

CAPTIVE BREEDING AND REHABILITATION OF MUGGER CROCODILE (*CROCODYLUS PALUSTRIS*) IN SIMILIPAL TIGER RESERVE, ORISSA, INDIA

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Introduction

The Similipal Tiger Reserve is one of the eighteen Tiger Reserves to ensure perpetuation of the tiger in its traditional ecosystem. The Project Tiger was launched in India in 1973. Two years later, in 1975, the crocodile conservation project was launched in the State of Orissa as a part of the joint effort of the Government of India, U.N.D.P and F.A.O. of the United Nations. The mugger management project was established at Ramatirtha in the outskirts of Similipal Tiger Reserve. Since its inception, the project is being operated under the direct supervision of the Field Director of the Tiger Reserve. The project has been started to restock mugger in natural habitats in Hadgarh Sanctuary and Similipal Tiger Reserve. The present paper overviews the management and monitoring of the mugger crocodile (*Crocodylus palustris*) in Similipal Tiger Reserve.

Status in 1979

The Similipal hills form one of the most rich watershed areas of the Orissa State. The major perennial river systems constitute: Budhabalanga in the North, Khadkei and Khairi-Bhandan in the North-west, West Deo in the South-west, Salandi in the South and East Deo and Sanjo in the

East. Results of a survey conducted in November-December 1979 had indicated that the mugger had virtually become extinct in the Similipal Tiger Reserve area (Anon, 1979). The exact reasons for the extinction of muggers from Similipal were not clear. However, the survey party had taken note of adverse factors like (i) fishing by using explosives and nylon nets, (ii) fire in the river banks forming nesting sites, and (iii) natural effects of activities such as predation and/or exhuming a nest by wild boar and monitor lizards.

Captive Breeding At Ramatirtha

Ramatirtha is located on the banks of river Khairi-Bhandan, 1.5 km west of National Highway No. 6 from Jashipur town and is within the distributional range of *Crocodylus palustris*. The place experiences upto 165 cm annual rainfall and a temperature of 8°C in December-January to 41°C in May.

The facilities available include: (i) one egg hatchery, (ii) one set of ten hatching pens-each with a concrete pool measuring 2x2x0.3 m with 1m width vegetated basking land all around, (iii) one set of twelve yearling pens, each holding about 36,000 litres water over a surface area of 32 m² and having a basking area of 1.5 to 2.0 m width

all around, (iv) one breeding enclosure with land over 974 m² and water over 1810 m² and holding over 2.263 million litres water in three pools of 0.826, 0.233 and 1.189 million litres connected with narrow channels, (v) two water pump houses on the river bank, (vi) two water tanks with holding capacities of 1,45,000 litres and 40,000 litres, (vii) one small laboratory, (viii) four halls, and (ix) eleven residential buildings.

The captive breeding programme was started with young mugger brought in phases from Tamil Nadu Forest Department and Madras Crocodile Bank. Captive rearing was commenced in 1979 and first breeding took place in 1984 (Table 1).

During the past two years greater attention has been paid to improve husbandry conditions. Periodic health checks, study of each mortality report and approach to rectify physical deformities at the early stage of their appearance revealed possible nutritional deficiencies. Suitable food supplements were used and survival rates have been improved. The main supplements are : (i) a mineral salt-mix in the proportion of 30-35 gm per kg of pork fed to breeding adults and other juveniles, and

(ii) one 500 mg Ostocalcium tablet for every juvenile every 15 days. In order to improve the rate of fertility of eggs and the hatching success, before the 1990 breeding season vitamin-E has been administered at a dose of 400 mg per adult for ten days. The breeding group now constitutes two males and four females.

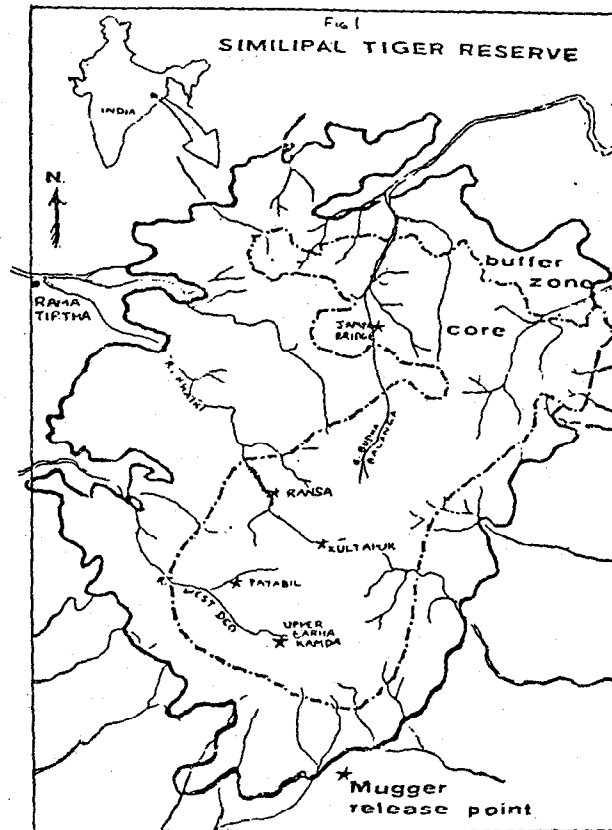
Other aspects of research at the captive breeding centre are : (i) territory occupation in relation to all phases of breeding to draw attention to spacio-temporal control measures needed to human activities in the mugger sanctuary, (ii) growth and survival of young mugger living in simulated natural conditions with the group of breeding adults, and (iii) sex ratio in mugger when eggs are incubated *in-situ* under shade and under direct sunlight.

Restocking in Similipal

Three river systems have been used for the restocking programme. These are rivers Budhabalanga, West Deo and Khairi. Since the natural populations had virtually become extinct, the attempt was to restock with animals from any particular geographic region. Therefore, all releases

Table 1
Record of captive breeding of C. palustris at Ramatirtha

Year	Total eggs	Total hatchlings	Survival		
			Numbers	% from eggs	% from hatchlings
1984	29	14	08	27.5	57.1
1985	76	33	26	34.2	78.7
1986	207	107	74	35.7	69.1
1987	79	35	31	39.2	88.5
1988	110	54	50	45.4	92.5
1989	110	51	50	45.4	98.0



have been with muggers directly produced from the State of Tamil Nadu or produced through captive breeding of Tamil Nadu strains at Ramtirtha and Nandankanan. There is, however, a possibility that strains from different localities in Tamil Nadu have got mixed for 'natural selection' to play its role through offsprings of the restocked muggers.

Out of the total 238 members of muggers released, 94 were brought from Tamil Nadu, 12 from Nandankanan captive breeding project and 132 from the Ramatirtha Project. These have been released in rivers Budhabalanga (99 nos), West Deo (72 nos) and Khairi (67 nos) (Fig. 1). The details of release are presented in (Table 2).

Monitoring results from river Khairi : All rivers in Similipal have rapids dotted with small stretches of deep pools. These deep pools have formed the main territories of the rehabilitated muggers. Because of the rocky nature, the rivers are unsuitable for navigation. Walking along the banks is generally difficult because of the terrain. Furthermore, because of a high concentration of the tiger and elephants monitoring expeditions have always presented risks of encounters with these animals. During the monsoon, from June through October ground leeches are innumerable. Under such inhospitable circumstances, monitoring has been kept limited to a stretch of 10 km in the river Khairi. From the point of mugger release at Ransa (Fig.1) the

Table 2
Record of release of Crocodylus palustris in Similipal Tiger Reserve (S.T.R.)

Date of release	River/Place in S.T.R. where released	Stock from which place	Total nos. released	Sex M/F	Scute clipping used
1981 Apr. 18	R. Budhabalanga	TN	60	-	-
1985 May 26	R. West Deo	TN	18	8/10	-
Jun.09					
1986 Nov. 30	R. West Deo	RT	26	-	-
		TN	16	8/8	-
1987 Dec. 05	R. Budhabalanga	RT	39	-	L3
	Jambu bridge				
1988 Feb. 24	R. West Deo	NK	12	1/11	L4 (male)
	Patabil Nalla				R4 (female)
1989 Apr. 24	R. Khairi :	RT	25	-	L5
	Ransaguda				
1990 Feb. 08	R. Khairi	RT	42	10/32	L6 (male)
	Kultapur				R6 (female)
Total			238		

Stock : NK : Nandankanan; RT : Ramatirtha; TN : Tamil Nadu

Sex : F : Female; M : Male

Scute clipping code on double-row tail whorls : left; R : right; digits 3, 4, 5 and 6 : the serial number of the scutes on left or right counted from behind to front.

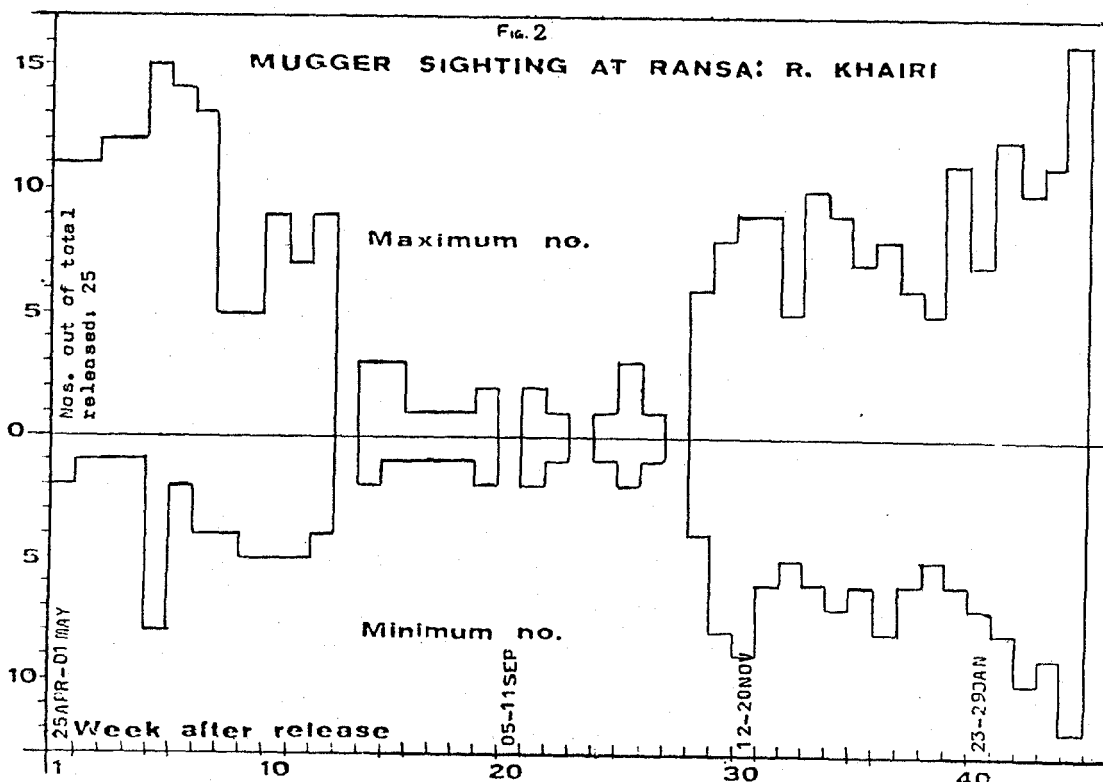
stretches are 6 km in the downstream and 4 km in the upstream. The river bank has been marked along both the direction at every 100 metres interval with increasing numerals.

Counting of muggers have been done by walking along the banks during the peak known hours of basking during the day. At the time of preparation of this report data on regular monitoring were received for 44 weeks. There were, in an average 3-4 observation days every week. No observation could be recorded during the weeks beginning July 24, September 11, October 2 and October 30. Rainfall during the study period, measured at Upper Barakamura in the South and Ramatirtha in the North-west of moni-

toring zone (Fig. 1), was 252 cm and 166 cm respectively. The ambient temperature during the study period ranged over 4-41°C at Upper Barakamura and 9-41°C at Ramatirtha.

During the first week of monitoring, that is, 25 April to 01 May 1989 the numbers of muggers sighted ranged from 2 to 11, only 1 to 3 muggers were sighted during the monsoon period of 25 July to 23 October 1989. Thereafter, the rates of sighting were better. During the 44th week, beginning on the 20th February upto 16 muggers were sighted out of the total 25 released on 24 April 1989 (Fig. 2).

With respect to the place of release the locations of 16 muggers sighted during the



44th week of monitoring as on 23 February 1990 are presented in (Table 3).

After the first ten months of release 16 of the 25 (64%) muggers remained within a stretch of 2.3 km; 900 m in the upstream and 1400 m in the downstream (Table 3).

Sighting record from rivers other than Khairi (January 1990) : In river Budhabalanga (Fig. 1) a total of 99 muggers have been released between 18 April 1981 and 05 December 1987. Twelve of these are sighted at present. The locations of these are at Jambu bridge: 2, downstream the bridge: 1, Balidarha: 3, Chhatadarha: 2 and Manikidarha: 4.

In river West Deo (Fig. 1) a total of 72

muggers have been released between 26 May 1985 and 24 February 1988. Locations known for 25 of these are at Tinadiha (6), Maniki-darha near Sapaghara field (4), Chhuagada (7) and Patabil bridge (8).

Compared with the data from Khairi, where 71.6% of the released muggers are sighted, the data for Budhabalanga (12.1%) and West Deo (34.7%) are low (Table 4). Nevertheless, hatching muggers have been sighted in the latter two river systems suggesting that the rehabilitated muggers have settled down to natural breeding in Similipal Tiger Reserve.

Discussion

Previous records of movement of

Table 3

Locations of juvenile C. palustris during the 44th week of monitoring after release in river Khairi at Ransa in Similipal Tiger Reserve

Distance from the place of release (m)	Numbers of mugger sighted	
	Upstream	Downstream
0-100	0	1
100-200	2	0
200-300	0	0
300-400	1	1
400-500	0	3
500-600	2	0
600-700	0	2
700-800	2	0
800-900	1	0
900-1000	0	0
1100-1200	0	0
1200-1300	0	0
1300-1400	0	1
1400-beyond	0	0
	(upto 4000 m)	(upto 6000 m)
Total	8 nos. (from 100-900 m)	8 nos. (from 0-1400 m)

muggers back in the wild are those of (i) one 170 cm young that moved over 1.5 km in nine months, (ii) two muggers, 56.9 cm and

54.3 cm long which moved over 10.8 km in 18 months, and (iii) seven of eight muggers confining to a stretch of 3 km in a post-release duration ranging from 3 months to 4 years. These movements refer to a lake habitat in Orissa (Acharjyo and Mahapatra, 1978; Singh, 1985), river Mahanadi in the Satkosha George Sanctuary (Singh, 1983) and river Krishna in Andhra Pradesh (Choudhury and Bustard, 1982), respectively. The data from Khairi in Similipal Tiger Reserve are for a much larger number of muggers and the monitoring was done continuously from the date of release. A low rate of sighting in the study area during the monsoon may be because of movement of the juveniles into the smaller tributaries and creeks to avoid the current of the main river and follow the movement of prey fish, as have been suggested for similar movements of gharial (Bustard and Singh, 1983).

A comparison of the data on movement of muggers under different studies

Table 4

Summarised data on C. palustris restocking during the year 1981-1990 and record of sighting in January-March 1990

Data \ Rivers	Budhabalanga	West Deo	Khairi (Ransa)	Khairi (Kultapur)
Year of restocking	1981-1987	1985-1988	April 1989	Feb. 1990
Nos. of mugger released	99	72	25	42
Interval between restocking and latest restocking	3-9 yrs.	2-5 yrs.	10 months	1 month
Nos. sighted during last observation	12 (12.1%)*	25 (34.7%)*	16 (64.0%)*	32 (76.1%)*

*Out of total nos. released

cited in the above, with those of gharial (Bustard and Singh, 1983; Singh, 1985) suggest that out of these two sympatric species, muggers moves less. It is true, however, that the first few weeks after release is a 'wandering or exploring phase' for both the species. The absence of 9 of the 25 muggers released in river Khairi indicates that these have shifted out of the study area either during the initial 'exploring phase' or during the monsoon floods. Soon after the monsoon we had reports about two juvenile muggers that entered a village pond situated close on the banks of, and getting flooded with waters from, river Khairi at about 45 km downstream from the point of release. The muggers had returned back to the river before more information could be collected on these.

The second release in river Khairi was conducted during 8th February, 1990 with 42 juveniles. After one month, 32 (76.1%) of the juveniles were localised within a stretch of 2 km of the point of release.

Future plan for mugger in Similipal

1. There will be no further release in

river West Deo and Khairi.

2. In river Budhabalanga 15 juveniles will be released in the last week of January 1991. This will constitute the last release of captive-reared mugger in Similipal Tiger Reserve.
3. The wild population in all the rivers will be monitored to assess the trend every year.
4. Round-the-year monitoring will continue for the release conducted in river Khairi with base camps from Kabatghai and Jenabil.
5. The captive breeding unit at Ramatirtha shall continue until the State Government decides otherwise, the products of captive breeding will be supplied, when not required for Similipal, for release elsewhere in the State or for purpose to be decided by the Government.
6. Research and education activities at Ramatirtha shall continue.

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SUMMARY

Crocodylus palustris was considered to be extinct in the perennial waters of Similipal Tiger Reserve by 1980. The terrestrial and aquatic habitats, encompassing an area of 2750 km², are under active conservation management since 1973 under Project Tiger. Between April 1981 and February 1990 a total of 238 captive reared juvenile muggers have been released in the reserve. Out of 99 muggers released during 1981-1987 in river Budhabalanga, 12.1% excluding wild-bred hatchlings are seen at present. In river West Deo 34.7% of 72 released (during 1985-1988) and wild-bred hatchling muggers are seen. In river Khairi, where releases have been made since April 1989, 71.6% are seen when reports last came in. During a thorough monitoring over 44 weeks, out of 25 muggers released at Ransaguda in river Khairi 16 young ones could still be seen within a stretch 900 m upstream and 1400 m downstream the point of release. During the monsoon, sightings were from 1 to 3 muggers. The future plan for mugger include (i) last release in January 1991, (ii) regular monitoring of the populations in the wild, (iii) continuation of the captive breeding unit at Ramtirtha for research, education and supply of captive reared juveniles for restocking elsewhere.

सिमिलीपाल बाघ संरक्षित क्षेत्र, उड़ीसा में मगर (*क्रोकोडायलस पैलुस्ट्रिस*)
का बंदी अवस्था में प्रजनन और पुनस्थापन

एस० आर० सागर व एल० ए० के० सिंह

सारांश

1980 में सिमिलीपाल बाघ संरक्षित क्षेत्र की सदानीरा नदियों में *क्रोकोडायलस पैलुस्ट्रिस* को विलुप्त माना जा चुका था। 1973 से बाघ परियोजना के अन्तर्गत 2750 वर्ग किमी० क्षेत्रफल में फैली हुई भूमि और जल क्षेत्र का सक्रियता से संरक्षण प्रबंध किया जा रहा है। अप्रैल 1981 से फरवरी 1990 के दरम्यान बंदी बनाकर पाले हुए मगर के 238 बच्चे इस संरक्षित क्षेत्र में छोड़े जा चुके हैं। 1981-1987 के दरम्यान बुधबालंगा नदी में छोड़े गए 99 मगरों में से मुक्त प्रजनित से ये बच्चों को छोड़कर 12.1% इस समय भी दिख रहे हैं। पश्चिमी देव नदी में मुक्त प्रजनित से ये मगरों के अतिरिक्त (1985-88) में छोड़े गए 72 में से 34.7% दिख रहे हैं। खैरी नदी में, जहाँ मगर अप्रैल 1989 से छोड़े जा रहे हैं, वहाँ अंतिम जानकारी मिलने तक 71.6% दिखाई दे रहे थे। 44 सप्ताह से अधिक चली पड़ताल में खैरी नदी में रणसागुडा में छोड़े गए 25 मगरों में से 16 बच्चे अभी भी उस जगह से 900 मीटर ऊपर की तरफ और 1400 मीटर नीचे की तरफ फैले जल क्षेत्र में दिखाई पड़ रहे थे। मानसून काल में दिखने वाले मगरों की संख्या 1 से 3 तक रही। मगरों के लिए बनाई भविष्य की योजना में (1) जनवरी 1991 में अंतिम बार बच्चे छोड़ना, (2) मुक्त दशा में उनकी संख्या की नियमित पड़ताल और (3) रामतीर्थ में अनुसंधान, शिक्षा और बंदी अवस्था में पाल कर मगर के बच्चे अन्यत्र पहुँचाने के लिए बंदी प्रजनन एकक चलाए रखना सम्मिलित है।

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