction project".

The first zoo held crocodiles to go into the wild were from this very Hyderabad zoo on February 7, 1977 to Ethipothalla Falls in Nagarjunasagar-Srisailam Sanctuary. This is also the first wild location in the country where reintroduced crocodiles bred in 1980, providing the much needed moral strength for future reintroduction by other state projects.

D. HOW DOES THIS HELP CONSERVATION ??

1. Captive breeding centres now produce more crocodile eggs in captivity for the "Headstart Programme", thereby delinking the expensive wild-laid egg collection.
2. Wild nests left in-situ in protected areas now gives field researchers an opportunity to study survival, movement, dispersal, predation, growth rate and many other ecological aspects never studied before because of the depleted status of Indian crocodiles in wild.
3. Reproductive behavior and biology, role of incubation temperature on sex determination, double-clutching, factors affecting growth rate, diseases, determination of parentage by DNA finger-printing and many other scientific studies have been initiated which was not possible prior to this tremendous success of captive

breeding. In short, success in captive breeding of Indian crocodiles has provided a living laboratory in captivity.

4. Media interest generated by this has helped create public awareness so much, that today, perhaps crocodiles are the most well known reptiles in India.

5. Today, India represents the IUCN/SSC crocodile specialist group with as many as 10 members even helping other nations in crocodile conservation.

A conservation project with clear out objectives and targets, adapting workable strategy coupled with field research has proved to be a success in its first phase. It now looks for a policy and guidelines to steer ahead to its second phase of considering the prospect of utilising crocodiles on a sustainable basis.

Table I. Zoological Parks in India

breeding crocodiles in captivity (1991)

Zoological Parks	Mugger	Saltwater Crocodile	Gharial
Jaipur Zoo	X	-	-
Baroda Zoo	X	-	-
Ahmedabad Zoo	X	-	-
Delhi Zoo	X	-	-
Madras Crododile Bank	X	X	X
Madras Snake Park	X	-	-
Nandankanan Biological Park	X	X	X
Nehru Zoo Park, Hyderabad	X	-	-
I.G.Zoological Park	X	X	-
Jodhpur Zoo	X	-	-
Bikaner Zoo	X	-	-
Junagadh Zoo	X	-	-
Lucknow Zoo	X	-	-
Kanpur Zoo	X	-	-
Mysore Zoo	X	-	X
Bannerghatta	X	-	X
Bandola (Goa)	X	-	-
Sholapur	X	-	-
Sundarvan (Gandhinagar)	X	-	-
Kurukshetra	X	-	-
Bombay (Boriville)	X	-	-

Table II. Crocodile Project satellite centres breeding crocodiles in captivity (1991)

Satellite Centres	Mugger	Gharial	Saltwater Crocodile
Tikerpada (Orissa)	X	X	-
Ramatirtha do	X	-	-
Dangamal do	-	-	X
Bhagabatpur (W.B)	-	-	X
Nagarjunasagar (A.P)	X	-	-
Amaravati (TN)	X	-	-
Sathnur do	X	-	-
Hoggenakal do	X	-	-
Tadoba (Maharashtra)	X	-	-
Kukrail (U.P)	X	X	X
Sasan (Gujrat)	X	-	-
Hazaribagh (Bihar)	X	-	-