

[Reprint. from *Journal of the Bombay Natural History Society*, Vol. 79, No. 2, August 1982]

RESTOCKING MUGGER CROCODILE *CROCODYLUS PALUSTRIS*
(LESSON) IN ANDHRA PRADESH: EVALUATION OF A PILOT
RELEASE. B. C. CHOUDHURY AND H. R. BUSTARD. (*With two plates and
three text-figures*)

RESTOCKING MUGGER CROCODILE *CROCODYLUS PALUSTRIS* (LESSON) IN ANDHRA PRADESH: EVALUATION OF A PILOT RELEASE¹

B. C. CHOUDHURY² AND H. R. BUSTARD³

(With two plates and three text-figures)

Four years' monitoring results of a pilot mugger crocodile release carried out at Ethipothalla falls in Andhra Pradesh indicated excellent survival and growth and very little movement in the wild. The methodology of planning and carrying out a crocodile restocking programme together with the monitoring methods evolved during a four years' observation period are reported. The success of this pilot release programme provided the background for further large-scale releases in the State of Andhra Pradesh. First ever breeding of these released mugger took place in 1981.

INTRODUCTION

The Indian mugger (*Crocodylus palustris*) was considered to be a depleted species by Gee (1964), Misra (1970), Daniel (1970), Biswas (1970), Mukherjee (1974), Bustard (1974) and Shahi (1977). Naturally, the degree of depletion shows considerable regional variation in a country of the size of India. The Government of India Crocodile Project, following the advice of Bustard (FAO 1974), aimed to quickly rehabilitate India's three species of crocodilians by active management—collection of wild laid eggs for safe hatchery incubation and subsequent rearing of the young to a size of 1.20 m before restocking them in selected, well-protected areas of the natural habitat.

In 1976, the Andhra Pradesh Forest Department initiated a State Crocodile Project in association with the Government of India Project Crocodile Breeding and Management, receiving technical assistance from FAO/UNDP.

Detailed surveys carried out in the two major river systems of Andhra Pradesh (the Krishna

and Godavari) and in the State's numerous reservoirs, during the winter of 1976/1977 indicated that the total population of mugger crocodiles in Andhra Pradesh was extremely small. Only six breeding females were recorded in the entire State and the total population estimate was 30 individuals of above 1.0-1.5m (Choudhury, in prepn.).

Clearly, the mugger was critically endangered in Andhra Pradesh. It was, therefore, considered essential to restock mugger in suitable habitat areas in the State which could be given adequate protection by gazettement as sanctuaries, in order to build up natural breeding groups. This restocking would be carried out using project hatched and reared juveniles.

Bustard (FAO 1974), after examining several mugger habitats in Andhra Pradesh, had recommended the large pool and associated portion of the Chandravanka River, a tributary of the Krishna river immediately below the Ethipothalla waterfalls (Fig. 1), as an ideal area for pilot restocking purposes. Ethipothalla falls now lies in the easternmost limits of the Nagarjunasagar-Srisaïlam (Krishna) Sanctuary declared and gazetted through the Crocodile Project in June 1978. The sanctuary covers an area of 3600 sq km including much excellent mugger and tiger habitat. Bustard

¹ Accepted December 1981.

² Andhra Pradesh Crocodile Conservation Project, Nehru Zoological Park, Hyderabad-500 264.

³ Central Crocodile Breeding and Management Training Institute, Lake Dale, Rajendranagar Road, Hyderabad-500 264.

pointed out that Ethipothalla was a natural mugger habitat and recommended restocking using captive-reared juveniles from Nehru Zoological Park, Hyderabad, where a number of individuals of Andhra Pradesh stock were currently being reared. He also recommended a number of management objectives for the area. These included posting of guards to prevent people from going down to the falls, [both the falls and the crocodiles could be viewed from the top of the falls (FAO 1974)], and to prevent cattle grazing and cutting of grass and other disturbances in the river-bed below the falls. These proposals were accepted by the Government of Andhra Pradesh and the first release in Andhra Pradesh, which was also the first release of captive-reared mugger in Asia, took place at Ethipothalla falls on 8th February, 1977 at which time the guards were posted.

Subsequent releases, each of two individuals, took place on 23-12-78 and 16-9-1980 respectively.

In order to evaluate the success of this pilot release, on which further releases in the State would be based, detailed monitoring of the released mugger was devised in order to collect data on their survival, growth and movement in the wild. This paper sets out this methodology and presents results obtained over the last four years.⁴

RESTOCKING

The pilot restocking of mugger crocodiles in Andhra Pradesh required the following action to be taken :

1. Selection of :
 - (a) a release site
 - (b) the best time for release
 - (c) crocodiles to be released.

⁴ Following this, a further 176 mugger have been released into three wild life sanctuaries in Andhra Pradesh.

2. Pre-release check on the habitat to decide immediate action required.
3. Marking crocodiles for release.
4. Transporting crocodiles to the release site.
5. Actual release.

1 (a). Selection of the release site

Ethipothalla was chosen as the first release site on the basis of the recommendation made by Bustard (FAO 1974) specifically :

- (a) The area was formerly a mugger habitat holding a good mugger population until the early 1960's.
- (b) By 1977, the site was still ideal as a mugger habitat—in addition to the main pool immediately below the falls, there are ten other pools up to 5 m deep in a 3 km stretch of the Chandravanka river before joining the Krishna river 5 km below Ethipothalla falls. (Plate 1). These deep pools provide abundant perennial water. There is a good fish population in the pools. This fish population in the pools and small mammals from the surrounding jungle, provide food for the crocodiles.

The cessation of fishing activity under the management regime would ensure that the food resources would be available only for the crocodiles.

Additional advantages of this site for a pilot release of its kind were :

- (a) a manageable small area for protection, from below the falls to the Krishna river confluence—a distance of 5 km. The ideal mugger habitat extended over approximately 3 km and, therefore, was easier to monitor closely.
- (b) Since there were no existing mugger at the time of release all observed mugger

could be positively identified as released individuals without the need to check for marking.

- (c) The waterfall and crocodiles can be viewed easily from the top of the falls by research/wildlife staff and by visitors alike, with minimum disturbance.

1 (b). Release time

The chosen release site experiences the southwest monsoon from June to September. During this time the waterfall is usually in flood inundating the banks. The monsoon flow, combined with release of surplus water from the right bank canal of the Nagarjunasagar reservoir into the Chandravanka river (Fig. 1) keeps the waterfall discharge high up to De-

cember-January (Plate 1). Therefore, from July to December, the waterfall is usually under heavy discharge depending on rainfall and surplus water release. For the rest of the year (January to end of June) there is a modest water flow over the waterfall (Plate 2). This low water period also coincides with the nesting season of mugger which is March to April in this region.

Early February was considered the best time for release in order to give the captive-reared crocodiles a four month period to settle down and get acquainted with the habitat before the onset of monsoon and resultant floods. Meanwhile, during this dry period, the released crocodiles could be monitored easily and on the basis of these data, a broad, clear-cut monitoring programme could be formulated.

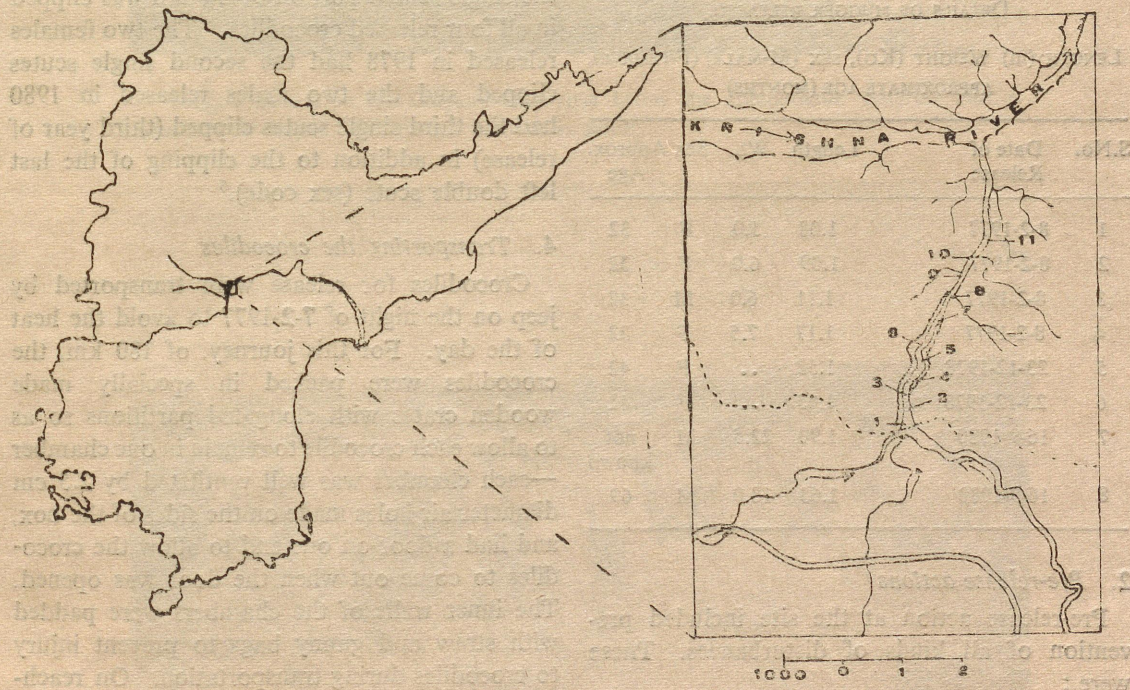


Fig. 1. Andhra Pradesh, showing the location of Nagarjunasagar Wild Life Sanctuary and inset showing the portion of the Sanctuary including Ethipothalla water falls on the Chandravanka River. The pools referred to in the text are numbered. Pool 1 is located immediately below the falls. Scale of inset in metres.

1 (c). *Selection of crocodiles for release*

At this time, Nehru Zoological Park, Hyderabad was rearing twelve wild caught juvenile mugger crocodiles—all caught in the nets of fishermen in the Krishna and Godavari rivers within the State. Four mugger, all above 1 m in size (Table 1) were chosen for release since it was considered that at this size crocodiles are capable of defending themselves. The group consisted of one male and three females. Subsequently, two more female mugger of 1975 year class, taken over from Nagarjunasagar P.W.D. were released and a further selection of two more males for release was made from the Nehru Zoological Park's collection (Table 1).

TABLE 1
DETAILS OF MUGGER RELEASED.

LENGTH (m) WEIGHT (KG), SEX (M-MALE) (F-FEMALE),
APPROXIMATE AGE (MONTHS)

S.No.	Date of Release	Length	Wt.	Sex	Approx. Age
1	8-2-1977	1.08	5.0	F	32
2	8-2-1977	1.09	6.0	F	32
3	8-2-1977	1.11	6.0	M	32
4	8-2-1977	1.17	7.5	F	32
5	23-12-1978	1.52	..	F	42
6	23-12-1978	1.63	..	F	42
7	16-9-1980	1.90	22.5	M	not known
8	16-9-1980	1.63	18.0	M	69

2. *Pre-release actions*

Pre-release action at the site included prevention of all kinds of disturbances. These were :

- (a) a ban on cattle and goat grazing below and near the fall and along the river banks.

- (b) a ban on fishing of any kind in the habitat combined with a general ban on the use of the main pool below the fall for recreational purposes, like swimming and bathing etc. This was considered essential in order to avoid conflict between the crocodiles and people.

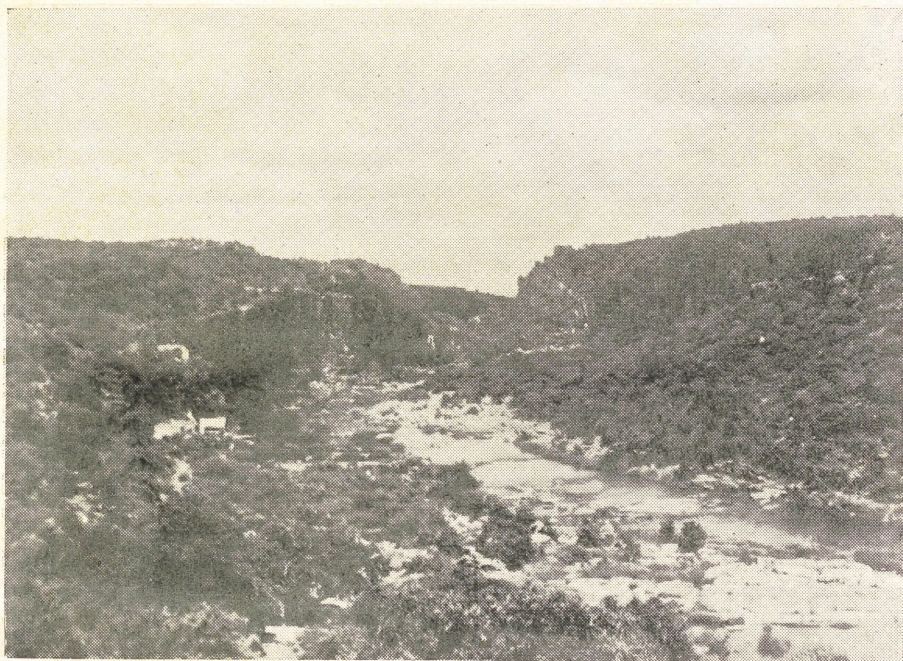
3. *Marking crocodiles for release*

Prior to release, the crocodiles were measured, sexed and marked for future identification. The marking method adopted was clipping of the enlarged scutes on the dorsal caudal region (Fig. 2). Males were clipped by removal (Plate 2) of the last left double caudal scute, looking at the animal from tail to head. No scute was clipped to indicate female sex. For the first year of release (1977), the first scute of the single scuted portion of the tail was clipped in all four released crocodiles. The two females released in 1978 had the second single scutes clipped and the two males released in 1980 had the third single scutes clipped (third year of release) in addition to the clipping of the last left double scute (sex code).⁵

4. *Transporting the crocodiles*

Crocodiles for release were transported by jeep on the night of 7-2-1977 to avoid the heat of the day. For this journey, of 180 km, the crocodiles were packed in specially made wooden crates with elongated partitions so as to allow each crocodile to remain in one chamber—each chamber was well ventilated by 2.5 cm diameter air holes made on the sides of the box, and had a door on one end to allow the crocodiles to come out when the door was opened. The inner walls of the chambers were padded with straw and gunny bags to prevent injury to crocodiles during transportation. On reach-

⁵ For details concerning the marking of crocodilians for release, see Bustard, H. R. and Choudhury, B. C. (1981).



Mugger habitat on the Chandravanka river below the Ethipothalla waterfall with a succession of rapids interspersed with deep pools.



Ethipothalla falls—monsoon level of water discharge.
(Photos : H. R. Bustard)



Ethipothalla falls during the lean season showing modest water discharge.



Clipping the second of the single scutes to identify year of release.

(Photos : H. R. Bustard)

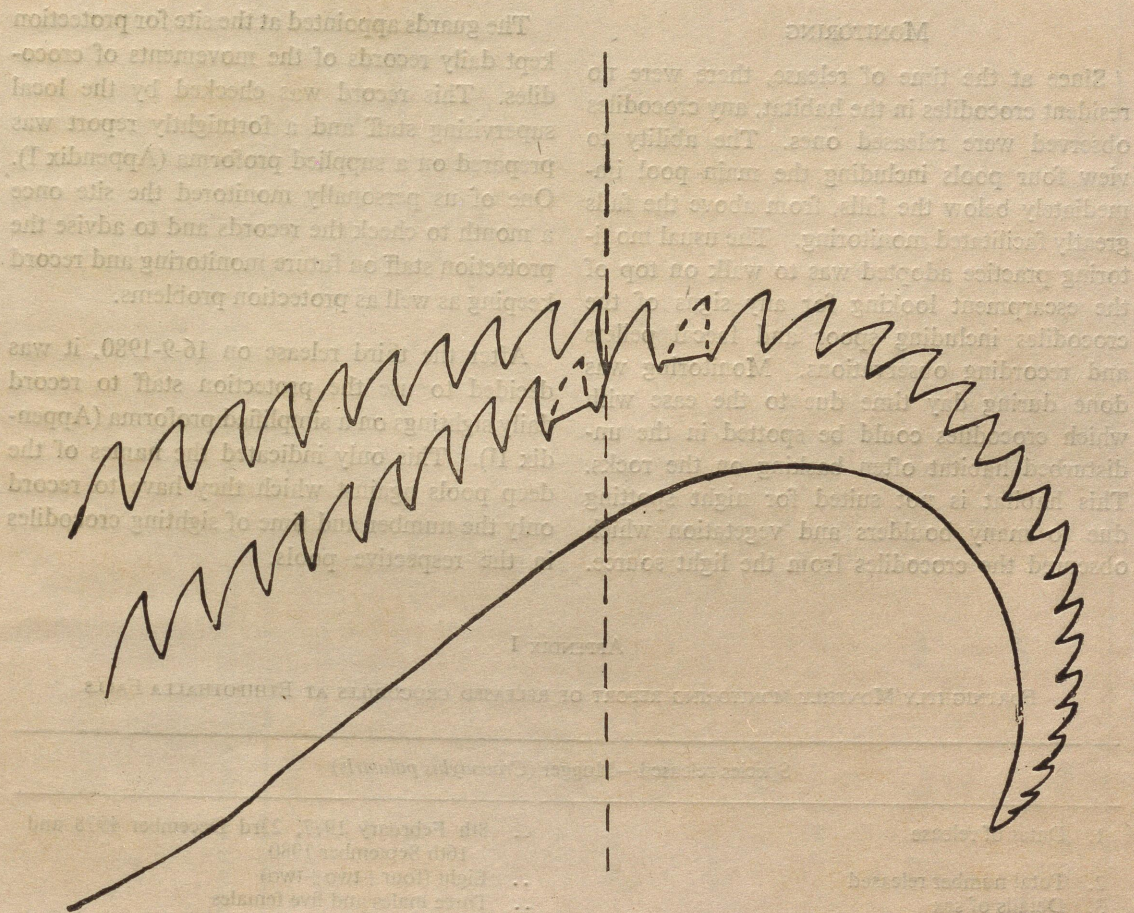


Fig. 2. Crocodile tail showing arrangement of double and single scutes. The dotted lines show the division between these. The last of the double scutes on the left hand side has been clipped denoting that the individual is a male. The second of the single scutes has also been clipped denoting year two release. In both cases the dotted portion of the scutes has been removed.

ing the destination, the crocodiles were kept in the shade well moistened until the release time.

5. Actual release

The initial release took place at 1700 hours on 8-2-1977. The crates containing the crocodiles were taken down to the main pool below the falls and kept with their door end facing

the water. On opening the door of the crates, the crocodiles faced the water, and could come out of the box on to the bank of the pool. The time taken for the crocodiles to emerge varied from five to fifteen minutes.

Further releases of two female mugger on 23-12-1978 and two males on 16-9-1980 were carried out at the same spot.

MONITORING

Since at the time of release, there were no resident crocodiles in the habitat, any crocodiles observed were released ones. The ability to view four pools including the main pool immediately below the falls, from above the falls greatly facilitated monitoring. The usual monitoring practice adopted was to walk on top of the escarpment looking for any signs of the crocodiles including spoor and faecal pellets and recording observations. Monitoring was done during day time due to the ease with which crocodiles could be spotted in the undisturbed habitat often basking on the rocks. This habitat is not suited for night spotting due to many boulders and vegetation which obscured the crocodiles from the light source.

The guards appointed at the site for protection kept daily records of the movements of crocodiles. This record was checked by the local supervising staff and a fortnightly report was prepared on a supplied proforma (Appendix I). One of us personally monitored the site once a month to check the records and to advise the protection staff on future monitoring and record keeping as well as protection problems.

After the third release on 16-9-1980, it was decided to use the protection staff to record daily sightings on a simplified proforma (Appendix II). This only indicated the names of the deep pools against which they have to record only the number and time of sighting crocodiles in the respective pools.

APPENDIX I

FORTNIGHTLY/MONTHLY MONITORING REPORT OF RELEASED CROCODILES AT ETHIPOTHALLA FALLS

Species released—Mugger (*Crocodylus palustris*)

1. Dates of release	.. 8th February 1977, 23rd December 1978 and 16th September 1980
2. Total number released	.. Eight (four+two+two)
3. Details of sex	.. Three males and five females
4. Marking codes	.. Males last left double caudal scute and first or third single caudal scutes clipped. Females first or second single caudal scutes clipped.

To be filled in by the Observer

1. Date of Observation	..
2. Water level in the fall	.. Low/Moderate/High
3. Weather condition	.. Sunny/Cloudy/Rainy
4. Air temperature	..
5. Water temperature	..
6. Crocodiles observed (number, location etc.)	..
7. Average basking time of crocodiles for the day	..
8. Information on observations by local watchmen during last fortnight/month	..
9. Remarks/Suggestions of the observer	..

Date :

Signature of the observer

Name in full :

APPENDIX II

DAILY OBSERVATION PROFORMA (TO BE RECORDED BY LOCAL WATCHERS)

Date	Day	Time	POOLS											Weather			Remarks	
			1	2	3	4	5	6	7	8	9	10	11	Sun	Cloud	Rain		
26-4-1981	..	Sunday	AM	10.30	..	11.30	..	..	..	..	..	..	..	..	..	..	..	..
			PM	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3.00	Nil
27-4-1981	..	Monday	AM	11.15	..	..	..	..	..	..	..	..	..	..	..	..	✓	Nil
			PM	..	..	3.00	4.30	..	..	..	..	..	..	..	..	Nil	..	..	..
28-4-1981	..	Tuesday	AM	9.30	..	10.30	..	..	..	..	..	..	..	..	..	..	..	..
			PM	..	..	..	3.15	..	..	4.45	..	..	..	..	..	✓	Nil	Nil	..
29-4-1981	..	Wednesday	AM	10.00	..	11.15	..	..	..	..	..	..	..	..	..	..	..	..
			PM	..	..	..	4.00	..	..	..	..	2.30	..	..	✓	Nil	Nil	..	..
30-4-1981	..	Thursday	AM	9.00	..	9.30	11.15	..	..	..	..	..	..	..	..	..	..	..
			PM	..	..	..	..	..	..	..	..	..	..	..	..	✓	Nil	Nil	..
1-5-1981	..	Friday	AM	8.00	..	8.30	..	..	9.00	..	..	..	..	..	..	..	..	..
			PM	..	..	..	..	..	..	..	..	3.00	..	..	✓	Nil	Nil	..	..
2-5-1981	..	Saturday	AM	..	..	..	..	..	10.00	..	..	8.30	..	..	..	..	..	..
			PM	3.30	..	4.00	12.00	..	..	..	..	..	..	..	✓	Nil	Nil	..	..

Name and signature of recorder

RESTOCKING MUGGER CROCODILE

RESULTS

The results set out below are grouped under three headings ; survival, movement and growth.

Survival

The total number of crocodiles observed on each monitoring trip by one of us (BCC) is given in Table 2. Table 3 gives the crocodiles sighted by the supervisory staff in each monitoring trip, and in Table 4 the daily records of the local protection staff are set out for the month of January 1981. Combining the data from the three Tables, a clear picture of the survival of released mugger can be obtained. The supervisory monitoring and the research monitoring visits were mostly of one day's duration and allowed a maximum 5-6 hours observation at the release site. On the last 6 visits by us, the actual monitoring time has been reduced to 2-3 hours per visit. Despite the brief duration of these visits, it can be clearly seen from Table 2 that the 1977 released crocodiles were resighted regularly following the release. That all survived after rehabilitation to the wild from zoo life is apparent from the monitoring result of 8 February 1978 (a full year after release), when all four were again resighted. One year later (on 13 March 1979) five of the (then) six released crocodiles were resighted. Following release of a further two individuals on 16-9-1980 the maximum number sighted has been seven.

The monitoring data of the local staff is more complete (Table 4), with 5 individuals seen on a single day (January 3, 1981) and on several observations six individuals have been observed (Fig. 3). On 17th May 1981 the local staff sighted 7 (of the 8) crocodiles. Since the local protection staff were present most of the time and operate from both ends of the habitat, their monitoring was more complete and they have sighted seven out of eight crocodiles so far.

Though all the eight mugger released have never been observed on any one day, it is believed that the survival has been 100% and that all mugger have not been observed because attempts to cover the whole area on a single day for a longer observation period have not been made. Pending this, it can be definitely stated that seven out of the eight mugger have survived.

Movement

Taking the 1977 release first, it can be seen that extremely little movement occurred in the year following release. Two mugger showed movement of within 100 m, one moved 500 m downstream and returned to pool 1 and one female moved a distance of 800 m and took up residence in pool 5. One individual of the second release (December 1978) has been sighted in pool 11 at a distance of 3 km below the release site from September 1980, and the sighting of most, if not all, crocodiles on each monitoring trip provided clear evidence that movement out of the area had not taken place. With improvement of the monitoring work and further releases over the years, all areas below the falls have been mapped and their distance from the main release pool measured. Since the mugger cannot move upstream due to the high falls, movement only took place in one direction—downstream. The data indicate how far mugger crocodiles move downstream, either voluntarily or due to effect of monsoon floods. As has been described above, the release site consists of a series of deep pools and for our monitoring purpose, 11 pools have been mapped. The last pool is located at a distance of 3 km below the fall. The nearest pool to the main pool is only 50 m distant. All movements were restricted to this 3 km stretch even allowing for four monsoon floods (the 1977 monsoon following the first release was the worst in living memory extensively flooding the area.)

RESTOCKING MUGGER CROCODILE

TABLE 2

MONITORING RESULTS OF RESEARCH STAFF. THE DISTANCE MOVED BY CROCODILES WHICH HAD MOVED DOWNSTREAM FROM THE MAIN POOL IS GIVEN IN METRES IN BRACKETS

Date	Total Number of crocodiles seen	Main Pool	Distance below main pool
1	2	3	4
1977			
25th March ¹	4	2	2 (100)
22nd April	3	2	1 (100)
17th May	4	2	1 (100), 1(50)
8th June	4	3	1 (300)
3rd July	3	2	1 (100)
8th August	3	2	1 (100)
9th October	4	2	2 (50)
23rd November	..	..	..
14th December	2	..	1 (100), 1(500)
1978			
28th January	2	2	..
8th February	4	3	1(800)
30th March	2	2	..
28th April	3	3	..
28th May	3	3	..
14th June	3	3	..
6th September	3	3	..
23rd December ²	4	2	1 (500), 1 (200)
1979			
13th March	5	4	1 (50)
3rd April	3	3	..
11th August	2	2	..
17th November	2	2	..
1980			
13th January	3	2	1 (500)
21st February	3	3	..
3rd May	4	2	1 (400), 1 (100)
15th June	3	2	1 (400)
17th September ³	2	1	1 (200)
9th November	3	1	1 (100), 1(800)
1981			
27th January	3	2	1 (500)
27th February	3	3	..

¹ Four crocodiles released.

² Two additional crocodiles released on 23-12-1978 increasing the total population to six individuals. On this date monitoring was carried out *prior* to this release and all four individuals sighted.

³ Two additional crocodiles released on 16-11-80 increasing the total to 8.

TABLE 3

MONITORING RESULTS OF LOCAL SUPERVISORY WILD LIFE STAFF, CONDUCTED AT APPROXIMATELY
FORTNIGHTLY INTERVALS, COVERING THE PERIOD 28 DECEMBER 1977 TO 1 SEPTEMBER 1980.
THE DISTANCE MOVED BY CROCODILES WHICH HAD MOVED DOWNSTREAM FROM THE MAIN POOL IS
GIVEN IN METRES IN BRACKETS

Date	Total number of crocodiles seen	Main Pool	Distance below main pool	Waterflow
1977				
28th December	..	..	..	Moderate
1978				
5th February ..	..	..	..	Moderate
9th March ..	2	2		Moderate
21st May ..	1	1		Low
24th May ..	2	2		Low
14th June ..	3	2	1 (500)	Moderate
11th August ..	3	3		Full
25th August ..	2	2	1 (500), 1 (100)	Full
22nd December ..	4	2		
1979				
6th January ..	4	3	1(500)	Moderate
18th January ..	3	3		Moderate
28th January ..	3	3		Low
3rd February ..	2	2		Low
11th February ..	4	4		Low
18th February ..	2	2		Low
9th April ..	2	2		Low
16th April ..	4	4		Low
23rd April ..	5	3	2 (600)	Low
6th May ..	3	3		Low
13th May ..	3	1	2 (600)	Low
20th May ..	5	3	2 (600)	Low
27th May ..	2	2		Low
3rd June ..	4	2	2 (600)	Low
12th June ..	5	3	2 (600)	Low
24th June ..	2	2		Low
10th July ..	3	3		Low
22nd July ..	4	4		Low
5th August ..	4	4		Low
12th August ..	3	3		Low
28th August ..	2	2		Low
11th September	1	1		Full
23rd September	2	2		Full
7th October ..	3	3		Moderate
14th October ..	3	3		Moderate
21st October ..	1	1		Moderate
28th October ..	2	2		Moderate
4th November	2	2		Moderate
19th November	2	2		Moderate
2nd December	3	3		Moderate

RESTOCKING MUGGER CROCODILE

Date	Total Number of crocodiles seen	Main Pool	Distance below main pool	Waterflow
1980				
1st January ..	2	2		Moderate
16th January ..	3	3		Moderate
1st February ..	3	3		Moderate
16th February ..	2	2		Moderate
2nd March ..	2	2		Moderate
16th March ..	2	2		Low
1st April ..	2	2		Low
16th April ..	2	2		Low
1st May ..	2	2		Low
16th May ..	2	2		Low
1st June ..	2	2		Low
16th June ..	3	2	1 (100)	Low
1st July ..	2	2		Low
16th July ..	2	2		..
1st August ..	2	2		..
16th August ..	2	2		..
1st September ..	2	2		..

Growth

At the time of the first release of four mugger of estimated age 2 years 8 months, on 8th February, 1977, the average size was 1.11 m (Table 1). At the time of the second release of two mugger estimated to be three and a half years old, on 23rd December, 1978 (22 months after the first release), a footprint of the first released mugger was measured and from this it was estimated that the size of the mugger was 1.6 m (the possible error of estimation at this size is ± 5 cm). This indicated a growth rate of about 50 cm in 22 months by which time the mugger were approximately four and a half years old.

Thereafter, no further footprints have been measured, and size estimation has been carried out visually. On the day of the third release on 16th September 1980, (22 months after second release) the resident mugger were almost identical with the 1.9 m male released on that day. The growth rate, therefore, during the next 22 months, by which time the mugger were about six and a half years old, was about

30 cm. An overall growth of 80 cm, was recorded in 44 months, in the wild, for mugger between the approximate ages of two and a half years and six and a half years.

Breeding

The first wild breeding of these released mugger took place in 1981. The female, from the second release, which bred, was in her seventh year. A full account of this will be published in due course.

DISCUSSION

The importance of selecting an ideal release site cannot be overstressed. If this is wrongly chosen the release is doomed to failure. In order to give the released crocodilians every opportunity to adjust to and become acquainted with their new surroundings, prior to the onset of the monsoon, the release season is also of key importance. Crocodiles should be released in the early spring, at least three months prior to the commencement of the monsoon.

TABLE 4

MONITORING RESULTS BY THE LOCAL PROTECTION STAFF ON A DAILY BASIS. THESE RESULTS ARE GIVEN FOR JANUARY 1981 FOR COMPARISON WITH THE DATA IN TABLE 2. AN ASTERISK (S) INDICATE(S) THE SIGHTING OF A CROCODILE(S), THE TIME OF SIGHTING IS ALSO GIVEN. THE LOCATION REFERENCES ARE GIVEN IN THE TEXT AND IN

FIGURE 1

Date (Jan. 1981)	Main Pool	Location											Total seen
		1	2	3	4	5	6	7	8	9	10	11	
1	.. **1545	..	..	*0900	..	..	..	..	*1200	..	..	..	4
2	.. *0930	..	..	..	..	..	*1200	..	..	..	*1600	..	3
3	.. *0900	..	..	*0945	..	..	*1200	..	*1400	..	*1600	..	5
4	.. *0900	..	..	*1000	..	..	*1330	..	..	..	*1600	..	4
5	.. *0930	..	..	*1100	..	..	..	..	..	..	..	..	2
6	.. *1000	..	..	*1030	..	..	..	..	..	..	*1545	..	3
7	.. *0900	..	..	..	..	..	*1100	..	*1500	..	..	..	3
8	.. *0930	..	..	..	..	..	*1200	*1230	..	..	..	..	3
9	.. ..	..	..	..	..	..	*1400	..	..	..	*1600	..	2
10	.. **0945	..	..	*1030	..	..	..	..	..	*1600	..	..	4
11	.. *0900	..	..	*1000	..	..	..	..	..	..	..	..	2
12	.. **1100	..	..	*0930	..	..	..	..	*1500	..	..	..	4
13	.. **1545	..	..	*1000	..	..	..	..	..	..	*1600	..	3
14	.. *1000	..	*1500	..	..	..	..	..	*1530	..	..	..	4
15	.. **1230	..	*1600	..	..	..	..	..	..	..	..	..	3
16	.. **1600	*1530	..	*1000	..	..	..	..	..	..	..	..	4
17	.. **1045	..	*1200	*1400	..	..	..	..	..	..	..	..	4
18	.. **1100	..	..	*1230	..	*1400	..	*1500	*1630	..	..	..	6
19	.. *0900	..	..	..	*1100	..	*1300	..	..	*1600	..	..	4
20	.. **1200	..	..	*1430	..	..	..	..	*1500	..	..	..	4
21	.. **0800	..	..	*1000	..	..	*1200	..	..	..	..	..	4
22	.. *0930	..	..	*1100	..	..	..	..	*1400	..	..	..	3
23	.. *1000	..	..	..	..	*1400	..	..	..	..	*1600	..	3
24	.. **1130	..	..	*1230	..	..	..	..	*1630	..	..	..	4
25	.. *0900	..	..	*1030	..	..	..	..	..	..	..	..	2
26	.. *0930	..	..	*1000	..	..	..	..	*1500	..	..	..	3
27	.. **1200	..	..	*1500	..	..	..	..	..	..	..	..	3
28	.. *1500	..	..	..	..	..	..	..	..	..	..	..	1
29	.. *1000	..	..	*1130	..	..	..	..	..	..	..	..	2
30	.. **1500	..	..	*1000	..	..	..	..	..	..	*1530	..	4
31	.. *1000	..	..	..	..	..	..	..	..	..	..	..	1

RESTOCKING MUGGER CROCODILE

The best size for release also requires discussion. It is possible with mugger crocodiles, for instance, to release individuals much smaller than the 1.1 m size used here. Singh (1976) reported on two mugger of 56 and

under all conditions throughout the country. There are a number of good reasons for selecting this size. There are also doubts that small mugger will show good survival at least in certain habitats as they will be unable to defend

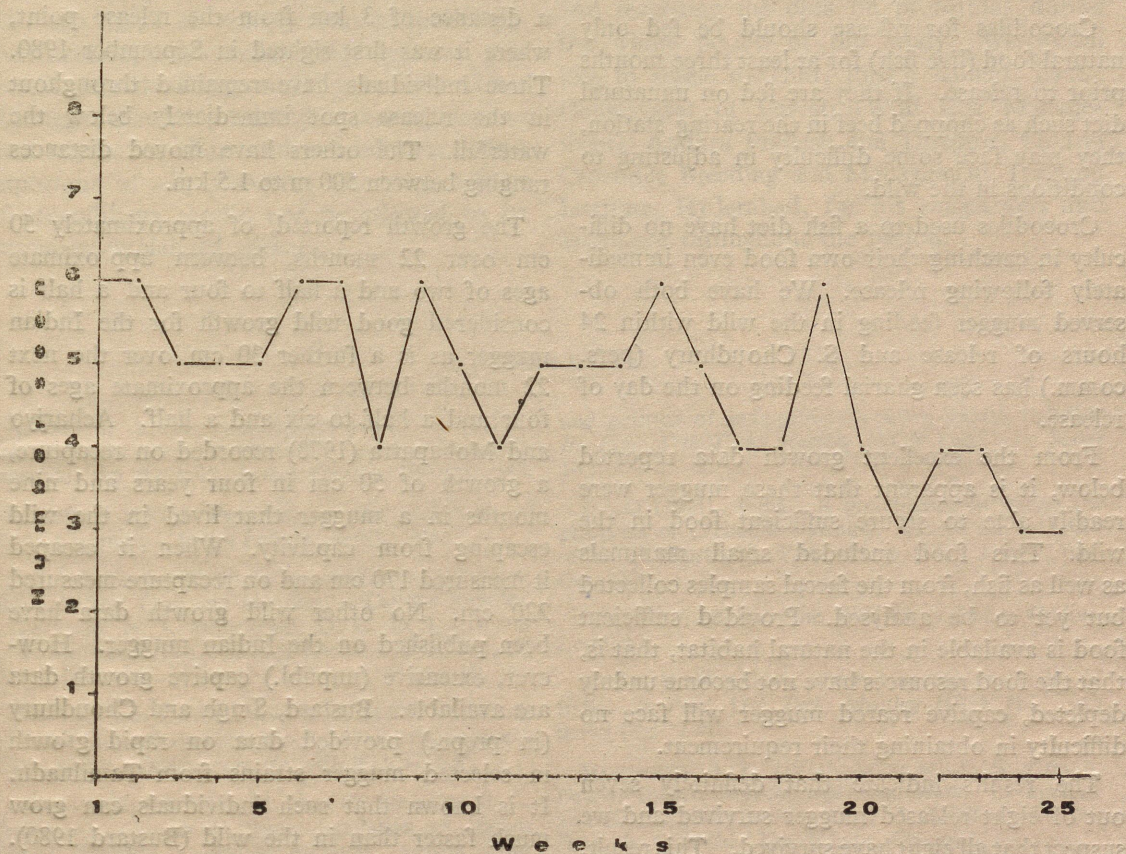


Fig. 3. Daily maxima for crocodile sightings plotted on a weekly basis for the period 29 September 1980 to 7th March 1981. The form of this plot does *not* indicate a falling trend in numbers observed. The apparent fall in February/March is due to the heat of the summer when the crocodiles remain mostly in the water making observation difficult. Furthermore, 7 individuals were seen on 17th May, 1981, a higher figure than that recorded since the study has commenced.

41 cm respectively, which escaped from their hatchling pool into the adjacent Mahanadi river (Orissa) during October 1975. Both survived and are still there today. The release sizes recommended here, of 1.0-1.2 m, is that for which we feel the survival rate will be high

themselves from all predators. Burrow construction is also important in the mugger as a means of avoiding extremes of both heat and cold. Animals of below 1.2 m have not been observed digging burrows (B.C. Choudhury, unpubl. observ.). Further below 80 cm, it is

not possible to reliably sex mugger using the cloacal probing technique.

It is essential that the protection staff are appointed prior to the release in order not to lose valuable data (see below).

Crocodiles for release should be fed only natural food (live fish) for at least three months prior to release. If they are fed on unnatural diet such as chopped beef in the rearing station, they may face some difficulty in adjusting to conditions in the wild.

Crocodiles used to a fish diet have no difficulty in catching their own food even immediately following release. We have both observed mugger feeding in the wild within 24 hours of release and S. Choudhury (pers. comm.) has seen gharial feeding on the day of release.

From the excellent growth data reported below, it is apparent that these mugger were readily able to secure sufficient food in the wild. This food included small mammals as well as fish, from the faecal samples collected but yet to be analysed. Provided sufficient food is available in the natural habitat, that is, that the food resources have not become unduly depleted, captive reared mugger will face no difficulty in obtaining their requirement.

The results indicate that definitely seven out of eight released mugger survived and we suspect that all eight have survived. This result, in itself, demonstrates the validity of the 'rear and release' technique.

We believe that given the ideal conditions, in undisturbed natural habitats, mugger move very little, if at all. This belief is also borne out by the results of this pilot release. The release point is 5 km upstream from the junction of the Chandravanka river with Krishna river. Even despite the massive floods of 1977, none of the mugger ever went down to the Krishna during the four years covered by this study. The maximum distance moved by

individuals of the first release was by one female which moved 800 m downstream in 1978 (the year following release). The female has subsequently remained at this site. A female of the December 1978 release, moved to pool 11, a distance of 3 km from the release point, where it was first sighted in September 1980. Three individuals have remained throughout in the release spot immediately below the waterfall. The others have moved distances ranging between 500 m to 1.5 km.

The growth reported, of approximately 50 cm over 22 months, between approximate ages of two and a half to four and a half is considered good wild growth for the Indian mugger as is a further 30 cm over the next 22 months between the approximate ages of four and a half to six and a half. Acharjyo and Mohapatra (1978) recorded on recapture, a growth of 50 cm in four years and nine months in a mugger that lived in the wild escaping from captivity. When it escaped it measured 170 cm and on recapture measured 220 cm. No other wild growth data have been published on the Indian mugger. However, extensive (unpubl.) captive growth data are available. Bustard, Singh and Choudhury (in prepn.) provided data on rapid growth in selected mugger strains from Tamilnadu. It is known that such individuals can grow much faster than in the wild (Bustard 1980). These rapid growing captives increased by about 65 cm, during the same period that the wild mugger here described increased by 50 cm. In the 5th year the captive mugger grew by 30 cm, whereas the wild individuals took two years to show this length increase from four and a half to six and a half years of age.

Data collected from the pilot release and monitoring of mugger crocodiles at Ethipothalla falls provided the Andhra Pradesh Crocodile Project the required informational

RESTOCKING MUGGER CROCODILE

basis for further releases. Other than confirming most of the hypothesis on mugger behaviour, survival, movement and growth, the pilot release also provided opportunity to evolve a good monitoring system and to train personnel on management methodology. Furthermore, such small pilot releases prevented the risk of large-scale, unsuitable release of mugger that are produced in rearing stations with maximum effort and expenditure. Most important of all, resources like rare species of crocodilians should not be allowed to be wasted by unplanned releases.

ACKNOWLEDGEMENTS

We wish to acknowledge our appreciation to the field personnel of the Andhra Pradesh Forest Department who helped in monitoring and recording the data on proformas during the whole period of the study. We would like to single out Shri Pushp Kumar, I.F.S., Conservator of Forests (Wild Life Management), Andhra Pradesh and Director, Central Crocodile Breeding and Management Training Institute, Hyderabad, for his suggestions and assistance throughout the period.

REFERENCES

- ACHARIYO, L. N. AND MOHAPATRA, S. (1978): Return of the Captive Marsh Crocodile (*Crocodylus palustris*) into the wild, *Indian Forester* 104 (5): 385.
- BISWAS, S. (1970): Proposal for the protection of Marsh Crocodile. *Indian Forester* 96 (9): 704.
- BUSTARD, H. R. (1980): Captive breeding of crocodiles. In *The Care and Breeding of Captive Reptiles*. S. Townson, N. J. Millichamp, D. G. D. Lucas and A. J. Millwood (Eds.). British Herpetological Society, 1980. 1-20.
- AND CHOUDHURY, B. C. (1981): Marking Crocodiles for release back into the wild for subsequent identification. *Indian Forester*, 107 (8): 477-485.
- , SINGH, L. A. K. AND CHOUDHURY, B. C. (*In prepn.*): Growth in three population of Indian mugger crocodile, *Crocodylus palustris*, Lesson, from Tamil Nadu, South India.
- CHOUDHURY, B. C. (*In prepn.*): Status of Mugger crocodile (*Crocodylus palustris*, Lesson) in Andhra Pradesh.
- DANIEL, J. C. (1970): A Review of the present status and position of endangered species of Indian Reptiles. *In Proc. 11th Tech. Meeting IUCN Pub. New Series* 18: 75-76.
- F.A.O. (1974): India. A preliminary survey of the prospects of Crocodile Farming. (Based on the work of H. R. Bustard.) FAO Rome (FO: IND/71/033) Oct. 1977.
- GEE, E. P. (1964): *The Wildlife of India*. Collins, London.
- MISRA, R. N. (1970): The endangered crocodiles of India. *In Proc. 11th Tech. Meeting IUCN Pub. New Series* 18: 77-81.
- MUKHERJEE, A. K. (1974): Some examples of recent Faunal Impoverishment and Regression. *In Ecology and Biogeography in India* (Ed) M. S. Mani. Dr. W. Junk. b. v. Pub. The Hague, 330-367.
- SINGH, L. A. K. (1976): When back to the wild and Back to the wild. *Cheetal*, Journal of the Wildlife Preservation Society of India. 18 (1 and 2): 20-23.
- SHAHI, S. P. (1977): *Backs to the Wall-Saga of wildlife in Bihar, India*. East-West Press, New Delhi.

DRAFT

SUCCESSFUL BREEDING OF REHABILITATED MUGGER CROCODILE
IN ANDHRA PRADESH, INDIA.

B.C.Choudhury
Andhra Pradesh Crocodile Conservation Project,
Nehru Zoological Park, Hyderabad

INTRODUCTION

At present only the mugger crocodile (Crocodylus palustris lesson) occurs in the wild mugger habitats of Andhra Pradesh state in India. The other species -the saltwater crocodile (Crocodylus porosus Schneider) is extinct in this state since the 1940's. A recent survey ^{carried out by} covering the ^{the author} river systems, lakes and reservoirs of the state in 1976-77 has shown even the mugger to be a heavily depleted species. Only six breeding groups could be located during this survey and the isolated wild adult population of mugger is estimated to be around thirty. After the adoption of the Wildlife (Protection) Act of 1972 by the state, the mugger along with the other two Indian crocodilians; Gharial (Gavialis gangeticus Gmelin) and ~~C. porosus~~ salt water crocodile is legally protected and even possession of any part of crocodiles without proper licence has been declared as an offence.

In Andhra Pradesh, the state Forest Department, custodian of all wildlife has been operating a Crocodile Conservation Project since 1976 with Govt. of India and FAO/UNDP assistance. The strategy adopted by the project is to collect wild laid mugger eggs for hatchery incubation and hatching, captive rearing to a release size of 1.2m and restocking suitable crocodile habitats ^{gazetted as wildlife sanctuaries} of the state ^{with these stocks}. This is in progress since 1977 and to date 186 mugger have been restocked in the ^{in three wildlife sanctuaries} wild crocodile habitats/ of the state under this Crocodile Rehabilitation Programme.

The first ever ^{organised} release ^{in Asia} of mugger crocodile/ on an experimental basis was carried out by this state in February 1977 at Ethipothalla Falls (see Fig) with 3yr old mugger taken from Nehru Zoological Park, Hyderabad. By September 1980 a total of three males and five female mugger have been restocked in this area: ~~in June~~ where mugger had become extinct by 1965. In June 1981, the first ever breeding of rehabilitated mugger took place at Ethipothala. This has raised the hopes of the project of achieving breeding success at other release places in the state and this will

increase the wild crocodile population of the state considerably in the near future. More than ~~this~~ ^{anything} this success has dispelled the doubts of conservationists on this method of rehabilitation of crocodiles. The paper here reports the details of the first pilot release, monitoring and breeding of mugger in Ethipothala Falls.

RELEASE SITE:

Ethipothala falls the release site is situated 18 Km below the Nagarjunasagar dam on the Krishna river -140 Km south east of the state capital Hyderabad. At this point Chandravanka river a tributary of Krishna river falls down in to a horseshoe shaped 25m gorge. Five Km below this chandravanka river joins river Krishna. From below the fall to a distance of three kilometer downstream there are eleven deep pools and alternating rapids- the ideal habitat of mugger crocodile. In these pools mugger were found till 1965.

Bustard (FAO 1974) after carrying out a survey of some of the crocodile habitats of the state has confirmed the Forest departments proposal of initiating a ^{mugger} rehabilitation programme at Ethipothala, on an experimental basis.

Absence of any resident mugger, relatively small manageable area, for protection, comparatively easiness of viewing mugger from above the falls ensuring proper monitoring of released mugger were some of the advantages of this pilot release point.

CROCODILES FOR RELEASE.

Crocodiles for release were chosen from the twelve mugger that were being reared at Nehru Zoological Park, Hyderabad. These mugger had arrived at the zoo as hatchlings and yearlings between 1974 to 1976, all accidentally caught in the nets of fishermen from Krishna and Godavari river, flowing through the state. From these twelve one male and four female mugger above 1m size were selected for release. (Table 1). For future identification the crocodiles were marked by mutilation method of clipping scutes of the tail region (Bustard and Choudhury and Choudhury and Bustard In Press).

TRANSPORTING CROCODILES :

For transporting to the release site the crocodiles were caught marked and crated in two specially designed wooden crates. Each crate had two compartments with well padded interiors. Each compartment could be opened independently by its own door at one end to liberate the crocodiles housed in that. The crocodiles were crated at 21 hrs on 7th February 1977 and were taken ~~by~~ ⁱⁿ a jeep to the release site. The 140km journey took 4hrs. From crating to release at 17hrs on 8th February 1977 the crocodiles were in the crate for 20hrs and during this time they were constantly kept moist by sprinkling water through the air holes made in the ~~boxes~~ crates.

RELEASE AND MONITORING

The release was chosen to take place in February to give the released crocodiles a four/^{to five}months of summer to adapt to their new home before the onset of ~~summer~~ south-west monsoon in mid June. The ^{Ethipothala}/~~waterfallz~~ in February is just a trickle (PLATE 1) but, in monsoon months the horse shoe shaped falls becomes a cascade of water (PLATE2). In addition to the monsoon flood water some more water is also released ~~in~~ to the Chandravanka river from the right canal of the Nagarjunasagar Dam.

It was decided to release the crocodiles just prior to sunset to give them a 10 to 12 hour of undisturbed time in their new habitat to explore and settle. On 8th February 1977 the four mugger were released on the banks of the biggest pool below the fall.

On the following morning the author could locate all the four released mugger in the main pool. A regular monitoring of the released mugger ^{is being} ~~was~~ carried out by the author by spending a whole day in the release site once a month. The local forest ^{keep} personnel also kept a record of sightings once a fortnight and the local guards appointed prior to release to protect and stop disturbances like fishing etc. maintained a daily record of the sightings of the crocodiles.

On 23rd December 1978 two more female mugger were released in this place followed by release of two males on 16th September 1980. (Table 1). By May 1981 the monitoring teams were able to locate seven out of the eight released muggers on a single day, within \pm 3km of the release site. The monitoring results are being published elsewhere (Chandra & Bhatnagar in press).

BREEDING IN THE WILD.

In June 1980, two female of the original twelve mugger (from which crocodiles were released at Ethipothala) started breeding at Nehru Zoological Park after having mated with newly introduced older males. This made us search for signs of nesting at Ethipothala Falls as the female mugger in the wild were now of the same year ^{and size} ~~class~~ . During the 1980 nesting season no breeding ^{for males in the wild at Ethipothala} ~~could be seen.~~

While examining the reasons for this it was seen that of the original four mugger consisting of one male and three female ~~was~~ ^{the} male has taken residence 800m downstream of the fall whereas ^{all five} the three females and ~~two~~ ^{including no as released in Dec 78} other female ~~later~~ introduced (in Dec 78) remained within 400m of the falls. This was considered a completely unsuitable proposition for successful breeding and plans were made to remedy this lopsided sex ratio of one male to five female. In September 1980—three months before the courtship and mating season for mugger in Andhra Pradesh - two more males both older than all the females at Ethipothala were released (Table 1).

In the winter months actual courtship could not be observed but the introduced males were observed forming groups with resident females. Areas surrounding the main pool was checked on several occasions for signs of nest but nothing could be located. However, on 13th June 1981 while carrying out a monitoring exercise a freshly hatched mugger nest of nine eggs was located about 600m below the fall. There were five spoiled eggs in the nest and four hatched empty shells were removed. Subsequently within a week the four hatchlings were observed along with the mother in the deep pool.

LETTER TO INDIAN FORESTER ~~2~~

~~Dr. R.N. Kaul~~
~~The Editor~~
Indian Forester

will not be ^{at all with} ~~more~~ ^{more} ~~page~~
Spring at ~~early~~ like ~~say~~ no

Dear Sir,

will never by my ~~photo~~ ^{grand}
with ~~only~~ ^{only} ~~clay~~ ^{clay} ~~Six~~ ^{Six} ~~road~~ ^{road}
Sub-first Successful breeding of ~~reintroduced~~ ^{wild} mugger
Crocodile in A.P.

will released

The Indian Muggers Crocodile (*Crocodilus palustris* Lesson)
at Sripothahalli, Andhra Pradesh
have bred for the first time anywhere in its distribution range.

This breeding of an schedule I species introduced ~~into~~
can be achieved in ^{with careful planning} reintroducing endangered species -
to the wild can be rehabilitated successfully.

To increase the depleting crocodile population of the state
The Andhra Pradesh Forest Department Crocodile Conservation
Project initiated in 1976 ^{with GOI / FAD/UNDP assistance} adopted the strategy of collection

^{predator} ^{vulnerable} ~~off~~ wildland crocodile eggs for artificial hatching and rearing
of the young ones to a ~~safe~~ ^{natural} post predation stage for
replanting them to the wild to create ^{natural} wild populations.

On 1st February 1977, the project - used ^{4 (one male & 3 female)} ^{used} ^{hyderabad} captive reared
released ^{six (above 1.1m)} ~~six~~ mugger Crocodiles from the ^{Hyderabad} ^{National Zoological Park}
~~Hyderabad~~ ~~State~~ and released them ~~into~~ ^{into} suitable muggers
crocodile ~~habitat~~ below Etihadra falls, a suitable

muggers habitat with ^{alternating} deep pools & rapids, situated
within the N.J. Sanctuary 160 km south of Hyderabad
on the Krishna river ~~at~~ ^{at} the ~~habitat~~ ^{habitat} ~~is~~

toil of Krishna river - ~~was~~ ^{was} once ~~had~~ ^{had} ~~passed~~ ^{passed} a group
number of muggers, but ~~from~~ ^{from} to release all had
been killed off. The first release was followed

release of
 by 2 more females of above 1.5m size on 23rd Dec
 1978 and again 2 more males of 1.6 & 1.5m size
 on 11th Sept 1980. on 13th June 1981 a
 freshly hatched nest of ^{2 eggs} was located, of which 4
 had hatched out. Subsequently the youngsters
 were observed with the mother.

Regular Monitoring of the released mussels ^{by protection & research staff of the project} have resulted in
 recording excellent data on the ^{wild} growth, survival and
 movement. Encouraged by the early findings of this
 experimental release the AP State Council (Environment & Forests)
 has already released 184 mussel corallites in
 suitable habitats in three other ~~other~~ general schemes

which are as follows.

1. N.S. Society - 136 (128 in Krishnarivera and 8 in Etimadipalle)
 2. Patanjali - 33
 3. P.K. Reddy - 15
 4. Coring and Harbor - 3 (Left with corallites)
- Most of the released stock size of 1977 yearlings

and from the breeding success at E.P. falls the
 AP state forest ^{is optimistic} ~~is optimistic~~ has ~~more~~ ^{more} of the
~~reintroduced~~ ^{reintroduced} mussels might start breeding ^{in the wild} by 1984-85.

~~making the state self sufficient but~~ ^{fully protected} their
 with in the scheme these mussels will find ~~breed~~
 their natural habitat.

near home

^{note}
draft - for EP full hatchling

~~note~~

✓ 1. ORYX

✓ ~~2. IVCN Bulletin~~

3. WWF - Merges

4. WWF - India

✓ ~~5. A letter to B. J. H. H.~~

✓ ~~6. Crea Gray newsletter~~

7. Tiger paper

✓ ~~8. Gray bridge~~

✓ ~~9. India forecast~~

✓ 10. Chetral

11. BNHS - - Publication

✓ ~~12. Hemadryad~~

Colony 1977 ~~at~~ Etipothale falls ^{In time}
 1981, the first ^{by the released} muffer breeding ^{of the released} was
 recorded at E.P. falls. ^{This by rain} ^{the hopes of the forest}
^{in the wild} ^{following is the}
 a future breeding success in the wild ^{breeder depend to mean} ^{causality in}
 as ^{to project what the} ^{the first} ^{bill} ^{release} ^{together}
 report of the success of the first ^{with the} ^{breeding} ^{success}
 the near future.

RELEASE SITE

with ~~the~~ ^{2 yr old} ^{crab} taken from the Nehru Zoological Park Hyderabad.

Nehru

Release site:

Etipothale falls. The release site is situated, 17 km
 below the Nagarjunasagar dam a Krishna river - ^{140 km southeast of} ^{the} ^{Hyderabad}
^{the photos} ^{at this point} ^{Chandrabhaga} ^{river} ^{tributary} ^{of} ^{Krishna} ^{river}
 falls ^{down} ^{into} a horseshoe shaped ^{gorge}, 5 km before
 joining Krishna river. In this 5 km stretch between Krishna
 Chandrabhaga confluence and Etipothale falls, there are eleven
 alternating deep pools and rapids - the ideal habitat of
 muffer crocodiles. This place ^{had} ^{been} ^{the} ^{habitat} ^{of} ^{muffer} ⁱⁿ
^{the} ^{'60s} ^{but} ⁱⁿ ¹⁹⁷⁵ ^{the} ^{muffer} ^{was} ^{extinct} ^{here}
^{In} ¹⁹⁷⁶ ^{to} ^{his} ^{report} - ^{Bombard} ⁽ ^{FAO} ¹⁹⁷⁴ ⁻ ^{also}
 among ^{out} ^a ^{limited} ^{habitat} ^{through} ^{of} ^{the} ^{state} ^{had}
 recommended this site as a ^{multiple} ^{rehabilitation} ^{area}
 the state forest department - ^{had} ^{also} ^{decided}
 to release a small number of muffer in this area on
 an experimental basis.

Absence of resident muffer ^{comparative} ^{occurrences}
 of ^{any} ^{crocodiles} ^{from} ^{top} ^{of} ^{the} ^{falls} ^{and} ^{the} ^{small}
 stretch of the habitat - (No fall - 3 km from below the falls)

and were taken by a jeep. The 140 km journey took about 4 hours. From crating to release, the crocodiles were in the crate for about 20 hours and during this time they were moistened by sprinkling water through the air holes in the crates.

Release ^{monitoring} The release was chosen to take place in February to give the released crocodile a four months ^{to five} of summer to adapt to their new home before the onset of south-west monsoon in mid June. The waterfall in February is just a trickle (Plate I) but in monsoon (Plate II) the limestone shaped falls are full with rainwater plus some ^{released} excess water from the canals of the NS dam 18 km ~~above~~ upstream.

On the release date it was decided to release the crocodiles just prior to sunset to give them a undisturbed 12 to 15 hrs to explore their new home. At 17 hrs on 8 Feb 1977 ^{on the} ~~at~~ ^{bank of} ~~the~~ ^{post} below the falls.

The four crocodiles were released.

The next day the author could spot all of them in the main post. The author carried out a regular monitoring of these crocodiles at an interval of 1 month. Guards posted prior to release to protect crocodiles and to prevent fishing in this area maintained a daily record of the sighting of released crocodiles and the local supervisory protection staff carried out a fortnightly monitoring of the ^{two} ~~one~~ ^{more} ~~female~~ ^{female} ~~crocodile~~ ^{crocodile} ~~the~~ ^{the} ~~1st~~ ^{1st} ~~released~~ ^{released} and two more males joined the ~~first~~ ^{first} released and two more males joined the

existing mix on 16 Sept- 1980. By this time the monitoring teams were able to spot seven out of the eight released within 3km of the release point - below the falls. Regular monitoring has proved this trial release a success (change noted in press).

BREEDING IN THE WILD.

→ The male released during the first release was spotted several times alone in one of the pools roughly 800m below the main pool. It was spotted in the same pool even after releasing two other females in Dec 1980.

↙ In June 1980, this female ^{misses} ^{2nd} collection (of the same age as the 1st. released ^{misses} ^{2nd} breed successfully in captivity after mating with females several years older. ^{This male in 1980 for headlings or any other misses have been released - that with}

An older male the released female might breed in Sept 1980 (3 months before the catch) at mating season for misses in EP) two older males were released (Table 1). ~~The same age as same age as~~

~~The male released first ^{being of same} ^{consider} incompatible for his first three female and 1 of year age was considered not suitable for the second released females. Further~~

This made an search for a network of EP falls in 1987/88 in next and be located

Date of release	Size TL (cm)	Wt (g)	Sex	Age at time of release
8.2.77	1.08	5	F	
"	1.09	6	F	
"	1.11	6.	F	
"	1.17	7.5	M	
23/12	1.52	-	F	
"	1.03	-	F	
15/51	1.90	22.5	M	
15/7	1.63	18.0	M	

Breeding in the Wild.

These were two

In June 1980, two female ~~mussel~~ ^{of the original} twelve (four which ~~the~~ ~~four~~ were released) ^{at St. Falls (an exhibit at in Feb 1977)} ~~younger~~ ^{Older males were} ~~of~~ ^{introduced} at Mohonk Zoological Park ^{successfully bred} ~~after~~ ^{breeding} ~~mating~~ ^{with} ~~older~~ ^{males}. This ~~made~~ ^{was} ~~us~~ ^{searched} for signs of nesting or hatchlings at St. John's falls - since the released ~~mussel~~ ^{were} of the same age and size class.

During the breeding season of 1980 no indication of nesting could be found. ^{in Feb 1978 and in November 1978} During monitoring ^{it was observed that} ~~the~~ ^{only} male ~~mussel~~ ^{remained} ~~at~~ ^{St. John's} ~~falls~~ ^{downstream}, whereas the female ~~mussel~~ ^{were} observed in the main pool below the fall ^{or} within 400m of the fall. ~~Since~~ ^{This was clearly considered an} ~~Two~~ ^{additional} ~~more~~ ⁱⁿ ~~Sept~~ ^{1980 - Three months,} ~~in~~ ^{Sept 1978 also} ~~before~~ ⁱⁿ ~~the~~ ^{Sept} ~~courtship~~ ^{and} ~~and~~ ^{meting} ~~occurs~~ ^{for} ~~for~~ ^{mussel} ~~in~~ ⁱⁿ ~~AP~~

~~incompatible~~ ^{unavoidable} ~~mate~~ ^{proposition} ^{for} ^{breeding}. ^{Two} ^{additional} ^{more} ⁱⁿ ^{Sept} ^{1980 - Three months,} ⁱⁿ ^{Sept} ^{1978 also} before the courtship and mating occur for mussel in AP two other older males were released at St. John's falls (Table I).

Lead made the sex ratio to be 1 male to five females. ^{Actual} ~~the~~ ^{courtship} ~~and~~ ^{and} ~~mating~~ ^{had} ~~not~~ ^{be} ~~observed~~ ^{but} ~~in~~ ¹⁹⁷⁸

13th June 1981, while monitoring the area ^a ^{probably} ^{located} ^{nest} ^{about} ^{500m} ^{downstream} ^{of} St ^{John's} ^{falls}. ⁵ ^{eggs} ^{with} ^{no} ^{hatchlings} ^{intact} ⁱⁿ ^{the} ^{nest} ^{and} ^{four} ^{empty} ^{egg} ^{shells} ^{from} ^{which} ^{hatchlings} ^{had} ^{emerged} ^{and} ^{could} ^{be} ^{located}. ^{Subsequently} ^{on} ^a ^{visit} ^{to} ^{the} ^{spotting} ^{the} ^{young} ^{were} ^{observed} ^{along} ^{with} ^{the} ^{mother}.

France becomes State Member

France has become the 48th State member of IUCN. Notification of adherence to the Union's Statutes was contained in a letter, dated 16 March 1977, from the Ambassador of France in Switzerland.

"Ecology" is now a force in France

The recent municipal elections in France marked the coming of age of the French ecology movement. It is now a political force with which other parties must reckon.

In 1974 the ecologist candidate for the Presidency, Mr. René Dumont, gleaned a bare 1.3% of the vote. Two years later, with the nuclear-power issue gathering momentum, the ecologists polled some 10% during a series of bye-elections. Last month ecologists all over the country were polling up to 12%, especially in Paris where natural *jolie-de-vivre* has been fighting a losing battle against unrestrained urban growth and ever-worsening traffic jams. Ecologists are calling for traffic restrictions, improved public transport, cycling paths, more parks, recreational facilities and better care for the elderly.

With their support now coming from all professions and trades, ranging from high-powered businessmen to local market shopkeepers, ecologists have compelled other political parties to reconsider their programmes. Suddenly everyone from rightwing Chiracians to left-wing Communists is talking ecology. Skyscrapers over seven stories are out, trees and parks are in. Certainly many who voted ecologist were simply making a political gesture. But at least they were showing disenchantment with the results of uncontrolled technology. France now has 220 new mayors. Will their policies reflect the new mood? Time will tell, but the signs are promising. *Ed Girardet*

Marine parks proposed for South Africa

Some 40 marine reserves spanning the coastline of South Africa have been proposed by the *Council for the Habitat* and the *Wildlife Society of South Africa*—between them representing most conservation-conscious people in the Republic. The proposed reserves cover the fullest possible range of marine ecosystems, and include various estuaries and lagoons.

The Tongaland coast of Natal is perhaps top priority. The only truly sub-tropical part of the coastline, it includes corals, coral fishes and the nesting ground of turtles, as well as a vast diversity of Indo-Pacific fauna and flora. However the speed of development in coastal areas lends urgency to all the proposals. Soon it will be too late.

Endangered Species Convention: working session

During its first meeting held in Berne, Switzerland, from 2 to 6 November 1976, the Conference of the Parties to the Convention adopted a resolution requesting that a special working session be convened in order to discuss several items regarding the implementation of the Convention. For this purpose, the Conference of the Parties established a Steering Committee to coordinate with the Secretariat the organization of the session.

The Steering Committee met in February and took the following decisions:

- a. the special working session will be held at the World Health Organization (WHO) Headquarters in Geneva from 17 to 28 October 1977;
- b. all States are invited to participate;
- c. national and international organizations with specific interests may also

attend the special working session as observers; they should inform the Secretariat before 31 May 1977;

d. the objectives of the special working session will be the consideration of guidelines for shipments of living specimens, the examination of problems raised by the identification of specimens, the exchange of museum specimens and the placing of confiscated animals and the analysis of Appendices I and II;

e. to ask all of those having documentation relevant to the objectives of the session, to send it to the Secretariat before 31 May 1977 in order to facilitate the preparation by the Steering Committee of working documents for the session.

Further information may be requested from the Secretariat of the Convention, IUCN, Morges.

Small fish—big victory

The Tennessee Valley Authority, with its \$116 million Tellico Dam project nearing completion, has come up against an unexpectedly formidable obstacle: the 3-inch Snail Darter. Found only in the stretch of the river scheduled to be part of the Tellico Reservoir, this tan-coloured member of the perch family is fully protected by the Endangered Species Act. An appeals court has therefore ruled against completion of the dam.

The Authority argued that no one had heard of the Snail Darter when the dam was proposed in 1966. The argument was rebuffed. "The complexity of the ecological sciences suggests that the detrimental impact of a project upon an endangered species may not always be clearly perceived before construction is under way," the appeals court said in its decision.

The Authority is now trying to relocate the Snail Darter and officials have said they will appeal to the Supreme Court.

gramme. Further releases will follow in sanctuaries covering the habitat of all three crocodilians.

Greece protects pelicans

The pelican can no longer be hunted in Greece. A Government decree of 21 January gives both *Pelecanus onocrotalus* and *Pelecanus crispus* total protection for the next 10 years. Pelican populations in Greece have been declining for some time and numbers are now dangerously low. The ban on hunting follows vigorous representations made by the Hellenic Society for the Protection of Nature (an IUCN member) and other organizations.

Maurice Strong to be "Special Consultant"

Mr Maurice Strong has agreed to become a "Special Consultant" to IUCN. With his many high level contacts in both the conservation world and the business world, he sees his role as that of ambassador-at-large.

Maurice Strong was, of course, Secretary-General of the 1972 Stockholm Conference on the Human Environment, and thereafter the first Executive Director of UNEP. Although now based in Canada, he expects to be spending some four or five days a month in Switzerland. He will thus be able to keep in close touch with the Union's affairs.

Captive crocodiles go wild

For the first time ever in Asia captive-reared crocodiles have been returned to the wild. Last February saw a pilot release of four mugger crocodiles (one male and three females) at Ethipothala Falls, Andhra Pradesh, India as part of a long-term UNDP/FAO project to save all three species of Indian crocodilians.

In 1974 an FAO survey found the gharial to be critically endangered, the saltwater crocodile to be rare and the mugger to be fast disappearing. The Indian Government thereupon sanctioned a conservation programme. The young crocodiles reach a size of 1.2 metres in about 18 months and are then "planted out" in sanctuaries.

The group released was reared by Nehru Zoological Park at Hyderabad as part of its endangered species pro-

Published monthly by the International Union for Conservation of Nature and Natural Resources with the financial assistance of UNESCO, UNESCO Subvention 1976 DG/2.1/414/43, and the World Wildlife Fund.

N.B. Opinions expressed in the Bulletin are editorial opinions and should not be taken as the official view of IUCN.

All materials may be reprinted unless protected by copyright. Signed material reprinted should bear the author's name. The Editor would appreciate two copies of any reprinted material. Authors interested in submitting material for publication are invited to write to the Editor.

M. Kamal Naidu, I.F.S.,
Conservator of Forests.

Office of the Conservator of Forests,
Research & Development Circle, Hyderabad.

Ac.No.2190/77/M5 dated 11.8.1982.

Dear Sri Choudhury,

Sub:- Vanavikas - Regarding.

Refs:- This office D.O.No.2190/77/M5 dt.24.7.82.

.....

I invite your kind attention to the reference cited above and request to look into the matter personally and send the articles on the "Wild Life in Vanavikas" very urgently in order to reach me by 20th August 1982.

This may please be treated as urgent.

Yours sincerely,

M. Kamal Naidu
(M. Kamal Naidu.)

To
Sri B.C.Choudhry,
Nehru Zoological Park,
Hyderabad.

M. Kamal Naidu, IFS.,
Conservator of Forests



Office of the
Conservator of Forests,
Research and Development
Circle, Hyderabad-500004.

D.O.No.2120/77/M5 dt.24.7.1982.

Dear Sri *Choudhary*

Sub:- VANAVIKAS - Reg.

....

I intend to bring out a special issue on Wild Life in VANAVIKAS - the Forest Departmental Magazine on the occasion of the Wild Life Week 1982. I therefore request you to contribute a suitable article on the topic related to Wild Life in order to reach me by 20th August 1982, so as to enable me to get the magazine printed and brought out in time.

Thanking you,

With best wishes

Yours sincerely,

M. Kamal Naidu
(M. KAMAL NAIDU.)

To
Sri B. C. Choudhary
Nehru Zoological Park

PLATE CAPTIONS

Plate I. A general view of Etihad Falls during the summer months. Note the deep pools below the fall where the crocodiles were released.

Plate II. A released mugger crocodile basking on the edge of the pool below the falls.

The state Crocodile Conservation project's choice of a pilot release site had to narrow down to the ^{probs. sites below me} ~~the~~ scenic Etipahale falls on the Chandraventha-Nattakke river stream in the Pudukkottai R.F. of the Kanyakumari range of the Guntoor forest division. Located about 18 km below the Nayarjonespur dam, this popular tourist spot provided an ideal crocodile habitat in its alternating deep pools in a 3 km stretch before joining the Krishna river 2 km further down. This ideal major crocodile habitat, now devoid of any resident population also had the added advantages in ^{ethological} ~~ethological~~ ^{aspects} ~~aspects~~ ^{met} ~~met~~ as being a pilot release programme need of a small manageable area from where released crocodiles could be monitored and success evaluated.

5. Being a tourist spot, it provided opportunities to educate people on usefulness of crocodiles and to popularize the crocodile conservation programme through interactive board and labels and by showing ~~rearing~~ ^{rearing} of crocodiles to tourists in natural habitat.

With an ideal ^{crocodile} habitat and release site crocodiles ready at hand, the stage was set for the first ever release of any crocodilian species back to the wild in India.

The Release : On ~~the~~ Feb 1977 the Xelam Zoological Park staff created the four major crocodiles in

Specially designed wooden crates for the 160 km
journey from Hyderabad to Nagajunesagar. ~~On Feb 10~~
~~and Feb 11~~ ~~evening~~ The crocodiles were given a grand
farewell by the zoo ^{keeper & staff} wishing them a healthy home
in the ^{new} wilderness.

> > > >
At 5 AM of Feb 10 1977 The four myxos from Nehru
Zoological Park were making history by being the first ever
of their kind to be released back to the wild, anywhere in
their distributional limits in Asia. On being released from their
boxes, these zoo myxos oriented themselves in a few minutes
and happily swam into the deep pools below the spectacular
Etipathalle falls. What remained to be observed in the years to follow
was how well they adapt to their new home, ^{defying the} ~~and~~ ~~heavy~~
~~they~~ ~~on~~ ~~the~~ ~~falls~~ (to ~~avoid~~ their ~~water~~ cousins in the wild
avoid the strong flood currents going into sidestreams or into oxbow
lakes or riverbends)

> > > >
Regular monitoring of their movement by the project staff ~~has~~
~~resulted~~ ~~over~~ in observing them within 500m of release point - even after two
monsoon floods. ~~and~~ They ^{found company} ~~were~~ ~~joined~~ by two more females of their kind
in December 1978 ~~and~~ and two more males in Sept 1980. By
December 1980 all the eight were being monitored by the project-
staff. By now ^{all} ~~of~~ they were over 6 to 7 yr old. ~~and~~ ~~in~~ ~~captivity~~
Their cousins were already breeding at this age.

By March 1981 heavy beach marks were being observed on the
low area near the deepports but till ~~the~~ ~~13th~~ 13th June the staff
could not locate the ~~nest~~ eggs laid by one female.

On 13th June morning this nest was located ^{on a nest hole dip} very close to water
well concealed ~~below~~ behind a thorny Prosopis juliflora bush. Freshly
laid egg shells were observed and it was known that these
~~for~~ ~~the~~ captives need muffs have not only adapted themselves into
their new home but have created conservation history by breeding
^{for the first time}
in the wild for any species of crocodilians following release (they have

not let-down the expectations of their caretakers in the zoo and
their protectors in the wild. ~~They are on the earth for over last~~
~~12 million years their reptilian have shown that their time~~
~~is not yet over)~~

→ ~~Three~~ more female have ~~just~~ ^{started} breeding since 1982 ^{and}
~~the~~ ~~zoo~~ ~~two~~ ~~nests~~ ~~had~~ ~~previously~~ ~~hatched~~ ~~in~~ ~~the~~ ~~wild~~
It is expected that all the five females would join
the breeding force by 1985 ~~and~~ ~~Et~~ ~~hi~~ ~~h~~ ~~ally~~ ~~ful~~ ~~ly~~ ~~would~~ ~~harbour~~

many of the archaic reptiles as it did several decades ago.
It has been decided not to collect any eggs from this location
for artificial incubation but to leave the nests to hatch in the
wild and to study the natural population growth.

REHABILITATING MUGGER CROCODILES AT ETHIPOTHALLA FALLS

- a conservation success story.

by

B.C. Choudhury, Research Assistant
Crocodile Conservation Project, N.Z.P.
Hyderabad 500 264.

....

On a cloudy night of June 1981 the staff of the Andhra Pradesh Crocodile Conservation Project at Nagarjuna Sagar - Ethipothla Fall ^{bay} are scanning the waters of the deep pools below the falls using a heavy duty spotlight; looking for the tiny ruby red reflected glow from the eyes of the three day old mugger hatchlings. A search that continued for ~~three~~ ^{two} hour resulted in sighting of three out of the four youngones confirming a conservation success story unparalleled anywhere else. These ~~reared~~ ^{parents of these young ones were the first ever reared (for any Indian species)} mugger crocodiles (*Crocodylus palustris*) were the ~~first of any species of Indian crocodilians to have bred in the~~ wild following re-introduction.

The genesis of this story dates back to ~~February~~ ^{late 1976 and early 1977,} 1977 when the Andhra Pradesh Forest Department initiated ^{the a} Crocodile Conservation Project to ~~provide~~ help save the dwindling crocodilian resources of the state. The strategy included - assesment of existing crocodile population and their habitat by ^{methodical survey over aquatic habitats,} survey and determining and eliminating the causes of their decline, collection of wildlaid crocodile eggs for artificial hatching and rearing to eliminate natural loss of hatchlings ^{(only} and finally to release the reared crocodiles into ^{suitable habitats} ~~specially selected and protected~~ with an objective of building up the wild population.

While most other State Crocodile Conservation Projects launched their ~~projects~~ with hatching of wildlaid crocodile eggs in captivity the Andhra Pradesh project did it with liberation of captive reared crocodiles into the wild. This was made possible by the available mugger stock from the Nehru Zoological Park at Hyderabad. (One of the primary objective of this zoo is rearing and breeding of endangered species for ultimate reintroduction into wild habitats ~~and~~ ^{and} By 1977 several species of deers and antelopes have found new homes in the wild after a happy life inside the zoo).

In February 1977 the zoo had in its collection twelve 2 to 3 1/2 year old mugger crocodiles. All these had come to the zoo at an age of less than six months ^{after being caught} ~~by fishermen after they have been caught in~~ ~~trivots~~ in Krishna and Godavari river. From the day the crocodiles came to the zoo they were ~~maintained~~ reared in exhibit enclosures simulated to their natural habitat and fed with as natural diet as possible - mostly with live animals and fish. The zoo ^{readily} spared four of these mugger to the project for release into the wild.

Muggers for Release:

On 2nd February 1977 all the twelve mugger were captured, measured and sexed. (It is practically impossible to differentiate male and female crocodiles from their external appearance). One male and three female measuring over 1.1m in size were chosen for release and were marked by cutting the tail scutes in different combinations for future identification either by sighting or by capture. (For marking technique of crocodiles see Indian Forester Vol 107(8) Page 477-485 : Marking crocodiles for release back into the wild for subsequent identification: by H.R. Bustard and B.C. Choudhury).

The Release site:

The state crocodile projects choice of a pilot release site had by now narrowed down to the pools situated below the scenic Ethipothalla Falls on the Chandravanka-Nakkala vagu stream in the Puspuvimla R.F of Macherla range ~~in~~ Guntur Forest division located 18km below the Nagarjunasagar dam. This popular tourist spot provided an ideal mugger habitat in its eleven alternating deep pools in a 3km stretch before joining the Krishna River 2km ~~more~~ further down. This ^{ideal} habitat now devoid of any resident mugger crocodile had the added advantage of being a small manageable area for ~~some~~ pilot release and monitoring and evaluation of success. Further this being a tourist spot it provided the project an opportunity to educate people on usefulness of crocodiles and the conservation programme through interpretative boards ^{and} ~~and~~ by showing crocodiles in the wild.

With an ideal releasesite at Ethipothalla and releasesize mugger from Nehru Zoological Park ready at hand the stage was set for the first ever release of any crocilian species back to the wild in Asia.

The journey:

On 7th February 1977, the staff of the Nehru Zoological Park crated the four crocodiles in specially padded crates for their 160km journey to the releasesite.

→ The crocodiles were accorded a warm send-off by the zoo staff wishing them a happy and long life in their new wildhome. Many murmured of many offsprings to them in their new home. *On the cool ~~at~~ evening of the Feb the muggers made their journey to the releasesite.*

The Release:

At 5pm of 8th February 1977 the four mugger from Nehru Zoological Park were making history to be the ^{anywhere} ~~first~~ to go back to the wild ~~on~~ a major conservation objective. On being released from their boxes in which they were for the past 20 hours, the muggers had a look of the new surrounding for a full half an hour (during which they stretched their limbs and oriented themselves) as if saying good-bye to everyone and slowly swam into the deep pools below the spectacular falls to the sound of a big cheer and cascading water of the falls. Once they went in to the wild it remained to be seen how best they adopt to their new home defying the monsoon floods in this habitat (Their cousins in the wild avoid the flood current by going into sidestreams or oxbow lakes on riverben

Monitoring and further release:

Regular monitoring of their movement by the project staff during the next 20 months ~~was~~ found them within 500m from the release point and they had braved two monsoon floods. It was time for giving them some more friends. On December 1978 two more females and in September 1980 two males joined them in their new home. By December 1980 all the eight were being sighted by the project staff and three to four of them regularly showed up below the falls to greet the visitors. ~~By~~ ^{at Nehru Zoology as well} now all of them were 6 to 7 year old and in captivity, their cousins were already breeding at this age.

Breeding in the wild

By March 1981 heavy trackmarks were being observed on the land area near the pools suspecting successful egg laying but till 13th June the staff could not locate the eggs laid by the female.

On the morning of 13th June 1981 the nest was located on a nest hole dug well concealed behind the thorny Prosopis bush. The tell tale signs were the hatched out egg shells on the mother opened nest. A total of nine eggs were counted of which four had hatched out and on the night vigil three of them were spotted proving the captive reared muggers to have created another conservation success story in breeding for the first time in the wild following release. Such success has not been witnessed for any other species of crocodylians in Asia.

Since 1982 another female has started breeding and in 1983 two nests have successfully hatched in the wild. It has been decided by the project not to collect these eggs from this location but to leave the nests to hatch in the wild and to study how a natural population grows. It is expected that by 1985 all the five females ^{are will be existing} would join ~~the~~ breeding group and Ethipothalla Falls would harbour many of these archaic reptiles as it did several decades ago.

ad results of

(++ For a detailed paper on monitoring methods ^{at Ethipothalla Falls} see Journal of Bombay Natural History Society Vol 79(2) page 275-290: Restocking of Mugger Crocodiles (*Crocodylus palustris* lesson) in Andhra Pradesh : Evaluation of a pilot release =: By B.C.Choudhury and H.R.Bustard.)

From:
B.C.Choudhury,
Research Assistant,
Crocodile Scheme,
Nehru Zoological Park,
Hyderabad 500 264 .

To:
The Editor, VANA VIKAS,
Office of the Chief Conservator
of Forests,
Saifabad,
Hyderabad 500 004.

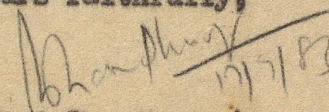
(Through Conservator of Forest, Wild Life Management)

Sir,

I am submitting herewith an article entitled " REHABILITATION OF MUGGER CROCODILES AT ETHIPOTHALLA - A CONSERVATION SUCCESS STORY , for publication in the special issue of VANA VIKAS being brought out in commemoration of the 1983 Vanya Prani Saptah. Please note that the paper is enclosed along with two plate which are relevant to the paper contents of the paper. Hope you will find the article to be suitable enough for publication .

Thanking you .

Yours faithfully,


(B.C.Choudhury)

Dated 17 September 83.

REHABILITATING MUGGER CROCODILES AT ETHIPOTHALLA

- a conservation success story.

by

B.C. CHOUDHURY, Research Assistant
Crocodile Conservation Project, Nehru Zoological Park
Hyderabad - 500 264.

.....

On a cloudy night of June 1981, the staff of the Andhra Pradesh Crocodile Conservation Project at Nagarjunasagar +Ethipothalla Falls are busy scanning the waters of the deep pools below the falls using a heavyduty spotlight looking for the tiny ruby red reflected glow from the eyes of the three day old mugger hatchlings. A search that contineued for two hours resulted in sighting of three of the four young ones confirming a conservation success story unparalleled anywhere else in India. The parents of these young ones were the first ever crocodiles (for any Indian species) to have been released into the wild and to have successfully bred following re-introduction.

The genesis of this story dates back to late 1976 and early 1977 when the Andhra Pradesh Forest Department initiated a Crocodile Conservation Project to help save the dwindling crocodilian resources of the state. The strategy included - assesment of existing crocodilian polpulation and their habitat in the state, determination and elimination of the causes of their decline, collection of wildlaid crocodile eggs for artificial hatching and rearing to eliminate largescale hatchling loss (only 1% survive in the wild) and finally to release back the resultant reared crocodiles into specially selected and protected habitats with an objective of building up of the wild polpulation.

While most other State Crocodile Conservation Projects launched their projects with hatching of wild collected crocodile eggs in captivity, the Andhra Pradesh Project began it with the liberation of captive reared crocodiles into the wild. This was made possible by the readily available mugger stock from the Nehru Zoological Park at Hyderabad. (One of the primary objective of this zoo is rearing of endangered species for ultimate re-introduction into the wild habitats. By 1977 several species of deers and antelopes have found new homes in the wild after a happy life inside this zoo).

..... 2

THE RELEASE SITE :

The state crocodile project by now had chosen the scenic deep pools below the Ethipothalla Falls as the first pilot release site . Located below the Nagarjunasagar dam on the Chandravanka - Nakkala vagu stream in the Puspuvimala R.^F of Guntur forest division , the location provided eleven alternating deep pools and rapids in a 3km stretch before joining the Krishna river 2km further down. This ideal habitat now devoid of any resident mugger had the added advantage of being a small manageable area for a pilot release and monitoring. Further , this being a tourist spot provided the project an opportunity to educate people on usefulness of crocodiles and the conservation programme through interpretative boards and by showing muggers in the wild.

MUGGER FOR RELEASE:

In February 1977 the Nehru Zoological Park had in its collection twelve two to three year old mugger (Crocodylus palustris). All these had come to the zoo from various regions of Krishna and Godavari river after being caught in the nets of fishermen. From the day they arrived in the zoo they were reared in exhibit enclosures simulated to their natural habitat and fed with as natural a diet as possible - mostly of live fish and small animals. The zoo readily agreed to spare four suitable sized mugger for this important conservation release programme.

On 2nd February 1977 all the twelve mugger were captured, measured and sexed (It is practically impossible to differentiate male and female crocodiles from their external appearance). One male and three females measuring 1.1m in size were chosen for release and were marked by cutting the tail scutes in different combination for future identification either by sighting or by capture. (For marking technique of crocodiles see Indian Forester Vol 107 (6) page 477-485 : Marking crocodiles for release back into the wild for subsequent identification: by H.R.Bustard and B.C.Choudhury).

With an ideal releasesite at Ethipothalla and release size mugger from Nehru Zoological Park at hand the stage was set for the first ever release of any Indian crocodylian species back to the wild.

THE JOURNEY:

On 7th February 1977, the staff of the Zoological Park crated the four crocodiles in specially designed padded crates for their 160km journey to the release site. The same day evening the crocodiles were accorded a warm send-off by the zoo staff wishing them a happy longlife in their new wild home. Senior and old keepers blessed the muggers of many many offsprings.

THE RELEASE:

At 5 pm of 8th February 1977, the four mugger from the zoo were making history by being the first anywhere in their distributional limits to go back to the wild from captivity. On being taken out of the boxes they had a look of the new surroundings for a full half an hour, stratching the limbs and orienting themselves to the water and slowly swam in as if saying good bye to every one watching them. For a while the cheer of every one drowned the sound of the waterfalls. Freedom proved intoxicating even for those who watched it. With this began the observation of the project staff of their (the muggers) gradual adaptation to their new home. The first obstacle they had to face was the monsoon floods . In the wild their cousins avoid the flood currents by going into side streams or oxbow lakes on riverbends .

THE MONITORING AND FURTHER RELEASE:

Regular monitoring of the movements of these muggers by the project staff during the next 20 months found them within 500m from the point of release. During this time they have braved two monsoon floods by going into small placid pools. It was time to introduce some more friends to them. On 23 December 1978 two more females and on 16 September two males were released in this habitat. By December 1980 all the eight mugger were being sighted by the project staff and three of them regularly showed up just below the falls to the delight of visitors.

BREEDING IN THE WILD:

By now all of them were 6 to 7 year old and in captivity at the zoo their cousins were already breeding. To show they also are capable of breeding the released ones made trial nest pits on the landarea surrounding the pools but the project staff could not locate the nest till 13th June 1981.

On the morning of 13th June 1981 ,while on a trial searching,~~the~~ the nest was located behind the thorny Prosopis bush. The tell tale signs were the hatched out empty egg shells on top of the mother-opened nest. A total of nine eggs were counted of which four have hatched out and on the night vigil that followed three of the four youngones were sighted along with the mother. With this a full circle of a conservation strategy was complete and the muggers from Nehru Zoo had created another conservation first - this time of breeding in the wild following re-introduction .

Since 1982 another female has started breeding and in 1983 two nests have successfully hatched in the wild. The project has decided not to collect any eggs from this location but to study the natural population growth at this site. Regular monitoring has resulted in recording their movements in the eleven pools and all the eight mugger are observed in this habitat as also a few of their offsprings. (For a detailed paper on monitoring methods and results at Ethipothalla Falls see Journal of Bombay Natural History Society Vol 79 (2) page 275-290 : Restocking of mugger crocodiles (Crocodylus palustris,Lesson) in Andhra Pradesh: Evaluation of a pilot release . By B.C.Choudhury and H.R.Bustard). Such success is yet to be achieved by any other state project.

By 1985 , it is expected that all the five females would join force with the breeding females and Ethipothalla Falls would again harbour many of these archaic reptiles as it did several decades ago.

.....

17th September 1983
Nehru Zoological Park.

(B . C . Choudhury)

Rehabilitating Mugger Crocodiles at Ethipothalla

A CONSERVATION SUCCESS STORY.

By B. C. CHOUDHURY,

Research Assistant, Crocodile Conservation Project,
Nehru Zoological Park, Hyderabad-500 264.

On a cloudy night of June 1981, the staff of the Andhra Pradesh Crocodile Conservation Project at Nagarjunasagar-Ethipothalla Falls are busy scanning the waters of the deep pools below the falls using a heavyduty spotlight looking for the tiny ruby red reflected glow from the eyes of the three day old mugger hatchlings. A search that continued for two hours resulted in sighting of three of the four young ones confirming a conservation success story unparalleled anywhere else in India. The parents of these young ones were the first ever crocodiles (for any Indian species) to have been released into the wild and to have successfully bred following re-introduction.

The genesis of this story dates back to late 1976 and early 1977 when the Andhra Pradesh Forest Department initiated a Crocodile Conservation Project to help save the dwindling crocodilian resources of the state. The strategy included -assessment of existing crocodilian population and their habitat in the state, determination and elimination of the causes of their decline, collection of wildlaid crocodile eggs for artificial hatching and rearing to eliminate largescale hatchling loss (only 1% survive in the wild) and finally to release back the resultant reared crocodiles into specially selected and protected habitats with an objective of building up of the wild population.

While most other State Crocodile Conservation Projects launched their projects with hatching of wild collected crocodile eggs in captivity, the Andhra Pradesh Project began it with the liberation of captive reared crocodiles into the wild. This was made possible by the readily available mugger stock from the Nehru Zoological Park at Hyderabad. (One of the primary objective of this zoo is rearing of endangered species for ultimate re-introduction into the wild habitats. By 1977 several species of deers and antelopes have found new homes in the wild after a happy life inside this zoo).

THE RELEASE SITE:

The state crocodile project by now had chosen the scenic deep pools below the Ethipothalla Falls as the first pilot release site. Located below the Nagarjunasagar dam on the Chandravanka-Nakkala vagu stream in the

Puspuvula R. F of Cuntur forest division, the location provided elean alternating deep pools and rapids in a 3 km. stretch before joining the Krishna river 2 km. further down. This ideal habitat now devoid of any



A general view of Ethipothalla Falls during the summer months Note the deep pools below the fall where the crocodiles were released.

resident mugger had the added advantage of being a small manageable area for a pilot release and monitoring. Further, this being a tourist spot provided the project an opportunity to educate people on usefulness of crocodiles and the conservation programme through interpretative boards and by showing muggers in the wild.

MUGGER FOR RELEASE :

In February 1977 the Nehru Zoological Park had in its collection twelve two to three year old mugger (**Crocodylus palustris**). All these had come to the zoo from various regions of Krishna and Godavari river after being caught in the nets of fishermen. From the day they arrived in the zoo they were reared in exhibit enclosures simulated to their natural habitat and fed with as natural a diet as possible-mostly of live fish and small animals. The zoo readily agreed to spare four suitable sized mugger for this important conservation release programme.

On 2nd February 1977 all the twelve mugger were captured, measured and sexed (It is practically impossible to differentiate male and female crocodiles from their external appearance). One male and three females measuring 1.1m in size were chosen for release and were marked by cutting the tail scutes in different combination for future identification either by sighting or by capture. (For marking technique of crocodiles see Indian Forester Vol 107 (8) page 477-485: Marking crocodiles for release back into the wild for subsequent identification: by H.R. Bustard and B. C. Choudhury).

With an ideal releasesite at Ethipothalla and release size mugger from Nehru Zoological Park at hand the stage was set for the first ever release of any Indian crocodilian species back to the wild.

THE JOURNEY :

On 7th February 1977, the staff of the Zoological Park crated the four crocodiles in specially designed padded crates for their 160 km. journey to the release site. The same day evening the crocodiles were accorded a warm send-off by the zoo staff wishing them a happy longlife in their new wild home. Senior and old keepers blessed the muggers of many many offsprings.

THE RELEASE :

At 5 pm of 8th February 1977, the four mugger from the zoo were making history by being the first anywhere in their distributional limits to go back to the wild from captivity. On being taken out of the boxes they had a look of the new surroundings for a full half an hour, stratching the limbs and orienting themselves to the water and slowly swam in as if saying good bye to every one watching them. For a while the cheer of every one drowned the sound of the waterfalls. Freedom proved intoxicating even for those who watched it. With this began the observation of the project staff of their (the muggers) gradual adoption to their new home. The first obstacle they had to face was the monsoon floods. In the wild their cousins avoid the flood currents by going into side streams or oxbow lakes on riverbends.

THE MONITORING AND FURTHER RELEASE :

Regular monitoring of the movements of these muggers by the project staff during the next 20 months found them within 500m from the point of release. During this time they have braved two monsoon floods by going into small placid pools. It was time to introduce some more friends to them. On 23rd December 1978 two more females and on 16th September two males were released in this habitat. By December 1980 all the eight mugger were being sighted by the project staff and three of them regularly showed up just below the falls to the delight of visitors.

BREEDING IN THE WILD :

By now all of them were 6 to 7 year old and in captivity at the zoo their cousins were already breeding. To show they also are capable of breeding the released ones made trial nest pits on the land area surrounding the pools but the project staff could not locate the nest till 13th June 1981. On



A RELEASED MUGGER CROCODILE BASKING ON THE EDGE OF THE POOL BELOW THE FALLS.

the morning of 13th June 1981, while on a trial searching, the nest was located behind the thorny **Prosopis** bush. The tell-tale signs were the hatched out empty egg shells on top of the mother-opened nest. A total of nine eggs were counted of which four have hatched out and on the night vigil that followed three of the four youngones were sighted along with the mother. With this a full circle of a conservation strategy was complete and the muggers from Nehru Zoo had created another conservation first this time of breeding in the wild following re-introduction.

Since 1982 another female has started breeding and in 1983 two nests have successfully hatched in the wild. The project has decided not to collect any eggs from this location but to study the natural population growth at this site. Regular monitoring has resulted in recording their

movements in the eleven pools and all the eight mugger are observed in this habitat as also a few of their offsprings. (For a detailed paper on monitoring methods and results at Ethipothalla Falls see Journal of Bombay Natural History Society Vol 79 (2) page 276-290: Restocking of mugger crocodiles (**Crocodylus palustris, Lesson**) in Andhra Pradesh: Evaluation of a pilot release. By B. C. Choudhury and H. R. Bustard). Such success is yet to be achieved by any other state project.

By 1985, it is expected that all the five females would join force with the breeding females and Ethipothalla Falls would again harbour many of these archaic reptiles as it did several decades ago.

