From:
Dr. L. A. K. Singh
Govt. of India
Crocodile Research Centre of
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Camp: National Chambal Sanctuary
Post Box 11, Morena 476 001, M.P., India

Dt. 11 Jan. 1983

Dr. F. W. King
Chairman
IUCN/SSC, Crocodile Specialists Group
Director
Florida State Museum
University of Florida
Gainesville 32611
Florida
U.S.A.

Dear Dr. King,

I have just received a letter from Sudhakar (Dr. S. Kar) that Mr. Samar Singh had visited his place during the year-ending, and it was suggested by Mr. Singh to Sudhakar to contribute a paper on the status of Indian crocodilians with me for the CSG meeting at Venezuella.

Accordingly, the tentative title and authorship of the papers intended for presentation at the Meeting (please refer my letter, 26 Dec.) are thus:

Theme 1: Indian Status Report on Wild Crocodilians: L.A.K. Singh, S. Kar and B. C. Choudhury

Theme 2: Indian crocodilians: a review of management over ten years:-

L.A.K. Singh, S. Kar and B. C. Choudhury.

With kind regards.

Yours sincerely,

(Dr. L. A. K. Singh)

Copy: Mr. Samar Singh, Director, Wildlife Preservation, Govt. of India.
Dr. S. Kar
Mr. B. C. Choudhury.

The Saltwater Crocodile in India - Present Conservation efforts -

Introduction.

The Estuarine Crocodile was perhaps more endangered in India by 1975 than the Gharial. But looking at its wide distribution range this was not considered rare. This species is limited more than any other crocodilian; mainly to its habitat the mangroves. Rapid decline of its habitat - Combined with the hunting pressure, nest robbing has made this species one of the rarest Crocodile in India - the last remains of which are now found in the Mahanadi Coast of Orissa, the Sundarbans and the Andaman & Nicobar Islands. Conservationists in India particularly Krishnan ( ) and Daniel Lall pointed at this and proposed conservation practices. Following the inclusion of this species in the 1972 Wildlife (Protection) Act Schedule I list with total legal protection and the initiation of the crocodile project in 1975 conservation efforts began for this species.

Conservation Programmes:

The pilot conservation project for the S.W. Crocodile started in 1975 in Orissa by collecting and hatching of wild laid nests for captive rearing. In January 1976 the AP project started captive rearing of S.W. crocs that hatched from eggs collected from Andaman Island and repeated the same again in 1978.

Madras Banger started a project for S.W. crocodiles

Table I. Rearing centres for S.W. Crocodiles in India

	State	Rearing Station	Year of initiation	Present stock No. held	Remarks
1.	Orissa	Dangmal	1975	500	Over 100 released to the wild
2.	West Bengal	Bhagbatpur	1977	150	over 50 released to the wild
3	Andhra Pradesh	Hyderabad	1977	15	6 released in to wild
4	Andaman & Nicobar Islands	Port-Blair	1979	50	

Table II Restocking in the wild S.W Crocodiles in India.

State	Release year	Release place	Number released
Orissa	1978/79	Bhitarkanika	150
W.B	1978	Sunderbans	50
Andhra Pradesh	1978	Coringa	4

Captive Breeding Attempts

1. Madras Crocodile Bank.
2. Nandankanan Biological Park.
3. Bhagatpur Crocodile Complex.
4. Port Blair Zoo.

Sanctuaries State	Sanctuary	Remarks
1. Orissa	Bhitarkanika W.L	176 sq km. Mangroves of Brahmini & Baitarani
2. W. Bengal	Sundarbans	Tiger Project area
3. Andhra Pradesh	Coringa	10,000 ha Mangroves of Godavari delta.

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ndia)

OPERATION
Saltwater Crocodile

Sudhakar Kar

Research Scholar, Saltwater Crocodile
Project Dangmal

Crocodile resources have shown a catastrophic decline worldwide in the postwar period, largely as a result of sophisticated hunting methods combined with large scale demand for hides by the luxury leather industry. The saltwater crocodiles have become critically reduced in numbers as a result of overhunting for its skin which makes a leather unsurpassed among the world's twenty-two species.

One of the two suitable habitats of Saltwater Crocodile (*Crocodylus porosus*) of India is in an area of tidal mangroves in Cuttack district, Orissa, called Bhitar Kanika. To save these rare reptiles, the Forest Dept. of Government of Orissa declared the entire habitat of the Saltwater Crocodile as a sanctuary on 22nd April 1975 called **Bhitar Kanika Saltwater Crocodile Sanctuary**. It includes 26 forest blocks and covers an area of about 171 6 sq. km. The Saltwater Crocodile is tied to this saline mangrove forest which provides its entire habitat—shelter for adults and young, food supply and resting sites.

Distribution of Saltwater Crocodiles

This broad snouted crocodile growing to over 8 metres in length, formerly ranged eastward through Asia as far as South China (where it is now extinct) and southwards through Malaysia, Indonesia, the Philippines to New Guinea, the Pacific Islands and North Australia. Through out most of this range the Saltwater Crocodile has become either extremely rare, its future survival endangered, or on the verge of extinction or extinct (East Asia). In the Indian subcontinent, it is restricted to Kerala, Orissa and West Bengal. But no reliable information about their occurence in Kerala is available and in Sunderban there are a few. Only two sanctuaries have been set aside for the species, the first in Western Australia and the second, the Bhitar Kanika Sanctuary. This is probably the last area where it still survives in reasonable, even if much reduced numbers.

Saltwater Crocodiles In The Wild

The complex ecosystem of Bhitar Kanika Sanctuary is especially suitable for the survival of Saltwater Crocodiles. In the past, people could see 30 to 40 crocodiles and if a shooting party went round, they could come back with 10-15 crocodiles, mostly juveniles. It has been reported (non official) that world's largest Saltwater Crocodile 7.55 m was killed by the Maharaja of Kanika, in Bhitar Kanika in the year 1926-27. Now Bhitar Kanika is the only Salt-waterCrocodile sanctuary in the country where there are a number of old males over 6.4 m in size and 5 to5.5 m long crocodiles are frequently seen in the river.

The Saltwater Crocodile Research and Conservation Project is now in full swing in the Bhitar Kanika Sanctuary. This Project is close to the Forest Rest House in Dangamal village. It was established in the year 1975 by the State Forest Department and the Government of India is financing all the non-recurring expenditures. Technical assistance is also being provided by the UNDP/FAO expert posted here.

Under the Scheme, detailed surveys of crocodiles, egg collection, artificial hatching, rearing of young ones in captivity release of the crocodile in the wild and other behavioural aspects have been undertaken.

Salt-water Crocodile eggs are collected in June-July from dffierent forest blocks of the Bhitar Kanika Sanctuary by the Research Scholar and staff. The female crocodile preparces a mound nest in a most secure place of the forest. She guards her nest, after laying her eggs, against predators. An average of 40-50 eggs are collected from each nest.

Eggs are brought to the project hatchery and kept for incubation in an artificially prepared mound nest. Temperature of the nests is recorded daily up till the end of hatching at regular intervals of time. Sunshine and rain is allowed if required to maintain the temperature. After 70-75 days the eggs start hatching. Hatchlings emit a croaking sound from inside the eggs. The nest is opened and within a day or two all hatchlings come out from the nest.

The hatchlings, after one day of post-hatching care are transferred to hatching pools which are specially designed to accommodate them. They are fed with small live fishes and prawns, supplied by the children of the local villages. Growth of the hatchling depends upon the food, temperature, care and hygienic condition of the pools and surroundings. Now there are twenty hatchling pools which can accommodate up to 200 hatchlings.

After one year the hatchlings become approximately one metre in length. Then they are transferred from hatchling pools to yearling pools which are bigger and deeper in size. Size of the fishes supplied is increased according to the size of the crocodiles. All round the pools, there are resting basking areas where the Crocodiles spend hours together for resting/basking at their own will. The surrounding was planted with large leaved plants, specifically mangrove species, to overhang the pool and provide additional cover. In winter the growth of the crocodiles is very slow. Maximum precautions are being taken to save the crocodiles from excess cold by providing winter cover around and above the pools.

Release In the Wild

As per the advice of Dr. H R. Bustard, .FA.O. expert on crocodiles, 95 crocodiles of approximately one metre length were released in the wild, both in the year 1977 and 1978, to build up the depeleted condition in the wild. The release of saltwater crocodiles in the wild is the first of its kind in Asia. Behaviour of the released crocodiles is regularly being studied by the Research Scholar attached to the Project. They are seen better adjusted in the estuarine habitat.

Present Position

Now 81 yearlings, 109 two year old, 5 three year old and 5 four year old crocodiles are being reared in captivity. Maximum length attained by a 4 year old crocodile of 1975 batch is 6'. Also of interest is the presence of one albino form (Sankuhua) which is very rare in the world. According to the F A O. xpert, there are only two albino crocodiles found all over the world, one of which is in our pools and the other is with the King of Thailand.

Future Prospects of the Project

The salient feature of the Saltwater Crocodile Project in Bhitar Kanika is not only to ensure conservation of the species but also to take up farming to build up an Export Industry with a potential for foreign exchange earning. In the future it will attract both foreign and inland tourists for photography in the natural habitat. This will also earn foreign exchange for the country

Finally, the project, besides educating the people about the usefulness of the species in improving their economy, will benefit the unemployed weaker sections in securing jobs.



The International Symposium on Tiger held by the Government of India, in New Delhi from February 22-24, 1979, signals an important land mark in the field of wildlife conservation

The PROJECT TIGER is a unique project in more senses than one It is a project not only to save an endangered species but to save the entire complex of biotic communities on whose apex the tiger stands. It is not only one of the biggest single conservation projects in the world, but also a typically Indian project manned wholly by Indian experts, though International Organizations like the World Wildlife Fund (WWF) and the International Union for Conservation of Nature & Natural Resources (IUCN) have co-sponsored it and provided financial support in the form of materials and equipm nt.

The Project Tiger has already been in operation for over 5 years now, and it was in the fitness of things that the Government of India should have hosted an International Symposium on the Tiger and invited all those countries where tiger exists, to participate, and share mutual experience. The Symposium was well attended In addition to about 200 Indian delegates, participants and observers, delegates from foreign countries like Bangla Desh, China, Indonesia, Nepal and Thailand and international organizations like WWF, IUCN UNEP and Smithsonian Institute attended the Symposium.

The Symposium was preceded by a beautifully illustrated talk on the Tiger by Shri Kailash Sankhala, the founder Director of the Project, on 20th February 1979, where he traced the history of the tiger from the time of Mohen-jo-daro and Harrapa, its place in art and mythology, and brought us to its present distribution in different Tiger Reserves in the country, illustrating both the beauty of the tiger and the variety of the habitats which the tiger inhabits.

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CRC/NCS/22
November, 1984
Revised: April, 1985

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Report on study tour to the 7th Working Meeting:
IUCN/Species Survival Commission
CROCODILE SPECIALISTS GROUP
held in Caracas, Venezuela (South America).

October 21-28, 1984

Indian delegation:

L. A. K. Singh
B. C. Choudhury
S. Kar

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Cover pic.: emblem of the COCODRILOS RACQUET PARK, Caracas, Venezuela.
Message: popularity of crocodiles from sport-hunters through sports-men.

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VI. INDIAN REPORTS

1. INDIA: STATUS OF WILD CROCODILIANS

L. A. K. Singh[1], S. Kar[2] and B.C. Choudhury[3]

INTRODUCTION

At the first Working Meeting of the Crocodile Specialists Group in 1971 the following were the status given to the Indian crocodilians (Honegger, 1971).

1. Gharial (Gavialis gangeticus): "Extremely rare" (based on Seshadri, 1969).
2. Saltwater crocodile (Crocodylus porosus): No mention, apparently thought to be fairly safe.
3. Mugger (Crocodylus palustris): "Exterminated in most areas of its range" (Daniel, 1970). Extremely rare (Seshadri, 1969).

By the fifth meeting in 1980 reports on the status were more clear and approximate number of crocodilians in the wild were known in most cases (Whitaker, 1982). The IUCN Red Data Book (1982 a) stated the status of Indian crocodilians as follows:

1. G. gangeticus: Endangered, extremely depleted.
2. C. porosus: Endangered, now seriously depleted and rare or extinct in most of its former ranges in India.
3. C. palustris: Vulnerable, now heavily depleted throughout the range.

At the last Working Meeting in 1982, the situations were accepted to be as before. The present paper provides updated information on the three species as regards their status before any release/rehabilitation took place through the Government's conservation management programme. Also given are the accepted population figures and the present locations of breeding populations.

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2 Government of Orissa, Crocodile Project, Camp: Chandabali, Balasore, Orissa.

3 Government of India, Crocodile Research Centre of Wildlife Institute of India, Bahadurpura, Hyderabad-500264, Andhra Pradesh.

GAVIALIS GANGETICUS (GMELIN)

I. LEGAL STATUS:

INDIA:

1. Wildlife (Protection Act, 1972): Schedule I (Total Protection).
2. Export I instruction No.46/73: Export of animals and their products prohibited.

INTERNATIONAL:

1. CITES: Appendix I (India is a party)
2. IUCN Red Data Book: Endangered

II. PRE-RELEASE POPULATIONS:

River	State	Adult	Juvenile	Total	Source
1. Brahmaputra (1982)	Arunachal Assam, Nagaland	?	?	50	Mohanta, H., 1981; Choudhury, 1983.
2. Chambal (1977)	Rajasthan, M.P. U.P.	40	81	121	FAO, 1974; Anon. 1976; Whitaker and Daniel, 1980; Singh, V.B., 1978; IUCN, 1982b, Whitaker and Basu, 1983.
3. Girwa (1977)	Uttar Pradesh	9	19	28	Ramanand and Johri, 1982.
4. Ken (1980)	Madhya Pradesh	1	0	1	Anon., 1976, Singh, 1980.
5. Mahanadi (1976)	Orissa	4	4	8	Bustard and Singh, 1982.
6. Ramganga (1976)	Uttar Pradesh	0	4	4	Anon, 1975(?).
7. Son (1984)	Madhya Pradesh	18	0	18	Pandey, 1984

Total population: 230 including 72+ adults.

Although the above figures are improvements over Bustard, 1982 (60-70 nos.) and Whitaker, 1982 (less than 50 adults), the overall status remains the same, "endangered".

III. BREEDING POPULATIONS (1984)

1. River Chambal: (Places vs. average number of nests as of 1982-84)
Baroli- 7, Bharrah- 7, Tigri-Rithaura-2, Pureini- 10, Gyanpura- 2.
Total- 28

2. River Girwa:
Within a stretch of about 12km up to six nests.

3. River Mahanadi:
Last successful breeding: 1974; recommenced: 1984; number of nests: one with 24 eggs at Majhipada.

4. Brahmaputra:
Reports of breeding in the following tributaries are available but the exact status is unknown.
Arunachal Pradesh- Subansiri river; Assam- Dikho river and Dhansari river; Nagaland- rivers Doyong, Dikho and Disang.

5. Ramganga:
Uncertain.

IV. TOTAL POPULATION (1984)

River	Natural			Released	Grand* Total	Population trend
	Adult	Other	Total			
Brahmaputra	?	?	50	0	50	Unknown
Chambal	53	192	245	912	1157	Increasing
Girwa	9	19	28	85	113	Increasing
Ken	1	—	1	3	4	Stable
Mahanadi	6	2	8	150	158	Increasing
Ramganga	4	-	4	12	16	Unknown
Son	18	-	18	2	20	Stable (no male)
TOTAL	141	213	354	1164	1518**	Increasing

*Without considering losses among released gharial

**and captive population about one thousand

TOTAL POPULATION IN THE COUNTRY: 2518.

CROCODYLUS POROSUS SCHNEIDER

I LEGAL STATUS:

INDIA: As for Gharial

INTERNATIONAL: As for Gharial

II.PRE-RELEASE POPULATIONS:

Location	State	Adult	Juvenile	Total	Source
1. Bhitarkanika (1977)	Orissa	34	64	95	Kar and Bustard, 1982
2. Sundarbans (1978)	W.Bengal	4	96	100	Mail, Madras (27 Jan. 1978)
3. Andaman and Nicobar			up to		Whitaker and Whitaker,
North A.		50	150	100-200	1978
Middle A.		20	80	50-100	
South A.		10	20	20-30	
Nicobar		—	—	20-25	(Bhaskara, 1981)

Total population: up to 550 including 125 adults

III. BREEDING POPULATIONS (1984)

1. Bhitarkanika:

Over an area of 176 sqkm. up to eight nests.

2. Sunderbans:

A total of two nests every year.

3. Andamans:

Most of the nests are predated in the wild (Choudhury and Bustard, 1980). Exact extents of reproductive effort uncertain.

4. Goa:

Existence of viable population reported. Exact position unknown.

IV. TOTAL POPULATION (1984)

Location	Natural			Released	Grand* Total	Population Trend
	Adult	Other	Total			
Bhitarkanika	38	130	168	350	518	Increasing
Sunderbans	4	96	100	65	165	Increasing
Andamans	80	up to 250	upto 330	0	330	Unknown
Goa	?	?	?	0	?	Unknown
TOTAL	118+	480+	598+	415	1013+ **	Increasing

*Without considering losses among released crocodiles.

**and captive population about 700. TOTAL POPULATION IN THE COUNTRY: 1713+

CROCODYLUS PALUSTRIS LESSON

I. LEGAL STATUS:

INDIA: As for Gharial

INTERNATIONAL: 1. CITES: Appendix I

2. IUCN Red Data Book: Vulnerable

II. PRE-RELEASE POPULATIONS:

Excepting the northern states of Jammu and Kashmir, Himachal Pradesh and Sikkim, mugger are reported to have occurred in all the other states during early 1970. Although no detailed census were conducted an accepted approximate population figure was around 1000 with a population trend "depleting faster than it could reproduce" (FAO, 1974). Based on the number of wild mugger some of the good states were in the order of Tamilnadu, Gujarat, Rajasthan, Andhra Pradesh, Karnataka and Maharashtra.

III. MAIN BREEDING POPULATIONS (1984)

Tamilnadu:	Amaravati, Sathanur, Hogennakal, Chidambaram, Killikudu, Mettur, Mundanthurai. Total approx. 50 nests.
Gujarat:	Hiran and other lakes (Gir). Total approx. 12 nests.
Andhra Pradesh	Ethipothala/Nagarjunasagar-Srisailam (Krishna), Kinnersani, Lanjamadugu, Manjira, Sileru. Total approx. 12 nests.
Karnataka:	Cauvery river at Ranganthitu-Sri Rangapatan, Tungabhadra and Bhima rivers. Total approx. 4 nests.
Maharastra:	Tadoba National Park, Powai Lake (Bombay). Total up to six nests.
Bihar:	Bher river (Mutta), Kaimur Sanctuary, Damodar Valley. Total up to 6 nests.
Rajasthan:	Ranthambhore, Pushkar Lake. Total up to 8 nests.
Madhya Pradesh:	Rangawa Dam (Panna), Bandhavgarh. Total up to 5 nests.
Uttar Pradesh:	Corbett, Dudhwa, Girwa (Katerniyaghat) Total up to 6 nests.
Chambal river:	(Madhya Pradesh/Rajasthan/Uttar Pradesh). Up to 12 nests.
Haryana:	Kurukshetra.
Kerala:	Neyaar, Perambiculum. Up to 3 nests.
Orissa:	Koraput (Balimela Dam Project), Ganjam (Bhanjanagar).

III. MAIN BREEDING POPULATIONS (1984) contd.....

North-east rivers: (Arunachal Pradesh, Assam, Nagaland and West Bengal) Occurrence reported but exact locations of breeding population not available.

IV. TOTAL POPULATION (1984)

Natural: Appwox. 1000 all sizes.

Released: 600 (all from wild-collected eggs)

Captive: From wild-collected eggs- 3000

By captive breeding- 2500

Total: 7100

Trend: Increasing. (Extensive captive breeding in at least twelve centres).

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2. INDIAN CROCODILIANS : A 10-YEAR REVIEW OF MANAGEMENT

L.A.K. Singh[1], S. Kar[2] & B.C. Choudhury[3]

I. INTRODUCTION

Indian crocodilians (Gavialis gangeticus, Crocodylus porosus and Crocodylus palustris) are known to have close association with the Indian culture as religious symbols and use in indigenous medicines. Crocodilians were also used as exhibits and even maintained as imperial executioners. Hunting of crocodilians as a sport was popular only among a few Indian sport-hunters and although sporadic commercial hunting for the luxury leather trade did occur such killings are considered as only one among the various other more serious causes that were responsible for the depletion of the populations during the post-independence era. Among the major causes were the introduction of nylon gill netting and the prejudice against crocodilians as the enemy of fisheries. Other causes were the construction of dams and barrages and increased number of human habitation near crocodilian habitats with better net-work of approach roads. These developments are reflected in a shrinkage or total loss of crocodilian habitats.

After the establishment of the Indian Board for Wildlife in 1952 efforts by some individual Forest Officers and naturalists are known to have been made for the 'protection' of crocodilian populations in areas under their jurisdiction. A proposal was under consideration during 1971 to start commercial farming of crocodiles but by 1974 it had been realised that Indian Crocodilian resources were so depleted that they were not in a position to support the commercial exploitation. This was the period when U.N.D.P./F.A.O. collaborations in the form of technical expertise, soon followed with financial assistance, was made available to the Government of India to commence and promote the crocodile breeding and management programme in different states.

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[1]Government of India, Crocodile Research Centre of Wildlife Institute of India, Camp: National Chambal Sanctuary, Post Box 11, Morena-476 001.

[2]Government of Orissa, Crocodile Project, Camp: Chandbali, Balasore, Orissa.

[3]Government of India, Crocodile Research Centre of Wildlife Institute of India, Bahadurpura, Hyderabad-500 264, Andhra Pradesh.

II. MANAGEMENT GOALS (1974-75) AND ACHIEVEMENTS

1. Protection to remaining natural population:

Objective: Location of all the best crocodilian areas and creation of a few special crocodile sanctuaries for habitat and species management.

All important habitats for the different species have been identified and if these were not already within a Sanctuary or National Park, were formally declared as Crocodilian Sanctuaries. Some of these protected areas have been identified for introduction or reintroduction. Two such sanctuaries are in Andhra Pradesh, one for the saltwater crocodile (Coringa sanctuary: reintroduction) and the other for the gharial (Papikonda: probably reintroduction since the species is now known to have occurred in the Godavari (Bustard and Choudhury, 1982). The number of areas in which active protection is given to Crocodilians is 34 (20399 sq. km) and the number of specially created Crocodilian Sanctuaries is 13 (8346 sq. km. +) (Table fig. 1).

Although no special law or regulations were enacted since 1974, implementation of the existing regulations was vigorous. The best example of the present state of protection and management of sanctuares is the resumption of breeding by the wild population of the gharial after a lapse of ten years, (Satkoshia Gorge Sanctuary, 1984). Regeneration of mangroves, especially seen in the Bhitarkanika Sanctuary, is yet another example of rehabilitation through protection.

2. Rebuild natural populations.

Objective: To reduce natural losses through 'management'. The technique adopted was 'grow and release'. This involves collection of wild-laid eggs, incubation of eggs in hatcheries, rearing of the emg crocodilians upto a 'releaseable' size (over a metre length), and release

of the juveniles in sanctuaries or other protected viable habitats.

The total number of eggs handled so far is, Gharial: c.6000; Mugger: c. 9000; Saltwater crocodile: 2500.
The total number of hatchlings handled is, Gharial: c. 4000; Mugger: c. 6000; Saltwater crocodiles: c. 1700 and the total number released is Gharial: 1164; Mugger: c. 600; saltwater crocodile: 415. The released Gharial are expected to commence breeding in 1985/86. Mugger breeding commenced with the population in Ethipothala in 1981 and Saltwater crocodiles are expected to commence breeding in 1985/86.

The post release monitor has been satisfactory. Recently, radio-tracking was used to monitor the movement and habiiat preference in sample populations including the released juveniles. Based on these studies species-wise recommendations have been made on restocking sites and seasons and to extend the limits of the sanctuaries into certain tributaties that are used during monsoon. While Gharial and Mugger have responded fairly well without causing any public concern stray incidents have come to the notice where C. porosus juveniles have entered village ponds. In response to complaints prompt action has been taken to shift such juveniles either back to captivity or th a different point for release.

Studies are in progress in selected sanctuaries to determine the average survival among released crocodilians. The indications have been very clear that the habitats have accepted the released juveniles and there are increasing trends in the populations. It is, however, felt particularly in the case of gharial that in the near future, as the recruitment into the adult group steadily increases, new areas may have to be developed to attract sub-adults to settle to form breeding groups. Studies are under progress to identify such potential areas and the extent of management requirements.

The public reaction has been indifferent to release. Several local people have been provided employment under the schemes as boatman, crocodile/sanctuary guards, husbandry attendants, fish-suppliers and other general help for the upkeep of the centres and camps in the sanctuaries. The sanctuaries have attracted visitors from which the local people have definitely experienced an economic uplift (Singh 1980).

3. Promotion of captive breeding

Objective: To breed under simulated natural surroundings the available adults in certain zoos and similar organisation. Mugger have responded the best to captive breeding attempts (Table 2, fig.2) Atleast 15 centres are regularly breeding the species and eight others are being set up.

Gharial being a very specialised species in its breeding habitat requirements, has set a record by breeding in the Nandankanan Biological Park, Orissa since 1980. A special breeding pool holding 2.7 million litres of water has been used for breeding. The maximum depth of the pool is 10 metres.

Saltwater crocodile have bred in captivity at the Bhagabatpur centre and the Madras Crocodile Bank (a non-Government Trust (1'

4. Research

Objective: To take up studies that will improve the ongoing management programme.

The aspects that were immediately relevant to the grow and release techniques and the management of the Sanctuaries were given priority. This has overlooked several bio-chemical or embryological studies which may involve or require to sacrifice eggs or young or both. Some of the important aspects that were studied are:

-interpretations of the various types of data collected during survey and census.

-determination of parameters for maximum hatching success; (This had overlooked the role of temperature on sex differentiation, an aspect that is now being studied).

- husbandry of young crocodilians including feeding prescription, food conversion and growth.

- behavioural biology including reproduction, thermoregulation, feeding, orientation, locomotion, and reproduction; and

- habitat features and population structures.

5. Build up levels of trained personnel

Objective: On the spot research/training guided through FAO expertise in collaboration with local Universities. On the spot infra-level training to persons like 'keepers'. Institutional training to in-service Government personnel who will manage sanctuaries and rearing/breeding projects. Six Ph.Ds. 46 Foresters and over 200 other personnel have trained. A few researchers/Managers have also been sent on overseas study tours and fellowships to gather on-the-spot know-how on the research and management techniques.

III. SITUATION OVERVIEW

Aspect	Prior to 1974	1984
1. Population status of all species	Endangered and depleting	Endangered and increasing
2. Status of conservation	Localised and dependant on individuals	Definite country-wide programme
3. Legal protection	Provided	Same but strongly endorsed
4. Killings in the wild	Sporadic	Stopped
5. Number of special crocodile sanctuaries	None	Thirteen
6. Surveys conducted	Few; not in detail	Extensive
7. Public attitude	Religious, or indifferent toward conservation	Religious, most favour conservation, others in the process of being weaned away from a negative attitude.
8. Public media	Curious toward 'accidents' and sport killings	Constructive explanation to accidents, promote conservation need and programme.
9. Croc.-Fish relation	Widely misunderstood	Studies under progress towards a better understanding.
10. Captive rearing	Zoos as exhibits	34 special units for conservation.
11. Captive breeding	3 zoos (all mugger)	16 (all species) 9 other places making serious breeding attep
12. Knowledge of ecology	Very limited	Much better understood.

IV. FUTURE PRIORITIES

The following priority programmes are suggested:

1. Sanctuary Management
   (a) Develop more adult zones.
   (b) Continue the search to identify other places where natural populations can be built up.

(c) Orient management on eco-system basis. (Extend the efforts to other flora and fauna, e.g. turtles, aquatic mammals and birds).

2. Captive husbandry

(a) Produce appropriate number of crocodilians of either sexes and try to restore a balanced ratio among the released populations.

(b) Study stress factors and maximise captive breeding productions.

3. Research

(a) Continue as needed in sanctuary and captive managements.

4. Training

(a) Extend specialised courses to persons already receiving general wildlife training.

(b) Build up expertise to permanently man each crocodilian sanctuary.

5. Farming

Commence the experimental closed-circuit pilot project with captive mugger.

V. OTHER EFFORTS

The Bombay Natural History Society have undertaken or supported extensive surveys of Crocodilians habitats. The Society have also remained as the only international organisation with a very strong appeal for conservation programmes in India. The Curator of the Society, Mr. J.C.Daniel, was the first Indian representative at the SSC/Crocodile Specialist Group.

Two other non-government organisations that have contributed to the cause of Crocodile Conservation in India are the Madras Snake Park Trust/Crocodile Bank and the World Wildlife Fund- India. The Snake Park have not only bred mugger and saltwater crocodiles, but have also

supplied several crocodiles to different states for restocking in the wild. The park now aims to become an international centre for breeding all species of Crocodilians.

VI. ACKNOWLEDGEMENTS

The authors are grateful to Shri Samar Singh, Joint Secretary and Director (Wildlife) to Govt. of India, Shri V.B. Saharia, Director, (Wildlife Institute of India) and Shri J.C. Daniel, Curator (Bombay Natural History Society) for their critical reading through the manuscripts and suggestions for improvements. Mr. R. Whitaker, provided information on the Madras Snake Park and Crocodile Bank.

VII. REFERENCES

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Singh, L.A.K. (1980): Sanctuary management as a tool in rural development. Paper presented at the International symposium on 'Wildlife Resources for Rural Development' held at Hyderabad, India, 7-11 July, 1980.

Fig. 3 Crocodilian sanctuaries and other areas offering active protection to crocodilians, 1984. Numbers as in Table 1.

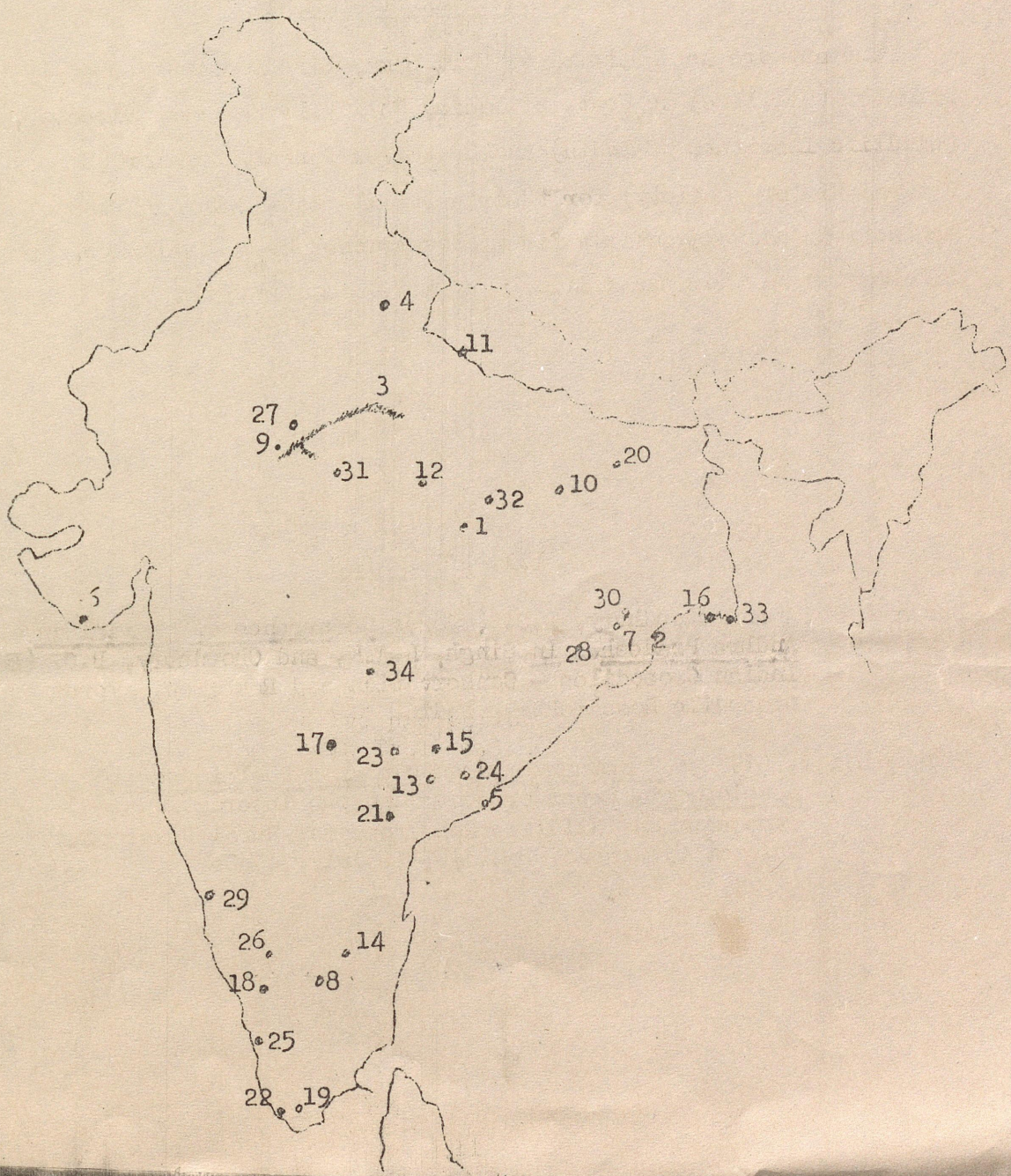

Fig. 4 Captive rearing/breeding schemes, 1984. Numbers as in Table 2. I, projects in the offing.

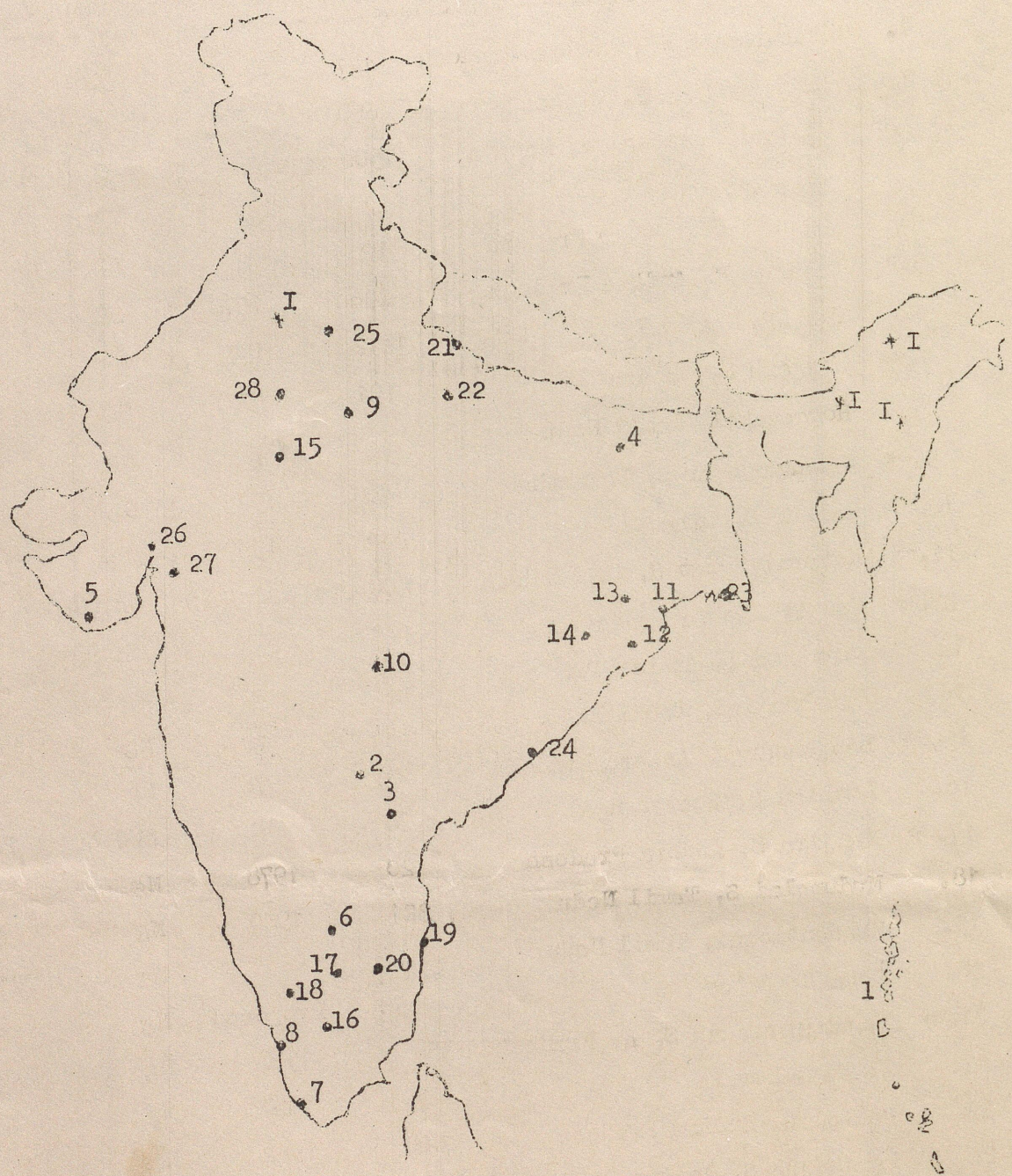

TABLE 1. CROCODILIAN SANCTUARIES(**) and other areas offering active protection to crocodilians, 1984. S, sanctuary; NP, National Park; Gh, gharial; Mg, mugger; SWC, saltwater crocodile.

Sl. No.	Name	Area sq.km.	Year commenced	Species managed	Number released
1.	Bandovgarh NP, Madhya Pradesh	437		Mg	
2.**	Bhitarkanika S, Orissa	650	1975	SWC	350
3.**	Chambal National S, Madhya Pradesh, Rajasthan, Uttar Pradesh	1500 approx.	1978	Gh (Mg)	912 (10)
4.	Corbett NP, Uttar Pradesh	525		Gh,(Mg)	12, (nil)
5.**	Coringa S, Andhra Pradesh	236	1978	SWC	3
6.	Gir NP, Gujarat	1412	1975	Mg	
7.**	Hadgarh S, Orissa	191	1978	Mg	
8.	Hoggenakal, Tamil Nadu			Mg	46
9.**	Jawaharsagar S, Rajasthan	100	1975	Gh	21
10.	Kaimur S, Bihar	1342	1969	Mg	
11.**	Katarniyaghat S, U. Pradesh	400 approx.	1976	Gh (Mg)	85 (nil)
12.**	Ken S, Madhya Pradesh	45	1982	Gh (mg)	3 (nil)
13.	Kinnersani, Andhra Pradesh	635		Mg	33
14.	Krishnagiri, Tamil Nadu			Mg	130
15.**	Lanjamodugu, Andhra Pradesh	20	1978	Mg	
16.	Lothian S, West Bengal	38		SWC	24
17.**	Manjira S, Andhra Pradesh	20	1978	Mg	
18.	Mudumalai S, Tamil Nadu	321	1940	Mg	6
19.	Mundanthorai, Tamil Nadu			Mg	21
20.	Muta S, Bihar	5	Proposed	Mg	
21.**	Nagarjunasagar S, A. Pradesh	3588	1978	Mg	154
22.	Neyyar, Kerala	270	1958	Mg	
23.	Pakhal S, Andhra Pradesh	860	1952	Mg	15
24.**	Papikonda S, Andhra Pradesh	591	1978	Gh	

contd.....

TABLE 1 contd.....

25.	Parambikulum, Kerala	285	1978	Mg	
26.	Ranganthittu S, Karnataka	26		Mg	
27.	Ranthambhore Tiger Reserve, Rajasthan	392	1959	Mg	
28.**	Satkoshia Gorge S, Orissa	796	1976	Gh (Mg)	150 (2)
29.	Sharawathy S, Karnataka	348	1972	Mg	
30.	Similipal Tiger Reserve, Orissa	2300	1970	Mg	60
31.	Shivpuri NP, Madhya Pradesh	156		Mg	25
32.**	Son S, Madhya Pradesh	209	1982	Gh (Mg)	2 (nil)
33.	Sunderban Tiger Reserve, West Bengal	2585		SWC	31
34.	Tadoba NP, Maharastra	116	1955	Mg	

TABLE 2. Captive rearing/breeding schemes, 1984. **Successful breeding commenced, *Successful breeding attempted; Gh, gharial; Mg, Mugger; SWC, Saltwater crocodile.

State/Union Territory	Sl.no.	Location	Year	Species
Andaman Nicobar	1.	Port Blair	1979	SWC
Andhra Pradesh	2.	Hyderabad	1976	Gh, SWC, Mg**
	3.	Nagarjunasagar	1979	Mg
Bihar	4.	Mutta	1976	Mg*
Gujarat	5.	Sasan Gir	1976	Mg
Karnataka	6.	Banarghatta	1980	Mg**, Gh*
Kerala	7.	Neyaar	1982	Mg
	8.	Peruvannamuzhy	1982	Mg
Madhya Pradesh	9.	Deori	1981	Gh

contd.....

TABLE 2 contd.....

Maharastra	10.	Tadoba	1977	Mg*
Orissa	11.	Dangamal	1975	SWC*
	12.	Nandankanan	1976	Gh**, Mg**, SWC*
	13.	Ramtirtha	1979	Mg**
Rajasthan	14.	Tikerpada	1975	Gh, Mg**
Tamil Nadu	15.	Kota	1975	Gh, Mg
	16.	Amaravati	1976	Mg**
	17.	Hogennakal	1976	Mg*
	18.	Masinagudi	1980	Mg
	19.	Madras	1975	Mg*
Uttar Pradesh	20.	Sathanur	1976	Mg**
	21.	Katerniyaghat	1975	Gh, Mg*
West Bengal	22.	Kukrail	1975	Gh, Mg*
	23.	Bhagabatpur	1976	SWC**

Other Captive breeding Records:

Andhra Pradesh	24.	Vishakapatanam Zoo	1978	Mg**, SWC*
Delhi	25.	Delhi Zoo	1976	Mg**
Gujarat	26.	Ahmedabad Zoo	1960	Mg**
	27.	Baroda Zoo	1965	Mg**
Rajasthan	28.	Jaipur Zoo	1967	Mg**
Tamil Nadu	29.	Madras Snake Park/ Crocodile Bank	1975	Mg**, SWC**

Other interested States:

1. Arunachal Pradesh, 2. Assam, 3. Haryana**, 4. Nagaland, 5. Goa**.

2nd draft/ 27.9.84

BCC

INDIAN CROCODILIANS : A 10-YEAR REVIEW OF MANAGEMENT

L.A.K. Singh[1], S. Kar[2], & B.C. Choudhury[3]

Fig/Tables
same as in 1st draft

I. INTRODUCTION

Indian crocodilians (Gavialis gangeticus, Crocodylus porosus and Crocodylus palustris) are known to have had a close association with the Indian ~~life and culture~~ culture & life as a religious symbol ~~and as of medicinal use. Crocodilians were also used~~ as private exhibits, as resource for food and medicine, and even maintained as imperial executioners. ~~Crocodilians were popular only among a few Indian sport-hunters.~~ Although ~~sporedic~~ evidences are known on killings to supplement the luxury leather market of ~~alien~~ other countries, ~~such killings~~ these are considered as only ~~one~~ few among the various other more serious causes that were responsible for the depletion of the populations during the post-independence era. One of the major events was the introduction of nylon set netting and an increased stance to treat crocodilians as the enemy of fisheries. Other causes were the construction of dams and barrages and increased number of human habitation with better net-work of approach roads. These developments reflected drastically ~~in a~~ shrinkage or total loss of crocodilian habitats.

After the establishment of the Indian board for wildlife (IBWL) in 1952 efforts by ~~rare~~ some individual Forest Officers and naturalists are known to have been made for the 'protection' of crocodilian populations in areas under their jurisdiction. (Sankhala 1977) ~~Apparently~~, due to exogenous ~~reasons~~ demands a proposal was under consideration during 1971 to commence crocodile commercial farming but by 1974 it had been realised that Indian Crocodilian resources were depleting and not in a position to support the commercial proposition. This was the period when U.N.D.P./F.A.O. technical & financial collaborations ~~in the farm of technical expertise soon followed with financial assistance too~~, were made available to the Government of India to commence and promote ~~the~~ the crocodile breeding and management programme at the levels of different states.

The abundance and variety of other big game in India had not made crocodiles a popular animal amongst the game-hunters.

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1. Govt. of India, Crocodile Research Centre of Wildlife Institute of India. Camp: National Chambal Sanctuary, Post Box-11, Morena 476001

2. Govt. of Orissa, Crocodile Project, Camp: Chandbali, Balasore, Orissa.

3. Govt. of Andhra Pradesh, Crocodile Project, Nehru Zoologigal Park, Hyderabad- 500264

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II. MANAGEMENT GOALS (1974-75)

1. Protection to remaining natural population.
   Procedure: Complete location of all the best crocodilian areas and create a few special crocodile sanctuaries for habitat and species management.

2. Rebuild natural population
   Procedure: Reduce natural losses through 'management'. The technique for adoption was 'grow and release'. This involves collection of wild-laid eggs, incubation of eggs in hatchery conditions. rearing of the young crocodilians up to a 'releaseable' size (over a metre length), and release of the juveniles in sanctuaries or other protected areas where potentiality to survive existed.

3. Promotion of captive breeding
   Procedure: Under simulated natural surrounding breed the available adults in certain zoos and such places.

4. Conduct research
   Procedure: Immediately take up studies that will improve the ongoing management programme.

5. Build up levels of trained personnal
   Procedure: a) On the spot research/training guided through FAO expertise in collaboration with local Universities.
   b) On the spot infra-level training of persons like 'keepers'. c) Institutional training to in-service Government pesonnel who will manage sanctuaries and rearing/breeding projects.

III. PROGRESS IN MANAGEMENT

1. Protection and creation of Crocodilian Sanctuaries.

   All important habitats for the different species have been identified and if these were already not within a Sanctuary or National Park, have been formally declared as Crocodilian Sanctuaries. Some of these protected areas have been identified for introduction or reintroductions. Two such sanctuaries are in Andhra Pradesh, one for the saltwater crocodile (Coringa sanctuary: reintroduction) and the other for the gharial (papikonda: probably reintroduction since the species

Contd.....3/

is not known to have occured in the Godavari (Choudhury and Bustard 1982).

Total No. of areas in which active protection is given to Crocodilians: 34 (20399 sq. km)

Total no. of specially created Crocodilian Sanctuaries: 13 (8346 sq km. +)

Although no special law or regulations were enacted since 1974, implementation of the existing regulations was vigorous.

The significance of the present state of protection and management of the sanctuaries in best exemplified in the resumption of wild breeding by the gharial after a lapse of ten years, (Satkoshia Gorge Sanctuary, 1984), Regeneration of mangroves, especially seen in the Bhitarkanika Sanctuary, its yet another example of the effect of the sanctuary creation..

2. Grow and release technique

The total number of eggs handled during the past:

Gharial: 6000 approx.

Mugger: 9000 approx. (3000 eggs)

Saltwater crocodiles: 2500 eggs

The total number of hatchlings handled:

Gharial: 4000 approx.

Mugger: 6000 +

Saltwater crocodile: 1500

The total number released:

Gharial: 1164

Mugger: 600 approx.

Saltwater crocodile: 415

Breeding by released crocodilians

Gharial: expected to commence in 1985/86

*Regeneration of mangroves, especially seen in the Bhitarkanika Sanctuary, its yet another example of the effect of the sanctuary creation.

Mugger: Breeding commenced with the population in Ethipothala, 1981.

Saltwater crocodiles: expected to commence in 1985/86.

Post release monitor: Satisfactory. Recently, radio-tracking equipments have been put to use to monitor the movement and habitat preference in sample populations including the released juveniles. Based on these studies varying extents of species-wise recommendations have been made regarding restocking sites and seasons and to extend limits of the sanctuaries into certain tributaries that are used during monsoon.

While Gharial and Mugger have responded fairly well without causing any public nuisance, stray incidents have come to the notice where juveniles have entered village ponds. In response to any complain, prompt actions have been taken to shift the juveniles either back to captivity or to an different point for release.

Survival among released crocodilians:

Studies are under progress in selected sanctuaries to determine the average survival. The indications have, however, been very clear that the habitats have accepted the released juveniles and there are increasing trends in the populations. It is, however, felt, particularly with the gharial that in near future as the recruitments into the adult group steadily increase, new areas may have to be developed to attract subadults to settle to form breeding groups. Studies are under progress to identify such potential areas and the extents of management requirements.

Public reaction to releases: Mostly not unfavourable. Several local people have been provided employment under the schemes. The employments are against the positions of boatmen, crocodile/sanctuary guards, husbandry attendants, fish-suppliers and other general workers for the upkeep of the centres and camps in the sanctuaries. Sanctuaries have attracted visitors for which local folk have definitely experienced an economic uplift (Sipl 1980).

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3. Captive breeding

Mugger have responded the best to captive breeding attempts (Table 2, Fig. 2) . At least ten centres are regularly breeding the species and eight others are in the queue to record it during any year now.

Gharial, being a very specialised species in its breeding habitat requirements, have set a record in the Nandankanan Biological Park since 1980. A special breeding pool holding 2.7 million litres of water have been used for breeding. The maximum depth of the pool is 10 metres.

Saltwater crocodile have bred in captivity at the Bhagabatpur centre and at the Madras Crocodile Bank, (a non-Govt. Trust) (1983).

4. Research

Those aspects were studied with priority that were immediately to be known in connection with the grow and release technique and the management of the sanctuaries. This has overlooked several other biochemical or embryclogical studies which may involve the sacrificing of the eggs or young or both. Some of the important aspects studied were the eggs or young or both. Some of theimportant aspects studied were:

- interpretations of the various types of data collected during survey and cansus.
- determination of parameters for maximum hatching sucess; (This had overlooked the role of temperature on sex differentiation, an aspect now being studied.)
- husbandry of young crocodilians including feeding prescription, food conversion and growth;
- behavioural biology including reproduction, thermoregulation, feeding, orientation, locomotion, and reproduction; and
- habitat features and population structures.

IV SITUATION OVERVIEW

Aspect	~~1974 (and before)~~ Prior 1974	1984
1. Population status of all species	Endangered and depleting	~~Endangered~~ vulnerable and increasing
2. Status of conservation	Localised and dependent on individuals	Definite country-wide programme
3. Legal protection	Provided	Same and strongly enforced
4. Killings in the wild	Sporadic	'Stopped'
5. Number of special crocodile sanctuaries	none	thirteen
6. Surveys conducted	Few, not detail	extensive
7. Public attitude	Religious, no or indifferent toward conservation	Religious, most favour conservation, others in the process of weaning away the negative attitude
8. Public media (Media response)	Curious toward 'accidents' and sport killings	Constructive explanation to accidents, promote conservation need and programme.
9. Croc-Fish relation	Widely misunderstood	Studies under progress towards an and a better understanding
10. Captive rearing	Zoos as exhibits	23 special units for conservation.
11. Captive breeding	3 Zoos(all mugger)	11 (all species) 9 other places making serious breeding attempts
12. Knowledge of ecology	Very limited	Much better understood.

V. FUTURE PRIORITIES

Sanctuary management

- Develop more adult zones.
- Continue the search to identify other places where natural populations can be built up.
- Orient management on eco-system basis. (Extend the efforts to other flora and fauna, e.g. turtles, aquatic mammals and birds)

Captive husbandry

- Produce appropriate number of crocodilians of either sexes and try restore a balanced ratio among the released populations.
- Study stress factors and maximise captive breeding productions.

Research

- Continue as per the requirements in sanctuary and captive managements.

Training:

- Extend specialised courses to persons already receiving general wildlife training.
- Build up expertise to permanently man each crocodilian sanctuary.

Farming

- Commence the experimental pilot project with captive mugger.

VI. NON-GOVERNMENT EFFORTS

1. BNHS (surveys and other activities in this regard)

2. Madras Snake Park Trust (activities in this regard)

→ See overleaf

VI NON-GOVERNMEN EFFORT

Bombay Natural History Society (BNHS): The BNHS is the first conservation agency to appeal in 1973 (Daniel 1973) for protection and creation of a sanctuary at Bhitarkanika mangrove in Orissa. In ~~recent years~~ 1976 (1976) the society ~~has~~ ~~taken up~~ from up a survey ~~for~~ to determining the status of crocodilians in Maharashtra. The society journal is one of the foremost publisher of papers related to conservation & management of Indian crocodiles.

Madras Crocodile Bank (MCB): An offshoot of the Madras Snake Park Trust, the Madras Crocodile Bank has been active in breeding crocodilians for the purpose of restocking wild habitats. The MCB has been successful in breeding both ~~the~~ ~~Cor~~ Mugger (Crocodylus palustris) and the Saltwater Crocodile (Crocodylus porosus) in captivity. Till today the MCB has supplied 400 mugger crocodiles to various Indian States for purposes of restocking and captive rearing & breeding.

J.C. Daniels review paper Bcc

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L.A.K. Singh[1], S. Kar[2], & B.C. Choudhury[3]

I. INTRODUCTION

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After the establishment of the Indian Board for Wildlife in 1952 efforts by some individual Forest Officers and naturalists are known to have been made for the 'protection' of crocodilian populations in areas under their jurisdiction. A proposal was under consideration during 1971 to start commercial farming of crocodile but by 1974 it had been realised that Indian Crocodilian resources were so depleted that they were not in a position to support the commercial exploitation. This was the period when U.N.D.P./F.A.O. collaborations in the form of technical expertise, soon followed with financial assistance was made available to the Government of India to commence and promote the crocodile breeding and management programme in different states.

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3. Govt. of Andhra Pradesh, Crocodile Project, Nehru Zoological Park, Hyderabad 500264.

II. MANAGEMENT GOALS (1974-75) AND ACHEIVEMENTS

1. Protection to remaining natural population.

Objective : Location of all the best crocodilian areas and creation of a few special crocodile sanctuaries for habitat and species management.

All important habitats for the different species have been identified and if these were not already within a Sanctuary of National Park, were formally declared as Crocodilian Sanctuaries. Some of these protected areas have been identified for introduction or reintroduction. Two such sanctuaries are in Andhra Pradesh, one for the saltwater crocodile (Coringa sanctuary: reintroduction) and the other for the gharial (papikonda: probably reintroduction since the species is now known to have occured in the Godavari (Choudhury and Bustard 1982). The number of areas in which active protection is given to Crocodilians is 34 (20399 sq. km) and the number of specially created Crocodilian Sanctuaries is 13 (8346 sq. km. +).

Although no special law or regulations were enacted since 1974, implementation of the existing regulations was vigorous. The best example of the present state of protection and management of sanctuaries is the resumption of breeding by the wild population of the gharial after a lapse of ten years, (Satkoshia Gorge Sanctuary, 1984). Regeneration of mangroves, especially seen in the Bhitarkanika Sanctuary, is yet another example of rehabilitation through protection.

2. Rebuild natural populations.

Objective : To reduce natural losses through 'management'.

The technique adopted was 'grow and release'. This involves collection of wild-laid eggs, incubation of eggs in hatcheries, rearing of the young crocodilians up to a 'releasedble' size (over a metre length), and release of the juveniles in sanctuaries or other protected viable habitats.

The total number of eggs handled so far is Gharial: c. 6000; Mugger: c. ~~4000~~ 9000; Saltwater crocodiles: ~~250~~

The total number of hatchlings handled is Gharial: c. 4000; Mugger: c. 6000 Saltwater crocodile: c. ~~1500~~ and the total number released is Gharial: 1164; Mugger: c. 600; Saltwater crocodile: 415. The released Gharial: are expected to commence breeding in 1985/86. Mugger breeding commenced with the population in Ethipothala, in 1981 and Saltwater crocodiles: are expected to commence breeding in 1985/86.

The post release monitor has been satisfactory. Recently, radio-tracking was used to monitor the movement and habitat preference in sample populations including the released juveniles. Based on these studies species-wise recommendation have been made on restocking sites and seasons and to extend the limits of the sanctuaries into certain tributaries that are used during monsoon.

While Gharial and Mugger have responded fairly well without causing any public concern stray incidents have come to notice where juveniles have entered village ponds. In response to complaints prompt action has been taken to shift such juveniles either back to captivity or to a different point for release.

Studies are in progress in selected sanctuaries to determine the average survival among released crocodilians. The indications have been very clear that the ~~released juveniles~~ habitats have ~~been~~ accepted the ~~existing population~~ juveniles and there are increasing trends in the populations. It is, however, felt, particularly in the case of the gharial that in the near future as the recruitment into the adult group steadily increases new areas may have to be developed to attract sub-adults to settle to form breeding groups. Studies are under progress to identify such potential areas and the extent of management requirements.

released

The public reaction has been ~~mostly unfavourable~~ to the release though several local people have been provided employment under the schemes as the boatmen, crocodile/sanctuary guards, husbandry attendants,

fish-suppliers and other general help for the upkeep of the centres and camps in the sanctuaries. The sanctuaries have attracted visitors from which the local people have definitely experienced an economic uplift (Singh 1980).

3. Promotion of captive breeding.

Objective : To breed under simulated natural surroundings the available adults in certain zoos and similar organisation.

Mugger have responded the best to captive breeding attempts (Table 2, Fig. 2). At least ~~ten~~ fifteen centres are regularly breeding the species and ~~eight~~ a few others are being set up.

Gharial, being a very specialised species in its breeding habitat requirements, has set a record by breeding in the Nandankanan Biological Park, Orissa since 1980. A special breeding pool ~~holding~~ 10 mts deep 2.7 million litres of water has been used for breeding. ~~The maximum depth of the pool is 10 metres.~~

Saltwater crocodile have bred in captivity at the Bhagabatpur centre and at the Madras Crocodile Bank (a non-Govt. Trust) ~~(1983)~~. during 1983.

4. Research

Objective : To take up studies that will improve the ongoing management programmes.

The aspects that were immediately relevant to the growth and release techniques and the management of the sanctuaries were given priority. This has overlooked several biochemical or embryological studies which may involve/require the sacrifice of eggs or young or both. Some of the important aspects that were studied are:

- interpretations of the various types of data collected during survey and census.

- determination of parameters for maximum hatching success; (This had overlooked the role of temperature on sex differentiation, an aspect that is now being studied).

- husbandry of young crocodilians including feeding prescription, food conversion and growth;
- behavioural biology including reproduction, thermoregulation, feeding, orientation, locomotion, ~~and~~ reproduction; and
- habitat features and population structures.

5. Build up levels of trained personnel

Objective : On the spot research/training guided through FAO expertise in collaboration with local Universities. On the spot infra-level training to persons like 'keepers'. Institutional training to in-service Government personnel who will manage sanctuaries and rearing/breeding projects.

3 foreign PhD's working in the project, of which three continue to be involved with management & research.
Keepers - in 23 rearing centres
46 - In-service personnels trained at CCBMTI

J/df:

IV SITUATION OVERVIEW

Post 1974

	Aspect		1984
1.	Population status of all species	Endangered and depleting	~~Endangered~~ and ~~increasing~~
2.	Status of conservation	Localised and dependent on individuals efforts	Definite country wide ~~inside~~ programme
3.	Legal protection	Provided	Same but strongly enforced
4.	Killings in the wild	Sporadic	Stopped
5.	Number of special crocodile sanctuaries	none	Thirteen
6.	Surveys conducted	Few, not in detail	Extensive
7.	Public attitude	Religious, or indifferent toward conservation	Religious, most favour conservation, others in the process of being weaned away from a negative attitude.
8.	Media response ~~Public media~~	Curious toward 'accidents' and sport killings	Constructive explanation to accidents, promote conservation need and programme.
9.	Croc-Fish relation	Widely misunderstood	Studies under progress towards a better understanding
10.	Captive rearing	Zoos as exhibits	23 special units for conservation.
11.	Captive breeding	3 Zoos (all mugger)	15 ~~11~~ (all species) 9 other places making serious breeding attempts.
12.	Knowledge of ecology.	Very limited	Much better understood

V FUTURE PRIORITIES

The following priority programmes are suggested

1. Sanctuary management

   (a) Develop more adult zones.

   (b) Continue the search to identify other places where natural populations can be built up.

   (c) Orient management on eco-system basis. (Extend the efforts to other flora and fauna, e.g. turtles, aquatic mammals and birds).

2. Captive husbandry

   (a) Produce appropriate number of crocodilians of either sexes and try restore a balanced ration among the released populations.

   (b) Study stress factors and maximise captive breeding productions.

3. Research

   (a) Continue as needed in sanctuary and captive managements.

4. Training

   (a) Extend specialised courses to persons already receiving general wildlife training.

   (b) Build up expertise to permanently man each crocodilian sanctuary.

5. Farming

   Commence the experimental pilot project with captive mugger.

VI Non-Government Efforts.

1973 Dec.

Dr. L. A. K. Singh
Lecturer/Research Officer
Crocodile Research Centre of
Wildlife Institute of India

Camp: National Chambal Sanctuary
Post Box 11, Morena 476001

D.O. No.22-CRC/NCS/405/15.9.84

My dear Bose

Further to my previous letter enclosing the 1st draft of our first paper, enclosed please find the 1st draft of our 2nd paper meant for the Venezuella meeting.

I request you to kindly do the needful corrections, updatings, and editings and send me back the notes by Regd. Post to Morena (if possible, also copy to Dehra Dun C/O Director, Wildlife Institute of India, New Forest, Dehra Dun 248006).

I will be back in Morena only during the 2nd week of October and will get about 2-3 days to prepare the final copies of the papers. I will arrange here for 100 copies of each paper. In case you need to communicate copies of the papers to the authorities as a matter of formality, please do so with a draft with a superscription: 2nd draft' or so.

If you can please come down to Morena around the 12th or 13th it will be better to finalise the papers and also proceed to Delhi after a short trip in the sanctuary (Chambal) for completing the various pre-departure formalities.

I look forward to hear from you. Please advise me ~~at~~ Dehra Dun address.

With choicest wishes.

Sincerely yours

(Dr. L. A. K. Singh)

Dr. S. K. Kar, Orissa and
Mr. B. C. Choudhury, A.P.

encl: 12 pages of typedscript
incl. 2 tables and 2 figs.

1st draft
15 Sept. 1984

INDIAN CROCODILIANS: A 10-YEAR REVIEW OF MANAGEMENT

(Prepared on behalf of Government of India, Department of Environment, Wildlife Section by L. A. K. Singh, S. Kar and B. C. Choudhury)

I. INTRODUCTION

Four stages may be recognised to have preceded India's current large-scale crocodilian conservation programme that had commenced in 1974. The first was during the historical periods when crocodilians were maintained as imperial executioners or as private exhibits ! The second phase (post-War period) saw wanton and indiscriminate, yet mostly spurious, killing in the wild to satiate the luxury leather market outside the country. In the same period a great deal of loss of the fauna also occurred as a result of habitat alienation and altered fishing practices. During the third phase (early 1960s) some individual Government officials backed by naturalists showed liking for the crocodilian resource and ensured the protection of the remnant population in the areas falling under the official's jurisdiction. The last phase, early 1970s, was evidently the most crucial when on one side general concerns were expressed over the depleted status of the resource and on the other plannings were still afoot to commence commercial farming ~~in captivity~~ as wild populations were not enough any more to meet the demand of the market. At this juncture, thanks, there was the timely recognition of the situation that, in 1974 the infra structure were not prepared to handle any rise on further pressure on the wild population behind ~~the~~ the curtain of a farming operation. With this background commenced several State-level conservation management programmes through the Government of India to which FAO/UNDP offered the needed technical and financial collaboration. As is the case in many such enterprises, several individual spirits both ~~at~~ native and alien, were responsible in shaping and driving ~~the programme to~~

the programme to this a stage. We express our reverence to to all these individuals and the others, as we analyse in the following the "Status" of Indian crocodilians in 1974 and today (1984), the "Management goals and achievements" after the first decade of implementation, and the "Management proiorities" as seen now.

II. STATUS: 1974 vs. 1984

Aspect	1974 (and before)	1984
1. Population status of all species	Endangered, depleting	Endangered, increasing
2. Status of conservation	Localised and dependent on individuals	Definite country-wide programme
3. Legal protection	Provided	Same, Strongly enforced.
4. Killings in the wild	Sporadic	'Stopped'
5. Number of special Croc sanctuaries	none	Thirteen
6. Surveys conducted	Few, not detail	Extensive
7. Public attidude	Religious, no or indifferent toward conservation	Religious, most favour conservation, others in the process of weaning away negative attitude
8. Public media	Curious toward 'accidents' and sport killings	Constructive explanation to accidents, promote conservation need and programme
9. Croc-Fish relation	Widely misunderstood	Improved understanding
10. Captive rearing	Zoos as exhibits	23 special units
11. Captive breeding	3 zoos (all mugger)	11 places successfully bred (includes all species) 9 other places making serious breeding attempts

Undoubtedly, the changes in the positions from 1974 and before to 1984 are because of the ongoing large-scale conservation programme discussed below.

III. MANAGEMENT GOALS (1974-75)

1. Protection to remaining natural population.

   Procedure: Complete location of all the best crocodilian areas and create a few special crocodile sanctuaries for habitat and species management.

2. Maximise natural recruitment.

   Procedure: Reduce natural losses through 'management'. The technique for adoption was 'grow and release'. This involes collection of wild-laid eggs, incubation of eggs in hatchery conditions, rearing of the young crocodilians up to a 'releaseable' size (over a metre length), and release of the juveniles in sanctuaries or other protected areas where potentiality to survive existed.

3. Promotion of captive breeding

   Procedure: Simulate as much as possible the natural surrounding and breed the available adults in captivity. It was suggested to use the adults already available in certain zoos and such places.

4. Conduct research

   Procedure: Immediately take up studies that will improve the ungoing management programme.

5. Build up levels of trained personnel

   Procedure: On the spot research/training guided through FAO expertise in collaboration with local Universities. On the spot infra-level training to persons like 'keepers'. Institutional training to in-service Government personnel who will manage sanctuaries and rearing/breeding projects.

IV. PROGRESS IN MANAGEMENT

1. Protection and creation of Crocodilian Sanctuaries.

All important habitats for the different species have been identified and if these were already not within a Sanctuary or National Park, have been formally declared as Crocodilian Sanctuaries. A few sanctuaries, with the requisite potentialities, have also been identified for introduction or reintroductions. Two such sanctuaries are in Andhra Pradesh, one for the saltwater crocodile (Coringa sanctuary: reintroduction) and the other for the gharial (Papikonda: probably reintroduction since the species is now known to have occured in the Godavari— Choudhury and Bustard 1982).

Total no. of areas in which active protection is given to crocodilians: 34; 20399 sq km +

Total no. of Specially created Crocodilian Sanctuaries:

13; 8346 sq km +

Although no special law or regulations were enacted since 1974, implementation of the existing regulations were vigorous.

The significance of the present state of protection and management of the sanctuaries is best exemplified in the resumption of wild breeding by the gharial after a lapse of ten years (Satkoshia Gorge Sanctuary, 1984).

*

~~2. Maximization of natural recruitment~~

2. Grow and release technique

The total number of eggs handled during the past:

Gharial:

Mugger:

Saltwater crocodile:

The total number of hatchlings handled:

Gharial:

Mugger:

Saltwater crocodile:

The total number released:

Gharial:

Mugger:

Saltwater crocodile:

Breeding by released crocodilians:

Gharial: expected to commence in 1985/86

* Regeneration of mangroves, especially seen in the Bhitarkanika Sanctuary, is yet another example of the effect of the sanctuary creation.

Mugger: Breeding commenced with the population in Ethipothala, 1981.

Saltwater crocodile: expected to commence in 1985/86.

Post release monitor: satisfactory. Recently, radio-tracking equipments have been put to use to monitor the movement and habitat preference in sample populations including the released juveniles.

While Gharial and Mugger have responded fairly well without causing any public nuissance, stray incidents have come to the notice where juveniles have entered village ponds. In such cases, even when reported for any other species, prompt actionas have been taken to shift the juveniles either back to captivity or to a different point for release.

Survival among released crocodilians:

Studies are under progress in selected sanctuaries to determine the average survival. The indications have, however, been very clear that the habitats have accepted the released juveniles and there are increasing trends in the populations. It is, however, felt, particularly with the gharial that in near future as the recruitments into the adult group steadily increase, new areas may have to be developed to attract subadults to settle to form breeding groups. Studies are under progress to identify such potential areas and the extents of management requirements.

Public reaction to releases: Mostly not unfavourable. Several local people have been provided employments under the schemes. The employments range from boatmen, crocodile/sanctuary guards, husbandry attendants, fish-suppliers and other general workers for the upkeep of the centresx and camps in the sanctuaries. Sanctuaries have attracted visitors and local folk have definitely experienced an economic uplift.

3. Captive breeding

Mugger have responded the best to captive breeding attempts (Table 2, Fig. 2). At least ten centres are regularly breeding the species and eight others are in the queue to record it during any year now.

Gharial, being a very specialised species in its breeding habitat requirements, have set a record in the Nandankanan Biological Park since 1980. A special breeding pool holding 2.7 million litres of water have been used in the process. The maximum depth of the pool is 10 metres.

Saltwater crocodile have bred in captivity at the Bhagabatpur centre and at the Madras Crocodile Bank (a non-Government Trust).

4. Research

Those aspects were studies with priority that were immediately required to be known in connection with the grow and release technique and the management of the sanctuaries. This has overlooked several other biochemical or embryological studies which may involve the sacrificing of the eggs or young or both. Some of the important aspects studied were:

- interpretations of the various types of data collected during survey and census;
- determination of parameters for maximum hatching success; (This had overlooked the role of temperature on sex differentiation- an aspect now being studied)
- husbandry of young crocodilians including feeding prescriptions, food conversion and growth;
- behavioural biology including reproduction, thermoregulation, feeding, orientation, locomotion, and reproduction, and
- habitat features and population structures.

5. Training

— Six Ph.D. level work have been undertaken under the projects.

— Appropriate expertise have emerged within the country and dependence on alien expertise (that was a key feature in the beginning) have gradually been minimised.

— A Central Crocodile Breeding and Management Training Institute was established during 1978, from where 46 in-service officers of various Forest Departments and a neighbouring country (Bhutan) have been trained through a ten months course on Crocodilian biology and Sanctuary Managament. Appropriate Training have been offered about the crocodilians and their management during general Wildlife Orientation Coyrse through the erstwhile Wildlife Directorate of the Government of India's Forest Research Institute.

— The Crocodile Institute, now redisgnated as the Crocodile Research Centre under the newly set up Wildlife Institute of India carries out the previous tasks of training, research and consultancy. (Currently, proposals are underway to train personnel from Pakisthan)

— Training to public (public education) have been conducted through various public media including newspapers, television and radios.

— Trained infra-structures have very well emerged at places where serious research students have remained involved.
This has enabled the emerged higher level expertise to extend their activities beyond their respective projects which can now be 'managed' by the infra levels .

— A few Universities have taken up crocodilian studies through research fellows. They are given appropriate assistance through the build up expertise.

V. FUTURE PRIORITIES

++

Sanctuary management

— Develop more adult zones.

— Continue the search to identify other places where natural populations can be built up.

— Orient management on eco-system basis. (Extend the efforts to other flora and fauna, eg., turtles, aquatic mammals and birds)

Captive husbandry

— Produce appropriate number of crocodilians of either sexes and try restore a balanced ratio among the released populations.

— Study stress factors and maximise captive breeding productions.

Research

— Continue as per the requirements in sanctuary and captive managemenets.

Training

— Build up more levels of trained personnel through specialised courses to persons already receiving general wildlife training.

— Build up expertise to permanently man each crocodilian sanctuary.

Farming

— Immediately commence the pilot project with captive mugger.

TABLE 1. Crocodilian Sanctuaries (**) and other areas offering active protection to crocodilians, 1984. S, sanctuary; NP, national park; Gh, gharial; Mg, mugger; SWC, saltwater crocodile.

Sl. no.	Name	Area sq.km.	Year commenced	Species managed	Number released
1.	Bandovgarh NP, Madhya Pradesh	437		Mg	
2.**	Bhitarkanika S, Orissa	650	1975	SWC	350
3.**	Chambal, National S, Madhya Pradesh/Rajasthan, Uttar Pradesh	1500 approx.	1978	Gh (Mg)	912 (10)
4.	Corbett NP, Uttar Pradesh	525		Gh, Mg	12, nil
5.**	Coringa S, Andhra Pradesh	236	1978	SWC	3
6.	Gir NP, Gujarat	1412	1975	Mg	
7.**	Hadgarh S, Orissa	191	1978	Mg	
8.	Hoggenakal, Tamilnadu			Mg	46
9.**	Jawaharsagar S, Rajasthan	100	1975	Gh	21
10.	Kaimur S, Bihar	1342	1969	Mg	
11.**	Katerniyaghat S, U. Pradesh	400	appro.1976	Gh (Mg)	85
12.**	Ken S, Madhya Pradesh	45	1982	Gh (Mg)	3
13.	Kinnersani, Andhra Pradesh	635		Mg	33
14.	Krishnagiri, Tamilnadu			Mg	130
15.**	Lanjamodugu, Andhra Pradesh	20	1978	Mg	
16.	Lothian S, West Bengal	38		SWC	24
17.**	Manjira S, Andhra Pradesh	20	1978	Mg	
18.	Mudumalai S, Tamilnadu	321	1940	Mg	6
19.	Mundanthorai, Tamilnadu			Mg	21
20.	Muta S, Bihar	5	Proposed	Mg	
21.**	Nagarjuna Sagar S, A. Pradesh	3588	1978	Mg	154
22.	Neyyar, Kerala	270	1958	Mg	
23.	Pakhal S, Andhra Pradesh	860	1952	Mg	15
24.**	Papikonda S, Andhra Pradesh	591	1978	Gh	
25.	Parambikulum, Kerala	285	1978	Mg	
26.	Ranganthitu S, Karnataka	26		Mg	
27.	Ranthambhore Tiger R., Rajasthan	392	1959	Mg	
28.**	Satkoshia Gorge S, Orissa	796	1976	Gh (Mg)	150 (2)
29.	Sharawathy S, Karnataka	348	1972	Mg	
30.	Similipal Tiger R, Orissa	2300	1970	Mg	60
31.	Sivpuri NP, Madhya Pradesh	156		Mg	25
32.**	Son S, Madhya Pradesh	209	1982	Gh (Mg)	2 (nil)
33.	Sundarban Tiger R., W. Bengal	2585		SWC	31
34.	Tadoba NP, Maharastra	116	1955	Mg	

TABLE 2. Captive rearing/breeding schemes, 1984. **Successful breeding commenced, *successful breeding attempted; Gh, gharial; Mg, mugger; SWC, Saltwater crocodile.

State and U.T.	Sl.no.	Location	Year	Species
Andaman Nicobar	1.	Port Blair	1979	SWC
Andhra Pradesh	2.	Hyderabad	1976	Gh, SWC, Mg**
	3.	Nagarjunasagar	1979	Mg
Bihar	4.	Mutta	1976	Mg*
Gujarat	5.	Sasan Gir	1976	Mg
Karnataka	6.	Banarghatta	1980	Mg*, Gh*
Kerala	7.	Neyyar	1982	Mg
	8.	Perambiculum	1982	Mg
Madhya Pradesh	9.	Deori	1981	Gh
Maharastra	10.	Tadoba	1977	Mg*
Orissa	11.	Dangamal	1975	SWC*
	12.	Nandankanan	1976	Gh**, Mg**, SWC*
	13.	Ramatirtha	1979	Mg
	14.	Tikerpada	1975	Gh, Mg**
Rajasthan	15.	Kota	1975	Gh, Mg
Tamilnadu	16.	Amaravati	1976	Mg
	17.	Hogemnakal	1976	Mg*
	18.	Masinagudi	1980	Mg
	19.	Madras	1975	Mg*
	20.	Sathanur	1976	Mg*
Uttar Pradesh	21.	Katerniyaghat	1975	Gh, Mg*
	22.	Kukrail	1975	Gh, Mg*
West Bengal	23.	Bhagabatpur	1976	SWC**
Other Captive Breeding Records:				
Andhra Pradesh	24.	Vishakhapatanam Zoo	1978	Mg**
Delhi	25.	Delhi Zoo	1976	Mg**
Gujarat	26.	Ahmedabad Zoo	1960	Mg**
	27.	Baroda Zoo	1965	Mg**
Rajasthan	28.	Jaipur Zoo	1967	Mg**
Tamilnadu	29.	Madras Snake Park/ Crocodile Bank	1975	Mg**, SWC**

Other Interested States:

1. Arunachal Pradesh, 2. Assam, 3. Haryana, 4. Nagaland.

CCI

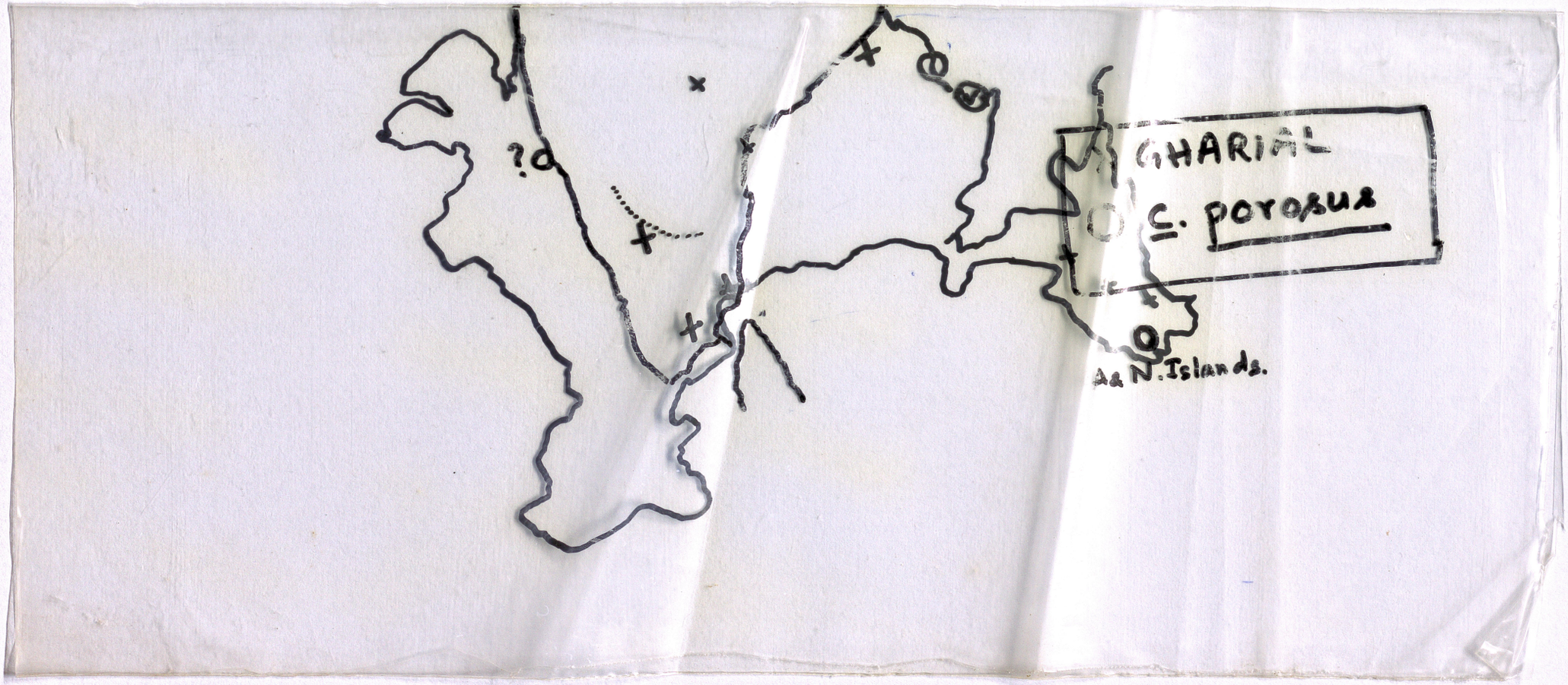
from Chief Controller of Imports & Exports

Fig. 1 Crocodilian sanctuaries and other areas offering active protection to crocodilians, 1984. Numbers as in Table 1.



STATUS OF INDIAN CROCODILES.

	PRE RELEASE	1984 (Release)	Population Trend	No. of Nests
Gavialis	230 (72 Adult)	1518 (1164)	Increasing	35+
porosus	550 (125 Adult)	1013 (415)	Increasing	20+
palustris	1000 (300 Adult)	1600 (600)	Increasing	125+ includes nests laid by released population.


GHARIAL
C. POROSUS
& N. Islands.

While delegates from ~~Venezuela~~ Spain, Australia, Africa & US are having an argument ~~Crocodilians in India~~ as to what is to be done ~~for~~ their crocodile populations which are ~~in thousands~~ we in India are ~~busy~~ desperate to save our crocodilians which are in just 100s. In 10 yrs of effort we have increased them to 1000s ~~and~~ ~~join the~~

① Three species ① Gavialis gangeticus - Gharial

2. Crocodylus porosus - saltwater crocodile

3. Crocodylus palustris - mugger.

② Gharial - Juvenile, Habitat

Gharial is basically a riverine species inhabiting the Ganges and ~~system~~ Brahmaputra. ~~and Indus~~. ~~out of this limit it is also present~~ and ~~in the~~ Mahanadi river system in the Peninsular India. ~~It is certain to be extinct in the Indus.~~ Its occurrence in the Indus is uncertain.

The name of Gharial is derived from a nasal protuberance ~~also~~ in maturing and matured males. Such a protuberance in Indian languages is known as 'Ghara' and therefore the name 'Gharial'. Most delegate present here know the Gharial as Gavial.

② Saltwater Crocodile. The saltwater crocodile (Crocodylus porosus) in India is now restricted to only three mangrove areas ① Sunderban in West Bengal ② Bhitar Kanika in Orissa and the ② Bay islands of Andaman & Nicobar. Its ~~mangr~~ habitat 'the mangroves' were ~~are~~ the most threatened and shrinking habitat in India at the time of begining of the crocodile conservation project. There is now an unconfirmed report that c. porosus also occurs in the mangrove creeks of Goa.

3. Mugger - The mugger (Crocodylus palustris) is adapted to all kinds of freshwater habitat starting from a village pond to big lakes, ~~[illegible]~~ below waterfalls and ~~mighty fast flowing~~ rivers. ~~as~~

Causes of decline:

1. Robbing of Eggs to be used as food and indegenous medicine
2. Use of gill set-nets across the river as conflict with fishery practice causing destruction of crocodile stock
3. Construction of dams & barrages and submergence of nesting grounds.
4. Alteration of habitat ~~by~~ ~~for~~ by
   a) clear felling
   b) Conversion of mangrove areas to cultivable land
5. ~~[illegible]~~ organised hunt for skin and.

These were the situation at the begging of 1970 and

Very little information existed on the ~~wild~~ status of wild crocodilian in India, ~~except~~

There were a few survey of ~~Gharial~~ Gavialis gangeticus habitats in north India by forest officials (~~Shahi 1969~~) & Zoological Survey of India in 1969-70 on ~~S.W. Crocodile~~ C. porosus by B.N.H.S. Daniel (1973) and reports on ~~mugger~~ C. palustris population in South India by R. Whitaker (1975),

All these have been reported at the various IUCN/SSC CSG group meetings from 1971 to 1980 and the status of wild crocodilians remained unchanged by 1982.

The IUCN Red Data Book of 1982 enlisted C. gangeticus and C. porosus as still endangered ~~and~~ changed C. palustris from endangered to Vulnerable. (**)

Following organised population counts since the one carried out by FAO in 1974, the various state projects have carried out surveys of crocodile habitats ~~and~~ updating the situation. These were carried out between 1976 and 1980.

By 1980 several in-service (Forest Deptt.) personnels have been trained by the Govt. of India/FAO/UNDP Crocodile Breeding and Management Project on the survey techniques and reports started coming in ~~from~~ ~~no~~ more areas.

The present paper is the most up-to-date situation on the status of wild crocodilians in India. However, it is to be borne in mind that several states - particularly in the north-east India have yet to take up surveys. The Crocodile Research centre of the wildlife Institute of India

is now planning to take up such surveys from time to time to up date the information

Map

Before B moving into a species wise report on the ~~[illegible]~~ 'status' We wish to point out that the population now ~~do not~~ also ~~include~~ ~~repeat do not~~ include the number of sub-adults released back following the management programme. ~~which my collegue Dr [illegible] is going to present in another paper.~~

Chart

~~Species wise details~~

~~Gharial~~	~~Pre release~~	~~Present 1984~~
	~~230 including 72 Adults.~~	~~1518 includes 1164 released.~~

Gharial

	Pre release	Present	Population Trend
	230 (72 Adults)	1518 (1164 released)	Increasing. Total No. of nest available from the wild 35+
S.W. Woodile	500 (125 Adults)	1013 (414 released)	Increasing. Total no of nest available from the wild 20+
Mugger	1000 (30% Adults)	1600 (600 released)	Increasing. No of nest available from the wild 125+

Conclusion

In conclusion we feel that the status of the crocodilians in India is improving because the factors that were detrimental for their increase have now been eliminated. This combined with the management programs, we hope would change the situation of Indian crocodilians in another decade. Additional habitats are being surveys and declared as protected areas for the crocodilians in Andaman.

INDIA: STATUS OF WILD CROCODILIANS

L. A. K. Singh[1], S. Kar[2] and B. C. Chaudhury[3]

INTRODUCTION

At the First Working Meeting of the Crocodile Specialists Group in 1971 the following were the status given to the Indian crocodilians (Honegger, 1971).

1. Gharial (Gavialis gangeticus): "Extremely rare" (based on Seshadri, 1969).
2. Saltwater crocodile (Crocodylus porosus): No mention, apparently thought to be fairly safe.
3. Mugger (Crocodylus palustris): "Exterminated in most areas of its range" (Daniel, 1970). Extremely rare (Seshadri, 1969).

By the Fifth meeting in 1980 reports on the status were more clear and approximate number of crocodilians in the wild were known in most cases (Whitaker, 1982). The IUCN Red Data Book (1982) stated the status of India crocodilians as follows:

1. G. gangeticus: Endangered, extremely depleted.
2. C. porosus: Endangered, now seriously depleted and rare or extinct in most of its former ranges in India.
3. C. palustris: Vulnerable, now heavily depleted throughout the range.

At the last Working Meeting in 1982, the situations were accepted to be as before. The present paper provides updated information on the three species as regards their status before any release/rehabilitation took place through the Government's conservation-management programme. Also given are the accepted population figures and the present locations of breeding populations.

GAVIALIS GANGETICUS (GMELIN)

I. LEGAL STATUS:

INDIA:
1. Wildlife (Protection) Act, 1972: Schedule I (Total Protection).
2. Export I Instruction no. 46/73: Export of animals and their products prohibited.
3. Instruction no. 57/75: Protection as religious symbol.

INTERNATIONAL:
1. CITES: Appendix I (India is a prty to CITES)
2. ~~IUCN Red Data Book: Endangered~~

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[1]Government of India, Crocodile Research Centre of Wildlife Institute of India. Camp: National Chambal Sanctuary, Post Box 11, Morena 476001, Madhya Pradesh.

[2]Government of Orissa, Crocodile Project, Camp: Chandabali, Balasore, Orissa.

[3]Government of India, Crocodile Research Centre of Wildlife Institute of India, Bahadurpura, Hyderabad 500264, Andhra Pradesh.

II. PRE-RELEASE POPULATIONS:

River	State	Adult	Juvenile	Total	Source
1. Brahmaputra (1982)	Arunachal Assam, Nagaland	?	?	50	Mohanta, H., 1981; Choudhury, 1983.
2. Chambal (1977)	Rajasthan, M.P., U.P.	40	81	121	FAO, 1974; Anon, 1976; Whitaker and Daniel, 1980; Singh, V.B., 1978; IUCN, 1983; Whitaker and Basu, 1983.
3. Girwa (1977)	Uttar Pradesh	9	19	28	Ramanand and Johri, 1982
4. Ken (1980)	Madhya Pradesh	1	0	1	Anon., 1976; Singh, 1980.
5. Mahanadi (1976)	Orissa	4	4	8	Bustard and Singh, 1982.
6. Ramganga (1976)	Uttar Pradesh	0	4	4	Anon, 1975(?).
7. Son (1984)	Madhya Pradesh	18	0	18	Pandey, 1984

Total population: 230 including 72+ adults.

Although the above figures are improvements over Bustard, 1982 (60-70 nos.) and Whitaker, 1982 (less than 50 adults), the overall status remains the same, "endangered".

III. BREEDING POPULATIONS (1984)

1. River Chambal: (Places vs. average number of nests as of 1982-1984)
   Baroli- 7, Bharrah- 7, Tigri-Rithaura- 2, Pureini- 10, Gyanpura- 2. Total- 28
2. River Girwa:
   Within a stretch of about 12km up to six nests.
3. River Mahanadi:
   Last successful breeding: 1974; recommenced: 1984; number of nests: one with 24 eggs at Majhipada.
4. Brahmaputra:
   Reports of breeding in the following tributaries are available but the exact status is unknown.
   Arunachal Pradesh- Subansiri river; Assam- Dikho river and Dhansari river; Nagaland- rivers Doyong, Dikho and Disang.
5. Ramganga:
   Uncertain

IV. TOTAL POPULATION (1984)

River	Natural			Released	Grand* Total	Population trend
	Adult	Other	Total			
Brahmaputra	?	?	50	0	50	Unknown
Chambal	53	192	245	912	1157	Increasing
Girwa	9	19	28	85	113	Increasing
Ken	1	—	1	3	4	Stable

IV. TOTAL POPULATION (1984) contd.

River	Natural			Released	Grand* Total	Population trend
	Adult	Other	Total			
Mahanadi	6	2	8	150	158	Increasing
Ramganga	4	-	4	12	16	Unknown
Son	18	-	18	2	20	Stable (no male)
TOTAL	141	213	354	1164	1518**	Increasing

* without considering losses among released gharial
** and captive population about one thousand
TOTAL POPULATION IN THE COUNTRY: 2518

CROCODYLUS POROSUS SCHNEIDER

I. LEGAL STATUS:
INDIA: As for Gharial
INTERNATIONAL: As for Gharial

II. PRE-RELEASE POPULATIONS:

Location	State	Adult	Juvenile	Total	Source
1. Bhitarkanika (1977)	Orissa	34	64	95	Kar and Bustard, 1982
2. Sundarbans (1978)	W.Bengal	4	96	100	Mail, Madras (27 Jan., 1978)
3. Andaman and Nicobar			up to		Whitaker and Whitaker, 1978
North A.		50	150	100-200	
Middle A.		20	80	50-100	
South A.		10	20	20-30	
Nicobar		—	—	20-25	(Bhaskara, 1979)

Total population: up to 550 including 125 adults

III. BREEDING POPULATIONS (1984)

1. Bhitarkanika:
Over an area of 176 sq.km. up to eight nests.
2. Sundarbans:
A total of two nests every year
3. Andamans:
Most of the nests are predated in the wild (Choudhury and Bustard, 1982).
Exact extents of reproductive effort uncertain.
4. Goa:
Existence of viable population reported. Exact position unknown.

IV. TOTAL POPULATION (1984)

Location	Natural			Released	Grand* Total	Population trend
	Adult	Other	Total			
Bhitarkanika	38	130	168	350	518	Increasing
Sundarban	4	96	100	65	165	Increasing
Andamans	80	up to 250	up to 330	0	330	Unknown
Goa	?	?	?	0	?	Unknown
TOTAL	118+	480+	598+	415	1013+**	Increasing

*without considering losses among released crocodiles
**and captive population about 700
TOTAL POPULATION IN THE COUNTRY: 1713+

CROCODYLUS PALUSTRIS LESSON

I. LEGAL STATUS:

INDIA: As for gharial

INTERNATIONAL:

1. CITES: Appendix I
2. IUCN Red Data Book: Vulnerable

II. PRE-RELEASE POPULATIONS:

Excepting the northern states of Jammu and Kashmir, Himachal Pradesh and Sikkim, mugger are reported to have occurred in all the other states during early 1970. Although no detailed census were conducted an accepted approximate population figure was around 1000 with a population trend "depleting faster than it could reproduce" (Bustard 1974). Based on the number of wild mugger some of the good states were in the order of Tamilnadu, Gujarat, Rajasthan, Andhra Pradesh, Karnataka and Maharastra.

III. MAIN BREEDING POPULATIONS (1984)

Tamilnadu:	Amaravati, Sathanur, Hogekkakal, Chidambaram, Killikudu, Mettur, Mundanthurai. Total approx. 50 nests.
Gujarat:	Hiran and other lakes (Gir). Total approx. 12 nests.
Andhra Pradesh:	Ethipothala/Nagarjuna Sagar Sirisailam (Krishna), Kinnersani, Lanjamadugu, Manjira, Sileru. Total approx. 12 nests.
Karnataka:	Cauvery river at Ranganthitu-Sri Rangapatan, Tungabhadra and Bhima rivers. Total approx. 4 nests.
Maharastra:	Tadoba National Park, Powai Lake (Bombay). Total up to six nests.
Bihar:	Bher river (Mutta), Kaimur Sanctuary, Damodar Valley. Total up to 6 nests.
Rajasthan:	Ranthambhore, Pushkar Lake. Total up to 8 nests.
Madhya Pradesh:	Rangawa Dam (Panna), Bandhavgarh. Total up to 5 nests.
Uttar Pradesh:	Corbett, Dudhwa, Girwa (Katerniyaghat). Total up to 6 nests.
Chambal river:	(Madhya Pradesh/Rajasthan/Uttar Pradesh). Up to 12 nests.
Haryana:	Kurukshetra.
Kerala:	Neyaar, Perambiculum. Up to 3 nests.
Orissa:	Koraput (Balimela Dam Project), Ganjam (Bhanjanagar).
North-east rivers:	(Arunachal Pradesh, Assam, Nagaland and West Bengal) Occurrences reported but not exact locations of breeding population not available.

IV. TOTAL POPULATION (1984)

Natural:	Approx. 1000 all sizes
Released:	600 (all from wild-collected eggs)
Captive:	From wild-collected eggs- 3000 By captive breeding- 2500
Total:	7100
Trend:	Increasing. (Extensive captive breeding in at least twelve centres.)

Dr. L. A. K. Singh
Lecturer/Research Officer

Camp: National Chambal Sanctuary
Post Box 11, Morena 476001

D.O. No. 22-CRC/NCS/396/3.9.84

My dear Binod.

Enclosed please find the first draft of the MSS of one of our papers intended for presentation at the next CSG Meeting. I have drafted the gharial portion to a fairly completeness, and the other two species are over for you. While I request that each of us should comment on all the species, I also request that please send back the draft within a couple of days so that I can send you back the 2nd draft. As you may be knowing, a meeting of the CWLWs is likely to be called, and we can place the paper for approval before we communicate it to the Chairman, CSG.

The second paper: 10 year review of management will be posted as soon as I finish the 1st draft.

With best wishes.

Yours sincerely,

(Lala A. K. Singh)

Dr.S. Kar, Chandbali
B.C.Choudhury, Hyderabad

encl: 7 pages of the draft.

1st draft/3.9.84

INDIA: STATUS OF WILD CROCODILIANS

(Prepared on behalf of Government of India, Department of Environment, Wildlife Section by L. A. K. Singh, S. Kar and B. C. Choudhury)

I N T R O D U C T I O N

At the First Working Meeting of the Crocodile Specialists Group in 1971 the following were the status given to the Indian crocodilians (Honegger, 1971).

1. Gharial, Gavialis gangeticus: "Extremely rare" (based on Seshadri, 1969)
2. Saltwater Crocodile, Crocodylus porosus: No mention, apparently thought to be fairly safe. (Actually status unknown)
3. Mugger, Crocodylus palustris: "Exterminated in most areas of its range" (Daniel, 1970). "Extremely rare" (Seshadri, 1969).

At the Fifth Meeting in 1980, by which time situations were becoming more clear and approximate number of crocodilians in the wild were mostly known, Whitaker (1982) described the populations and the status, as in IUCN Red Data Book, as follows:

1. G. gangeticus: Endangered, "Fewer than 50 adults".
2. C. porosus: Vulnerable, "unknown".
3. C. palustris: Endangered, "Fewer than 1000 adults".

At the last meeting in 1982, the situations were no further reviewed. This paper provided updated information on the three species as regards their status before any release/rehabilitation took place through the Government's

conservation-management programme. Also given are the present locations of viable populations and a figure of the population in the existing habitats.

GAVIALIS GANGETICUS (GMELIN)

Family: Gavialidae

I. LEGAL STATUS:

INDIA:

1. Wildlife (Protection) Act, 1972:
   Schedule I (Total Protection)
2. Export I Instruction No. 46/73:
   Export of animals and their products prohibitted.
3. Instruction No. 57/75:
   Protection as religious symbol.

INTERNATIONAL:

1. CITES: Appendix I
2. IUCN Red Data Book: Endangered

II. PRE-RELEASE POPULATIONS:

River	State	Adult	Juvenile	Total	Source
1. Brahmaputra	Arunachal, Assam, Nagaland	?	?	50	Mohanta, H., 1981; Choudhury, B.C., 1983
2. Chambal	Rajasthan, Madhya Pradesh, Uttar Pradesh	40	81	121	F.A.O., 1974; Anon, 1976; Whitaker and Daniel 1980; Singh, V.B., 1978, 1982; Whitaker, 1982; IUCN 1983; Whitaker and Basu 1983.
3. Girwa	Uttar Pradesh	9	19	28	Ramanand and Johri 1982
4. Ken	Madhya Pradesh	1	0	1	Anon, 1976; Singh 1980
5. Mahanadi	Orissa	4	4	8	Bustard and Singh, 1982
6. Son	Madhya Pradesh	18	0	18	Pandey, S.P., 1984
7. Ramganga	Uttar Pradesh	0	4	4	Anon, undated (1975?)

Total: 230 including 72+ adults.

Although the above figure is an improvement over Bustard, 1982 (60-70 nos.) and Whitaker, 1982 (less than 50 adults), the overall status remains the same, "endangered".

III. PRESENT VIABLE POPULATIONS

1. River Chambal: (Places vs. average number of nests as of 1982/1983/1984)

Baroli - 7, Bharrah - 7, Tigri-Rithaura- 2, Pureini - 10,

Gyanpura - 2. Total - 28.

2. ~~Girwa~~ River Girwa:

Within a stretch of about 12km upto six nests are collected.

3.River Mahanadi:

The last successful breeding had occurred in 1974. Significantly, breeding has recommenced in 1984. One clutch of 24 eggs were ~~collected~~ laid during this season at Majhipada.

4. Brahmaputra:

Reports of breeding in the following tributaries are available, but the exact status is unknown.

Arunachal Pradesh - Subanhira River

Assam - Dikho River, Dhansri River

Nagaland - Doyong River, Dikho River and Disang River

5. Ramganga:

Uncertain.

IV. PRESENT POPULATION

River	Natural recruitment		Total	Released	Grand Total*	Status
	Adult	Other				
1. Brahmaputra	?	?	50	0	50	Unknown
2. Chambal	53	192	245	912	1157	Increasing
3. Girwa	9	19	28	85	113	Increasing
4. Ken	1	-	1	3	4	Stable
5. Mahanadi	6	2	8	150	158	Increasing
6. Son	18 (no confirmed male)	-	18	2	20	Stable
7. Ramganga	4	-	4	12	16	Unknown
TOTAL	141	213	354	1164	1518	Increasing

* assuming 100% survival among released juveniles.

CROCODYLUS POROSUS SCHNEIDER

Family: Crocodilidae

I. LEGAL STATUS:

INDIA: As for gharial

INTERNATIONAL: As for gharial

II. PRE-RELEASE POPULATIONS:

Location	State	Adult	Juvenile	Total	Source
1. Bhitarkanika	Orissa	34	61	95	Kar and Bustard, 1982
2. Sundarban	W.Bengal	4	96	100	(Mail, Madras, 27 Jan. 1978.
3. Andamans ~~ks~~ -					
North A.		50	rest	100-200	Whitaker and Whitaker, 1978
Middle A.		20	rest	50-100	"
South A.		10	rest	20-30	"

Total: Up to 525 including 118 adults.

III. PRESENT VIABLE POPULATIONS

1. Bhitarkanika:

Over an area of 176 sq.km. upto six nests are collected.

2. Sundarbans:

A total of two nests are collected every year.

3. Andamans:

Most of the nests are predated in the wild (Choudhury and Bustard, 1982).

Exact extents of reproductive effort uncertain.

4. Goa:

Existence of viable population is reported. Exact position unknown.

IV. PRESENT POPULATION

Location	Natural recruitment			Released	Grand Total*	Status
	Adult	Other	Total			
1. Bhitarkanika	34	134	168	350	518	Increasing
2. Sundarban	4 (no further census)	96	100	65	165	Increasing
3. Andamans	80 (no further census)	rest	Up to 330	0	330	Unknown
4. Goa	?	?	?	0	?	Unknown

CROCODYLUS PALUSTRIS LESSON

Family: Crocodilidae

I. LEGAL STATUS:

INDIA: As for gharial

INTERNATIONAL: As for gharial

Binod, I am not drafting anything further. The following may, however, be useful to you.

K'ghat: 2 adults: (CCBMTI, 1979 through 1982)

Tadoba: Ramanand reports 6 females but never that many nests.
In Dec. 1982 I had seen (night survey) 2 (2.5m+) and 2 (less than 2m)

Ranthambhore: 21 (12 adults) (LAKS, March 1982)

Chambal: at least 12F, 7M, 2 jv.: seen in 325km of Chambal.

Ken (Rangawa): 3 nests available (report recd. by LAKS, 1980 during survey)

Corbett: 10 (CSG Newsletter no. 13, May 1978, Annon.)

Dudhwa: Few (")

Chidambaram: 20(")

Kilikudu: 20 (")

Neyyar: Few (")

Rangnthithoo 7 (") (LAKS see in July 1980: 3 adults)

Whitaker (1982: in CSG volume) writes:

Main population:

Hiran Lake, Gir:	50+adults	——stable
Amarabati, TN	25 adults	stable
Sathanur, TN	15 adults	stable

Total wild population: Fewer than 1000 adults

Total captive population over 1500 (most juveniles)

He presented the work at the 1980 Meeting.

Total: 230 including 72+ adults.

Although the above figure is an improvement over that given by Whittaker

Brad; As per Dr. Sexy's message that Dr. Sale, the Director had seen the 1st draft. This 2nd draft includes his remarks and suggestions. I have no response from you. Lala.

2nd draft/25.9.84

INDIA : STATUS OF WILD CROCODILIANS

L.A.K. Singh [1], S. Kar [2] and B.C. Choudhury [3]

INTRODUCTION

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At the last meeting in 1982, the situations were no further reviewed. The present paper provides updated information on the three species as regards their status before any release/rehabilitation took place through the Government's conservation-management programme. Also given are the accepted population figures and the present locations of breeding populations.

---

1. Government of India, Wildlife Institute of India, Camp: National Chambal Sanctuary, Post Box-11, Morena 476001, M.P.
2. Govt. of Orissa, Crocodile Project, Camp: Chandbali, Balasore, Orissa.
3. Govt. of Andhra Pradesh, Nehru Zoological Park, Hyderabad- 500264.

Contd.....2/

GAVIALIS GANGETICUS (GMELIN)

Family: Gavialidae

I. LEGAL STATUS:

INDIA :

1. Wildlife (Protection) Act, 1972 : Schedule I (Total Protection)
2. Export I Instruction No. 46/73: Export of animals and their products prohibitted.
3. Instruction No. 57/75 : Protection as religious symbol.

INTERNATIONAL :

1. CITES: Appendix I (India is a party to CITES)
2. IUCN Red Data Books Endangered.

II. PRE-RELEASE POPULATIONS :

River	State	Adult	Juvenile	Total	Source
1. Brahmaputra (1982)	Arunachal Assam Nagaland	?	?	50	Mohanta, H., 1981 Choudhury, B.C., 1983
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3. Girwa (1977)	Uttar Pradesh	9	19	26	Ramanand & Johri 1982.
4. Ken (1980)	M.P.	1	0	1	Anon, 1976 Singh 1980
5. Mahanadi (1976)	Orissa	4	4	8	Bustard & Singh, 1982
6. Ramganga (1976)	U.P.	0	4	4	Anon, undated (1975
7. Son (1984)	M.P.	18	0	18	Pandey, S.P 1984.

Cond.....3/

Total : 230 including 72+ adults.

Although the above figure is an improvement over Bustard, 1982 (60-70 nos.) and Whitaker, 1982 (less than 50 adults), the overall status remains the same, "endangered".

III. BREEDING POPULATIONS (1984)

1. River Chambal: (Places vs. average number of nests as of 1982-1984)

Bareli- 7, Bharrah-7, Tigri-Rithaura-2, Pureini- 10, Gyanpura - 2. Total- 28.

2. River Girwa :

Within a stretch of about 12 Km. upto six nests.

3. River Mahanadi:

Last Successful breeding: 1974; recommenced 1984, a single clutch of 24 eggs laid at Majhipada.

4. Brahmaputra :

Reports of breeding in the folliwing tributaries are available, but the exact status is unknown.

Arunachal Pradesh- Subansiri River

Assam.- Dikho River, Dhansri River

Nagaland - Dayong River, Dikho River and Disang River

5. Ramganga :

Uncertain.

IV. TOTAL POPULATION (1984)

River	Natural			Released	Grand* Total	Population Trend
	Adult	Other	Total			
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2. Chambal	53	192	245	912	1157	Increasing
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7. Son	18 (no confirmed male)	-	18	2	20	Stable
TOTAL	141	213	354	1164	1518**	Increasing

* without considering losses among released gharial

** and captive population about one thousand.

Total population in the country 1518 + 1000 = 2518

Contd.....4/-

CROCODYLUS POROSUS SCHNEIDER

Family: Crocodilidae

I. LEGAL STATUS:

INDIA: As for gharial

INTERNATIONAL: As for gharial

II. PRE-RELEASE POPULATIONS:

	Location	State	Adult	Juvenile	Total	Source
1.	Bhitarkanika (1977)	Orissa	34	61	95	Kar & Bustard, 1982
2.	Sundarban (1978)	W.Bengal	4	96	100	(Mail, Madras, 27 Jan. 1978)
3.	Andamans & Nicobars	-		upto		
	North A.	"	50	150	100-200	Whitaker & Whitaker, 1978.
	Middle A.		20	80	50-100	"
	South A.		10	20	20-30	"

Total: Up to 525 including ~~116~~ adults.

III. BREEDING POPULATIONS (1984)

1. Bhitarkanika:

Over an area of 176 sq. km. upto eight nests.

2. Sundarbans:

A total of two nests every year.

3. Andamans:

Most of the nests are predated in the wild (Choudhury and Bustard, 1982). Exact extents of reproductive effort uncertain.

4. Goa:

Existence of viable population is reported. Exact position unknown.

CONTD.....5/

IV. TOTAL POPULATION (1984)

	Location	Natural Adult	Natural Other	Natural Total	Released	Grand* Total	Population Trend
1.	Bhitarkanika	38	130	168	350	518	Increasing
2.	Sundarban	4 (no recent census)	96	100	65	165	Increasing
3.	Andamans	80	upto 250	upto 330	0	330	Unknown
4.	Goa	?	?	?	0	?	**Unknown
	Total	118+	480+	598+	415	1013+	Increasing

* without considering losses among relaased crocodiles.

** and captive populatio: about 700.

Total Population = 1713+

CROCODYLUS PALUSTRIS LESSON

Family: Crocodilidae

I. LEGAL STATUS:

INDIA: As for gharial

INTERNATIONAL: As for Gharial

II. PRE-RELEASE POPULATIONS:

Excepting the northern states of Jammu & Kashmir, Himachal Pradesh and Sikkim, mugger are reported to have accured in all other states during early 1970. Although no detailed census were conducted an accepted approximate population figure was around 1000 with a population trend, "depleting faster than it could reproduce" (Bustard, 1974). Based on the number of wild mugger ~~each state had in the wild~~, some of the good states were in the order of Tamilnadu, Gujarat, Rajasthan, Andhra Pradesh, Karnataka and Maharashtra.

III. MAIN BREEDING POPULATIONS (1984)

Tamilnadu: ① Amaravati, Bogenanal, Mettur, Mundanthurai,
② Sathanur, Chidambaram, Killikudu

Total: approx. 50 nests.

Gujarat: Hiran Lake (Gir)

Total: approx. 12 nests.

Andhra Pradesh: Ethipothala, Kinnersani, Lanjamadugu, Manjira, Nagarjun Sagar (Krishna), Srisailam, Gilera

Total:approx. 12 nests.

Contd.....6/

Karnataka:	Cauvery river at Ranganthitu-Sri Rangapatan Total: approx. 4 nests.
Maharashtra:	Tadoba National Park Total: upto 6 nests.
Bihar:	Bher River (Mutta), Kaimur Sanctuary Total: up to 6 nests.
Rajasthan: (excl. Chambal River)	Ranthambhore Total: up to 8 nests.
Madhya Pradesh (excl. Chambal)	Rangawa Dam (Panna), Bandhavgarh, Total: up to 5 nests
Uttar Pradesh: (excl. Chambal)	Corbett, Dudhwa, Girwa (Katerniyaghat) Total: up to 6 nests.
Chambal River	(M.P./Rajasthan/U.P.) Total: up to 12 nests.
Kerala:	Neyaar, Total: up to 3 nests.
~~West Bengal:~~	~~Damodar Valley.~~
Haryana:	Kurukshetra
Orissa:	Koraput (Balimela Dam Project), Ganjam (Bhaiyyanagar)
Arunchal Pradesh Assam, Nagaland and others:	Occurence reported but exact locations of breeding population not available.

IV. TOTAL POPULATION (1984)

Natural: approx. 1000 all sizes.

Released: ~~approx. 600~~ 600 — all results of wild collected eggs

Total: approx. 1600
(captive population: about 1500)

Trend: Increasing
(Extensive captive breeding taking place; ~~see another paper from this region~~).

*****

Captive Stock (Produced from wild collected eggs) — 3000

By captive breeding — 2500

Total Population — 7100

CRC/NCS/22
November, 1984
Revised: April, 1985

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Report on study tour to the 7th Working Meeting:
IUCN/Species Survival Commission
CROCODILE SPECIALISTS GROUP
held in Caracas, Venezuela (South America).

October 21-28, 1984

Indian delegation:

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Cover pic.: emblem of the COCODRILOS RACQUET PARK, Caracas, Venezuela.
Message: popularity of crocodiles from sport-hunters through sports-men.

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VI. INDIAN REPORTS

1. INDIA: STATUS OF WILD CROCODILIANS

L. A. K. Singh[1], S. Kar[2] and B.C. Choudhury[3]

INTRODUCTION

At the first Working Meeting of the Crocodile Specialists Group in 1971 the following were the status given to the Indian crocodilians (Honegger, 1971).

1. Gharial (Gavialis gangeticus): "Extremely rare" (based on Seshadri, 1969).
2. Saltwater crocodile (Crocodylus porosus): No mention, apparently thought to be fairly safe.
3. Mugger (Crocodylus palustris): "Exterminated in most areas of its range" (Daniel, 1970). Extremely rare (Seshadri, 1969).

By the fifth meeting in 1980 reports on the status were more clear and approximate number of crocodilians in the wild were known in most cases (Whitaker, 1982). The IUCN Red Data Book (1982 a) stated the status of Indian crocodilians as follows:

1. G. gangeticus: Endangered, extremely depleted.
2. C. porosus: Endangered, now seriously depleted and rare or extinct in most of its former ranges in India.
3. C. palustris: Vulnerable, now heavily depleted throughout the range.

At the last Working Meeting in 1982, the situations were accepted to be as before. The present paper provides updated information on the three species as regards their status before any release/rehabilitation took place through the Government's conservation management programme. Also given are the accepted population figures and the present locations of breeding populations.

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GAVIALIS GANGETICUS (GMELIN)

I. LEGAL STATUS:

INDIA:

1. Wildlife (Protection Act, 1972): Schedule I (Total Protection).
2. Export I instruction No.46/73: Export of animals and their products prohibited.

INTERNATIONAL:

1. CITES: Appendix I (India is a party)
2. IUCN Red Data Book: Endangered

II. PRE-RELEASE POPULATIONS:

River	State	Adult	Juvenile	Total	Source
1. Brahmaputra (1982)	Arunachal Assam, Nagaland	?	?	50	Mohanta, H., 1981; Choudhury, 1983.
2. Chambal (1977)	Rajasthan, M.P. U.P.	40	81	121	FAO, 1974; Anon. 1976; Whitaker and Daniel, 1980; Singh, V.B., 1978; IUCN, 1982b, Whitaker and Basu, 1983.
3. Girwa (1977)	Uttar Pradesh	9	19	28	Ramanand and Johri, 1982.
4. Ken (1980)	Madhya Pradesh	1	0	1	Anon., 1976, Singh, 1980.
5. Mahanadi (1976)	Orissa	4	4	8	Bustard and Singh, 1982.
6. Ramganga (1976)	Uttar Pradesh	0	4	4	Anon, 1975(?).
7. Son (1984)	Madhya Pradesh	18	0	18	Pandey, 1984

Total population: 230 including 72+ adults.

Although the above figures are improvements over Bustard, 1982 (60-70 nos.) and Whitaker, 1982 (less than 50 adults), the overall status remains the same, "endangered".

III. BREEDING POPULATIONS (1984)

1. River Chambal: (Places vs. average number of nests as of 1982-84)

Baroli- 7, Bharrah- 7, Tigri-Rithaura-2, Pureini- 10, Gyanpura- 2.

Total- 28

2. River Girwa:

Within a stretch of about 12km up to six nests.

3. River Mahanadi:

Last successful breeding: 1974; recommenced: 1984; number of nests: one with 24 eggs at Majhipada.

4. Brahmaputra:

Reports of breeding in the following tributaries are available but the exact status is unknown.

Arunachal Pradesh- Subansiri river; Assam- Dikho river and Dhansari river; Nagaland- rivers Doyong, Dikho and Disang.

5. Ramganga:

Uncertain.

IV. TOTAL POPULATION (1984)

River	Natural			Released	Grand* Total	Population trend
	Adult	Other	Total			
Brahmaputra	?	?	50	0	50	Unknown
Chambal	53	192	245	912	1157	Increasing
Girwa	9	19	28	85	113	Increasing
Ken	1	—	1	3	4	Stable
Mahanadi	6	2	8	150	158	Increasing
Ramganga	4	-	4	12	16	Unknown
Son	18	-	18	2	20	Stable (no male)
TOTAL	141	213	354	1164	1518**	Increasing

*Without considering losses among released gharial

**and captive population about one thousand

TOTAL POPULATION IN THE COUNTRY: 2518.

CROCODYLUS POROSUS SCHNEIDER

I LEGAL STATUS:

INDIA: As for Gharial

INTERNATIONAL: As for Gharial

II. PRE-RELEASE POPULATIONS:

Location	State	Adult	Juvenile	Total	Source
1. Bhitarkanika (1977)	Orissa	34	64	95	Kar and Bustard, 1982
2. Sundarbans (1978)	W.Bengal	4	96	100	Mail, Madras (27 Jan. 1978)
3. Andaman and Nicobar			up to		Whitaker and Whitaker,
North A.		50	150	100-200	1978
Middle A.		20	80	50-100	
South A.		10	20	20-30	
Nicobar		—	—	20-25	(Bhaskara, 1981)

Total population: up to 550 including 125 adults

III. BREEDING POPULATIONS (1984)

1. Bhitarkanika:

Over an area of 176 sqkm. up to eight nests.

2. Sunderbans:

A total of two nests every year.

3. Andamans:

Most of the nests are predated in the wild (Choudhury and Bustard, 1980). Exact extents of reproductive effort uncertain.

4. Goa:

Existence of viable population reported. Exact position unknown.

IV. TOTAL POPULATION (1984)

Location	Natural			Released	Grand* Total	Population Trend
	Adult	Other	Total			
Bhitarkanika	38	130	168	350	518	Increasing
Sunderbans	4	96	100	65	165	Increasing
Andamans	80	up to 250	upto 330	0	330	Unknown
Goa	?	?	?	0	?	Unknown
TOTAL	118+	480+	598+	415	1013+**	Increasing

*Without considering losses among released crocodiles.
**and captive population about 700. TOTAL POPULATION IN THE COUNTRY: 1713+

CROCODYLUS PALUSTRIS LESSON

I. LEGAL STATUS:

INDIA: As for Gharial

INTERNATIONAL: 1. CITES: Appendix I

2. IUCN Red Data Book: Vulnerable

II. PRE-RELEASE POPULATIONS:

Excepting the northern states of Jammu and Kashmir, Himachal Pradesh and Sikkim, mugger are reported to have occurred in all the other states during early 1970. Although no detailed census were conducted an accepted approximate population figure was around 1000 with a population trend "depleting faster than it could reproduce" (FAO, 1974). Based on the number of wild mugger some of the good states were in the order of Tamilnadu, Gujarat, Rajasthan, Andhra Pradesh, Karnataka and Maharashtra.

III. MAIN BREEDING POPULATIONS (1984)

Tamilnadu:	Amaravati, Sathanur, Hogennakal, Chidambaram, Killikudu, Mettur, Mundanthurai. Total approx. 50 nests.
Gujarat:	Hiran and other lakes (Gir). Total approx. 12 nests.
Andhra Pradesh	Ethipothala/Nagarjunasagar-Srisailam (Krishna), Kinnersani, Lanjamadugu, Manjira, Sileru. Total approx. 12 nests.
Karnataka:	Cauvery river at Ranganthitu-Sri Rangapatan, Tungabhadra and Bhima rivers. Total approx. 4 nests.
Maharastra:	Tadoba National Park, Powai Lake (Bombay). Total up to six nests.
Bihar:	Bher river (Mutta), Kaimur Sanctuary, Damodar Valley. Total up to 6 nests.
Rajasthan:	Ranthambhore, Pushkar Lake. Total up to 8 nests.
Madhya Pradesh:	Rangawa Dam (Panna), Bandhavgarh. Total up to 5 nests.
Uttar Pradesh:	Corbett, Dudhwa, Girwa (Katernivaghat) Total up to 6 nests.
Chambal river:	(Madhya Pradesh/Rajasthan/Uttar Pradesh). Up to 12 nests.
Haryana:	Kurukshetra.
Kerala:	Neyaar, Perambiculum. Up to 3 nests.
Orissa:	Koraput (Balimela Dam Project), Ganjam (Bhanjanagar).

III. MAIN BREEDING POPULATIONS (1984) contd.....

North-east rivers: (Arunachal Pradesh, Assam, Nagaland and West Bengal)
Occurrence reported but exact locations of breeding population not available.

IV. TOTAL POPULATION (1984)

Natural: Approx. 1000 all sizes.

Released: 600 (all from wild-collected eggs)

Captive: From wild-collected eggs- 3000

By captive breeding- 2500

Total: 7100

Trend: Increasing. (Extensive captive breeding in at least twelve centres).

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2. INDIAN CROCODILIANS : A 10-YEAR REVIEW OF MANAGEMENT

L.A.K. Singh[1], S. Kar[2] & B.C. Choudhury[3]

I. INTRODUCTION

Indian crocodilians (Gavialis gangeticus, Crocodylus porosus and Crocodylus palustris) are known to have close association with the Indian culture as religious symbols and use in indigenous medicines. Crocodilians were also used as exhibits and even maintained as imperial executioners. Hunting of crocodilians as a sport was popular only among a few Indian sport-hunters and although sporadic commercial hunting for the luxury leather trade did occur such killings are considered as only one among the various other more serious causes that were responsible for the depletion of the populations during the post-independence era. Among the major causes were the introduction of nylon gill netting and the prejudice against crocodilians as the enemy of fisheries. Other causes were the construction of dams and barrages and increased number of human habitation near crocodilian habitats with better net-work of approach roads. These developments are reflected in a shrinkage or total loss of crocodilian habitats.

After the establishment of the Indian Board for Wildlife in 1952 efforts by some individual Forest Officers and naturalists are known to have been made for the 'protection' of crocodilian populations in areas under their jurisdiction. A proposal was under consideration during 1971 to start commercial farming of crocodiles but by 1974 it had been realised that Indian Crocodilian resources were so depleted that they were not in a position to support the commercial exploitation. This was the period when U.N.D.P./F.A.O. collaborations in the form of technical expertise, soon followed with financial assistance, was made available to the Government of India to commence and promote the crocodile breeding and management programme in different states.

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[1]Government of India, Crocodile Research Centre of Wildlife Institute of India, Camp: National Chambal Sanctuary, Post Box 11, Morena-476 001.

[2]Government of Orissa, Crocodile Project, Camp: Chandbali, Balasore, Orissa.

[3]Government of India, Crocodile Research Centre of Wildlife Institute of India, Bahadurpura, Hyderabad-500 264, Andhra Pradesh.

II. MANAGEMENT GOALS (1974-75) AND ACHIEVEMENTS

1. Protection to remaining natural population:

Objective: Location of all the best crocodilian areas and creation of a few special crocodile sanctuaries for habitat and species management.

All important habitats for the different species have been identified and if these were not already within a Sanctuary or National Park, were formally declared as Crocodilian Sanctuaries. Some of these protected areas have been identified for introduction or reintroduction. Two such sanctuaries are in Andhra Pradesh, one for the saltwater crocodile (Coringa sanctuary: reintroduction) and the other for the gharial (Papikonda: probably reintroduction since the species is now known to have occurred in the Godavari (Bustard and Choudhury, 1982). The number of areas in which active protection is given to Crocodilians is 34 (20399 sq. km) and the number of specially created Crocodilian Sanctuaries is 13 (8346 sq. km. +) (Table fig. 1).

Although no special law or regulations were enacted since 1974, implementation of the existing regulations was vigorous. The best example of the present state of protection and management of sanctuares is the resumption of breeding by the wild population of the gharial after a lapse of ten years, (Satkoshia Gorge Sanctuary, 1984). Regeneration of mangroves, especially seen in the Bhitarkanika Sanctuary, is yet another example of rehabilitation through protection.

2. Rebuild natural populations.

Objective: To reduce natural losses through 'management'. The technique adopted was 'grow and release'. This involves collection of wild-laid eggs, incubation of eggs in hatcheries, rearing of the young crocodilians upto a 'releaseable' size (over a metre length), and release

of the juveniles in sanctuaries or other protected viable habitats.

The total number of eggs handled so far is, Gharial: c.6000; Mugger: c. 9000; Saltwater crocodile: 2500.
The total number of hatchlings handled is, Gharial: c. 4000; Mugger: c. 6000; Saltwater crocodiles: c. 1700 and the total number released is Gharial: 1164; Mugger: c. 600; saltwater crocodile: 415. The released Gharial are expected to commence breeding in 1985/86. Mugger breeding commenced with the population in Ethipothala in 1981 and Saltwater crocodiles are expected to commence breeding in 1985/86.

The post release monitor has been satisfactory. Recently, radio-tracking was used to monitor the movement and habiiat preference in sample populations including the released juveniles. Based on these studies species-wise recommendations have been made on restocking sites and seasons and to extend the limits of the sanctuaries into certain tributaties that are used during monsoon. While Gharial and Mugger have responded fairly well without causing any public concern stray incidents have come to the notice where C. porosus juveniles have entered village ponds. In response to complaints prompt action has been taken to shift such juveniles either back to captivity or th a different point for release.

Studies are in progress in selected sanctuaries to determine the average survival among released crocodilians. The indications have been very clear that the habitats have accepted the released juveniles and there are increasing trends in the populations. It is, however, felt particularly in the case of gharial that in the near future, as the recruitment into the adult group steadily increases, new areas may have to be developed to attract sub-adults to settle to form breeding groups. Studies are under progress to identify such potential areas and the extent of management requirements.

The public reaction has been indifferent to release. Several local people have been provided employment under the schemes as boatmen, crocodile/sanctuary guards, husbandry attendants, fish-suppliers and other general help for the upkeep of the centres and camps in the sanctuaries. The sanctuaries have attracted visitors from which the local people have definitely experienced an economic uplift (Singh 1980).

3. Promotion of captive breeding

Objective: To breed under simulated natural surroundings the available adults in certain zoos and similar organisation. Mugger have responded the best to captive breeding attempts (Table 2, fig.2) Atleast 15 centres are regularly breeding the species and eight others are being set up.

Gharial being a very specialised species in its breeding habitat requirements, has set a record by breeding in the Nandankanan Biological Park, Orissa since 1980. A special breeding pool holding 2.7 million litres of water has been used for breeding. The maximum depth of the pool is 10 metres.

Saltwater crocodile have bred in captivity at the Bhagabatpur centre and the Madras Crocodile Bank (a non-Government Trust (1'

4. Research

Objective: To take up studies that will improve the ongoing management programme.

The aspects that were immediately relevant to the grow and release techniques and the management of the Sanctuaries were given priority. This has overlooked several bio-chemical or embryological studies which may involve or require to sacrifice eggs or young or both. Some of the important aspects that were studied are:

-interpretations of the various types of data collected during survey and census.

-determination of parameters for maximum hatching success; (This had overlooked the role of temperature on sex differentiation, an aspect that is now being studied).

- husbandry of young crocodilians including feeding prescription, food conversion and growth.
- behavioural biology including reproduction, thermoregulation, feeding, orientation, locomotion, and reproduction; and
- habitat features and population structures.

5. Build up levels of trained personnel

Objective: On the spot research/training guided through FAO expertise in collaboration with local Universities. On the spot infra-level training to persons like 'keepers'. Institutional training to in-service Government personnel who will manage sanctuaries and rearing/breeding projects. Six Ph.Ds. 46 Foresters and over 200 other personnel have trained. A few researchers/Managers have also been sent on overseas study tours and fellowships to gather on-the-spot know-how on the research and management techniques.

III. SITUATION OVERVIEW

Aspect	Prior to 1974	1984
1. Population status of all species	Endangered and depleting	Endangered and increasing
2. Status of conservation	Localised and dependant on individuals	Definite country-wide programme
3. Legal protection	Provided	Same but strongly endorsed
4. Killings in the wild	Sporadic	Stopped
5. Number of special crocodile sanctuaries	None	Thirteen
6. Surveys conducted	Few; not in detail	Extensive
7. Public attitude	Religious, or indifferent toward conservation	Religious, most favour conservation, others in the process of being weaned away from a negative attitude.
8. Public media	Curious toward 'accidents' and sport killings	Constructive explanation to accidents, promote conservation need and programme.
9. Croc.-Fish relation	Widely misunderstood	Studies under progress towards a better understanding
10. Captive rearing	Zoos as exhibits	34 special units for conservation.
11. Captive breeding	3 zoos (all mugger)	16 (all species) 9 other places making serious breeding attep
12. Knowledge of ecology	Very limited	Much better understood.

IV. FUTURE PRIORITIES

The following priority programmes are suggested:

1. Sanctuary Management

   (a) Develop more adult zones.

   (b) Continue the search to identify other places where natural populations can be built up.

(c) Orient management on eco-system basis. (Extend the efforts to other flora and fauna, e.g. turtles, aquatic mammals and birds).

2. Captive husbandry

(a) Produce appropriate number of crocodilians of either sexes and try to restore a balanced ratio among the released populations.

(b) Study stress factors and maximise captive breeding productions.

3. Research

(a) Continue as needed in sanctuary and captive managements.

4. Training

(a) Extend specialised courses to persons already receiving general wildlife training.

(b) Build up expertise to permanently man each crocodilian sanctuary.

5. Farming

Commence the experimental closed-circuit pilot project with captive mugger.

V. OTHER EFFORTS

The Bombay Natural History Society have undertaken or supported extensive surveys of Crocodilians habitats. The Society have also remained as the only international organisation with a very strong appeal for conservation programmes in India. The Curator of the Society, Mr. J.C.Daniel, was the first Indian representative at the SSC/Crocodile Specialist Group.

Two other non-government organisations that have contributed to the cause of Crocodile Conservation in India are the Madras Snake Park Trust/Crocodile Bank and the World Wildlife Fund- India. The Snake Park have not only bred mugger and saltwater crocodiles, but have also

supplied several crocodiles to different states for restocking in the wild. The park now aims to become an international centre for breeding all species of Crocodilians.

VI. ACKNOWLEDGEMENTS

The authors are grateful to Shri Samar Singh, Joint Secretary and Director (Wildlife) to Govt. of India, Shri V.B. Saharia, Director, (Wildlife Institute of India) and Shri J.C. Daniel, Curator (Bombay Natural History Society) for their critical reading through the manuscripts and suggestions for improvements. Mr. R. Whitaker, provided information on the Madras Snake Park and Crocodile Bank.

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Fig. 3 Crocodilian sanctuaries and other areas offering active protection to crocodilians, 1984. Numbers as in Table 1.

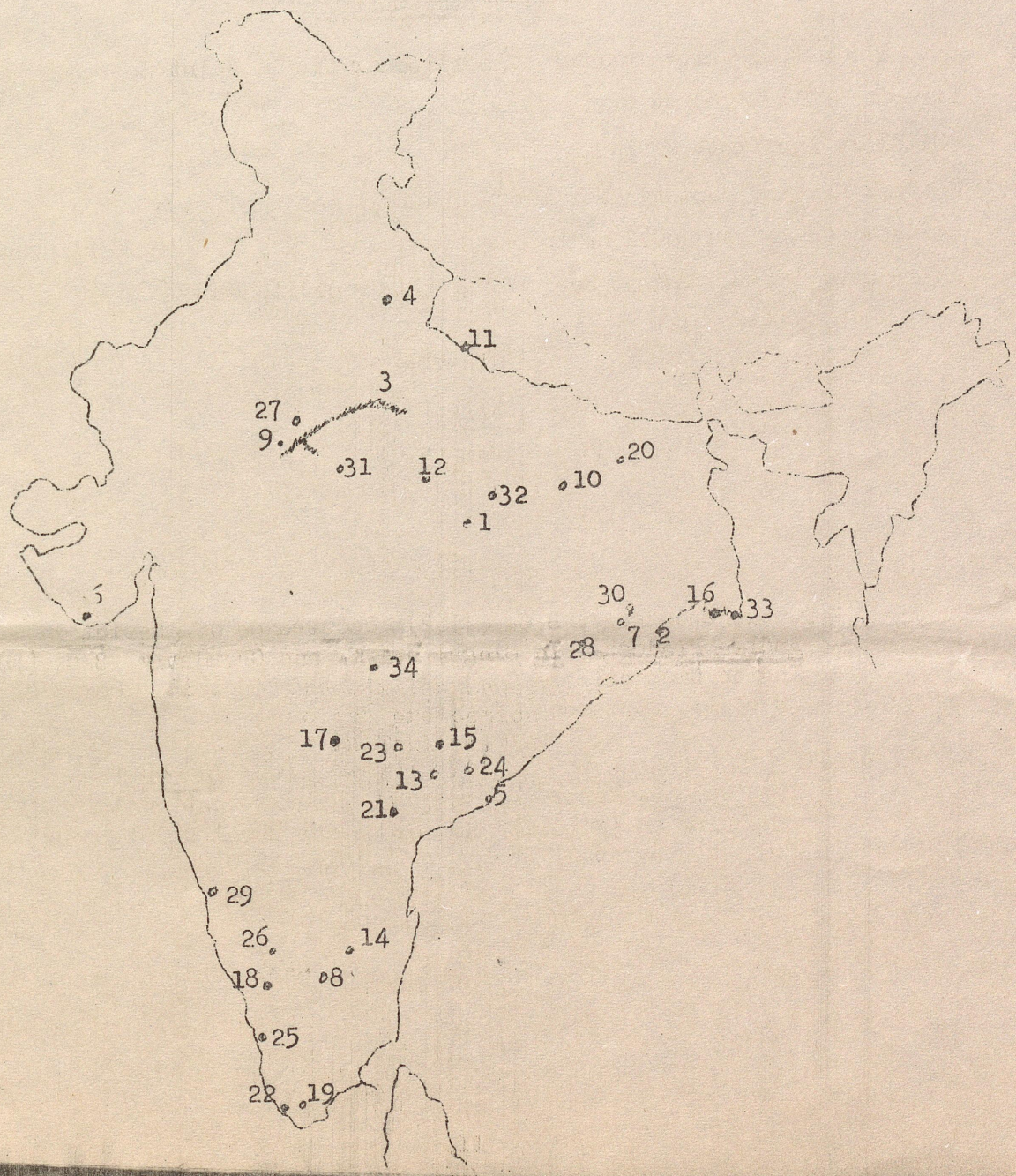

Fig. 4 Captive rearing/breeding schemes, 1984. Numbers as in Table 2. I, projects in the offing.

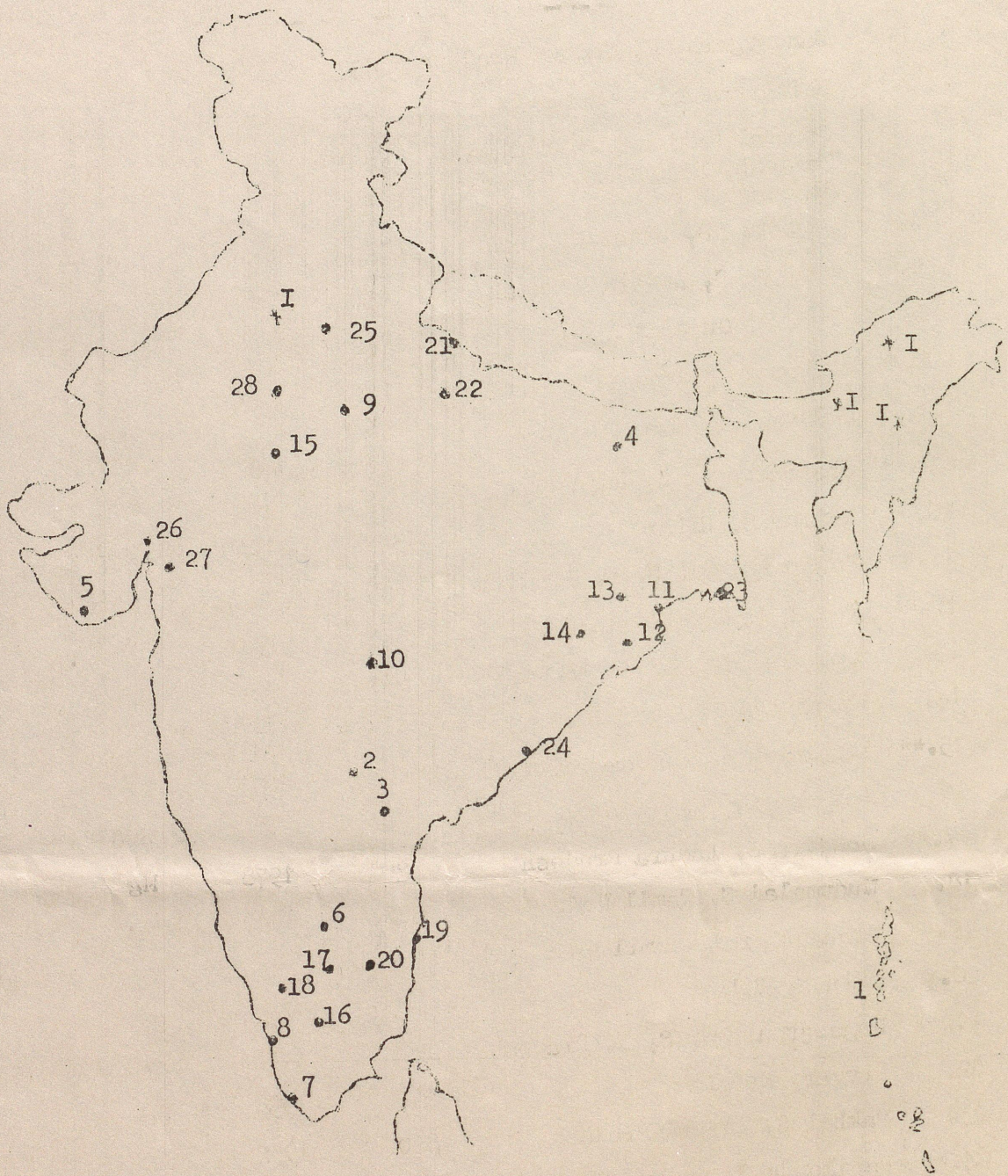

TABLE 1. CROCODILIAN SANCTUARIES(**) and other areas offering active protection to crocodilians, 1984. S, sanctuary; NP, National Park; Gh, gharial; Mg, mugger; SWC, saltwater crocodile.

Sl. No.	Name	Area sq.km.	Year commenced	Species managed	Number released
1.	Bandovgarh NP, Madhya Pradesh	437		Mg	
2.**	Bhitarkanika S, Orissa	650	1975	SWC	350
3.**	Chambal National S, Madhya Pradesh, Rajasthan, Uttar Pradesh	1500	approx. 1978	Gh (Mg)	912 (10)
4.	Corbett NP, Uttar Pradesh	525		Gh,(Mg)	12, (nil)
5.**	Coringa S, Andhra Pradesh	236	1978	SWC	3
6.	Gir NP, Gujarat	1412	1975	Mg	
7.**	Hadgarh S, Orissa	191	1978	Mg	
8.	Hoggenakal, Tamil Nadu			Mg	46
9.**	Jawaharsagar S, Rajasthan	100	1975	Gh	21
10.	Kaimur S, Bihar	1342	1969	Mg	
11.**	Katorniyaghat S, U. Pradesh	400	approx. 1976	Gh (Mg)	85 (nil)
12.**	Kon S, Madhya Pradesh	45	1982	Gh (mg)	3 (nil)
13.	Kinnersani, Andhra Pradesh	635		Mg	33
14.	Krishnagiri, Tamil Nadu			Mg	130
15.**	Lanjamodugu, Andhra Pradesh	20	1978	Mg	
16.	Lothian S, West Bengal	38		SWC	24
17.**	Manjira S, Andhra Pradesh	20	1978	Mg	
18.	Mudumalai S, Tamil Nadu	321	1940	Mg	6
19.	Mundanthorai, Tamil Nadu			Mg	21
20.	Muta S, Bihar	5	Proposed	Mg	
21.**	Nagarjunasagar S, A. Pradesh	3588	1978	Mg	154
22.	Neyyar, Kerala	270	1958	Mg	
23.	Pakhal S, Andhra Pradesh	860	1952	Mg	15
24.**	Papikonda S, Andhra Pradesh	591	1978	Gh	

contd.....

TABLE 1 contd.....

25.	Parambikulum, Kerala	285	1978	Mg	
26.	Ranganthittu S, Karnataka	26		Mg	
27.	Ranthambhore Tiger Reserve, Rajasthan	392	1959	Mg	
28.**	Satkoshia Gorge S, Orissa	796	1976	Gh (Mg)	150 (2)
29.	Sharawatly S, Karnataka	348	1972	Mg	
30.	Similipal Tiger Reserve, Orissa	2300	1970	Mg	60
31.	Shivpuri NP, Madhya Pradesh	156		Mg	25
32.**	Son S, Madhya Pradesh	209	1982	Gh (Mg)	2 (nil)
33.	Sunderban Tiger Reserve, West Bengal	2585		SWC	31
34.	Tadoba NP, Maharastra	116	1955	Mg	

TABLE 2. Captive rearing/breeding schemes, 1984. **Successful breeding commenced, *Successful breeding attempted; Gh, gharial; Mg, Mugger; SWC, Saltwater crocodile.

State/Union Territory	Sl.no.	Location	Year	Species
Andaman Nicobar	1.	Port Blair	1979	SWC
Andhra Pradesh	2.	Hyderabad	1976	Gh, SWC, Mg**
	3.	Nagarjunasagar	1979	Mg
Bihar	4.	Mutta	1976	Mg*
Gujarat	5.	Sasan Gir	1976	Mg
Karnataka	6.	Banarghatta	1980	Mg**, Gh*
Kerala	7.	Neyaar	1982	Mg
	8.	Peruvannamuzhy	1982	Mg
Madhya Pradesh	9.	Deori	1981	Gh

contd.....

TABLE 2 contd.....

Maharastra	10.	Tadoba	1977	Mg*
Orissa	11.	Dangamal	1975	SWC*
	12.	Nandankanan	1976	Gh**, Mg**, SWC*
	13.	Ramtirtha	1979	Mg**
	14.	Tikerpada	1975	Gh, Mg**
Rajasthan	15.	Kota	1975	Gh, Mg
Tamil Nadu	16.	Amaravati	1976	Mg**
	17.	Hogennakal	1976	Mg*
	18.	Masinagudi	1980	Mg
	19.	Madras	1975	Mg*
Uttar Pradesh	20.	Sathanur	1976	Mg**
	21.	Katerniyaghat	1975	Gh, Mg*
West Bengal	22.	Kukrail	1975	Gh, Mg*
	23.	Bhagabatpur	1976	SWC**

Other Captive breeding Records:

Andhra Pradesh	24.	Vishakapatanam Zoo	1978	Mg**, SWC*
Delhi	25.	Delhi Zoo	1976	Mg**
Gujarat	26.	Ahmodabad Zoo	1960	Mg**
	27.	Baroda Zoo	1965	Mg**
Rajasthan	28.	Jaipur Zoo	1967	Mg**
Tamil Nadu	29.	Madras Snake Park/ Crocodile Bank	1975	Mg**, SWC**

Other interested States:

1. Arunachal Pradesh, 2. Assam, 3. Haryana**, 4. Nagaland, 5. Goa**.