Cobra

Chennai Snake Park Silver Jubilee Souvenir

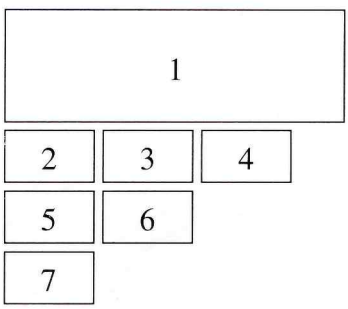
Quarterly Newsletter Vol. 33 July - September 1998

CHENNAI SNAKE PARK TRUST

Chennai Snake Park Trust
Rajbhavan Post, Chennai - 600 022. India

CHENNAI SNAKE PARK TRUST 25 YEARS IN THE SERVICE OF REPTILES AND AMPHIBIANS

Cover



1. The Entrance to the Chennai Snake Park.
2. Water monitor lizard (*Varanus salvator*)
3. Indian python (*Python molurus*)
4 Chittul or Annulated sea snake (*Hydrophis cyanocinctus*)
5. Gharial (*Gavialis gangeticus*)
6. Indian cobra (*Naja naja*)
7. Aldabra tortoise (*Geochelone gigantea*)

Photo : 1 and 7 **Ranga R. Chari**; 2 to 5 **R.J. Ranjit Daniels** ; 6 **Tito Chandy**.

Cobra

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Cobra invites articles and short notes on reptiles and amphibians, their ecology, biology, natural history, conservation or other aspects. These may be of scientific or popular interest. Black and white photographs are also welcome.

Please send your contributions to the Editor, ***Cobra***, Chennai Snake Park Trust, Rajbhavan Post, Chennai 600 022.

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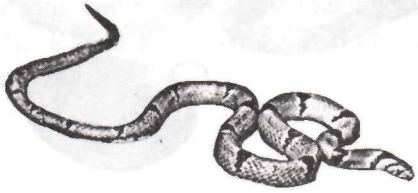
"The snake with its many unique and, in some ways, contradictory attributes has been worshipped, feared, puzzled over, hated, loved, exploited, exterminated, studied and even petted. It has been used in magic, witchcraft, religion, medicine, war, torture, sport, science, commerce and entertainment. On the one hand, it has been a symbol of procreation, health, longevity, immortality and wisdom; on the other, it has represented death, disease, sin, lechery, duplicity, and temptation. It is a paradox... Mankind has seldom ignored it"

- Ramona & Desmond Morris
(in *Men and Snakes*)



"The Huichol Indians (of Mexico) admire the beautiful markings on the back of serpents. Hence, when a Huichol woman is about to weave or embroider, her husband catches a large serpent and holds it in a cleft stick, while the woman strokes the reptile with one hand down the length of its entire back; then she passes the same hand over her forehead and eyes, that she may be able to work as beautiful a pattern in the web as the marking on the back of the serpent".

Quoting the above passage from *The Golden Bough* (1922), Sir James G.Fraser's classic on magic and religion, Des Kennedy says in *Nature's Outcastes - A New Look at Living things We Love to Hate* (1992):

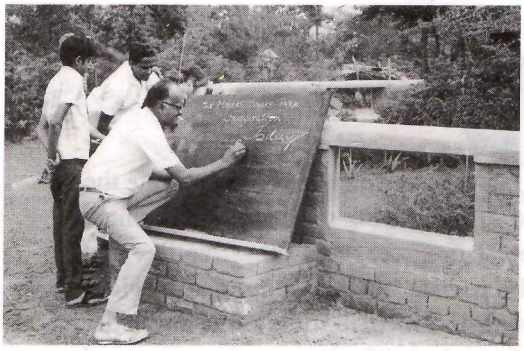
"That's the kind of reverence for the natural world we somehow lost... Snakes, I think, are a good starting point for rediscovering Eden".

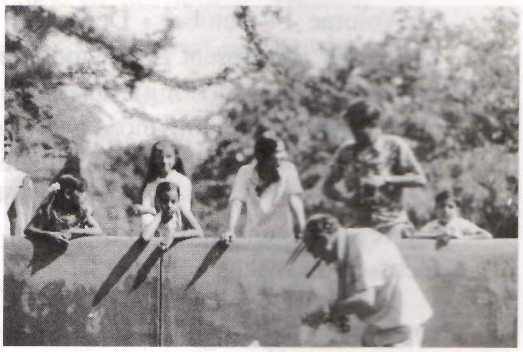
EDITORIAL

This volume of *Cobra* has been brought out as a souvenir to commemorate the 25th anniversary of the Chennai Snake Park. During the years the Chennai Snake Park has strived to promote interest in snakes and other reptiles and amphibians not only in students and biologists but also amongst a wider spectrum of lay people throughout the country. *Cobra,* the quarterly Newsletter of the Chennai Snake Park, first appeared in July 1990. Since its inception and till Volume 14(October - December 1993), it was edited by Dr.R.S. Pillai whereafter the present Editor took charge. Dr.Pillai broadened the scope of this Newsletter by inviting articles on issues relating to our knowledge of reptiles in the country including those published as folklore. Starting with Volume 15 there have been articles on amphibians also appearing from time to time in the Newsletter. In all, over the years, 150 articles of both scientific and popular nature have been published in *Cobra.* Of these, a little more than a third have focussed on snakes in particular.

While contemplating a special issue of *Cobra* as a Silver Jubilee Souvenir, letters of invitation were sent far and wide within the country requesting articles. A number of responders took the trouble to contribute very interesting papers to this Volume. The present compilation is a selection of articles made to reflect the contribution the Chennai Snake Park and its Founders and Guardians have made to the scientific study of snakes and other herpetofauna in the country. Further, the choice of articles was made such that the reader gets a clear idea of where we currently stand in this country in terms of herpetological studies. To this end a range of articles which highlight the history of snake studies in India, the origin and growth of Chennai Snake Park, the role of zoos in conservation of reptiles, health care of reptiles in captivity, many studies on reptiles and amphibians as little known contributors to the Earth's Biodiversity, conservation efforts through captive breeding and rehabilitation and the need to create more awareness amongst children in schools have been included. I sincerely hope that the articles are of interest to all readers. I also take this opportunity to thank all those who contributed to the making of this Volume. Special thanks are due to Mr.Ranga R. Chari who kindly provided the photographs used in this volume.

Editor





The Chennai Snake Park - The early years.

THE CHENNAI SNAKE PARK

B. Vijayaraghavan,

Chairman,

Chennai Snake Park Trust, Chennai - 600 022.

The Chennai Snake Park (Madras Snake Park as it was known till recently) owes its origin to the pioneering work of Romulus Whitaker, an American-born naturalised Indian. Whitaker, who even as a child during his school years in India, had developed a deep fascination for snakes, had his skills honed during his two years' work in Miami Serpentarium, Florida, U.S. He returned to India in 1967 and, in 1970, established a small Snake Park in Selaiyur village on the outskirts of Chennai. This elicited the interest of many and, among them, was a group of naturalists from Chennai, A.N. Jagannatha Rao, K.S. Murthy, D.S. Rao, S.V. Devaraj and S.C. Buch. With their help, Whitaker set up the Snake Park at Guindy in Chennai on a piece of land obtained on lease from the Forest Department of the State Government. This was in 1972.

The same year, a Trust was constituted to manage the affairs of the Snake Park. The Board of Trustees consisted of Doris N. Chattopadhyaya, Harry Miller, M.V. Rajendran, S. Meenakshisundaram, M. Krishnan, Romulus Whitaker and A.N. Jagannatha Rao. At the time of the renewal of the land lease in 1976, and on the instructions of the State Government, the Deputy Director of Tamil Nadu Tourism Dept. and the Wildlife Warden, Tamil Nadu Forest Dept., were inducted as *ex officio* Trustees.

The aims and objectives of the Trust are listed on the back cover of this issue.

The Snake Park went through a bad patch during 1986-88 because of conflicts between two groups among the trustees leading to litigation before the High Court of Madras. The case was ultimately settled by mutual consent in April 1988 and the High Court framed a scheme for the administration of the Trust.

The Board of Trustees has on it a mix of persons experienced in administration, finance, wildlife biology, veterinary science and environmental education. The Chairman of the Board is also the Chief Executive and he is assisted by a Secretary. Both are honorary and part-time. The whole-time staff is headed by a Director, assisted by a Dy. Director with twenty employees under them. Special mention has to be made of the fact that seven out of the nine animal keepers are Irula tribals who have been weaned away from their traditional occupation of catching snakes for the, now illicit, trade in snake skins.

The Snake Park received statutory recognition from the Central Zoo Authority as a medium zoo in 1995.

The Snake Park has, at present, 31 species of Indian snakes, all the three species of Indian crocodiles, four species of exotic crocodiles, one Aldabra tortoise, three species of Indian turtles/tortoises and five species of lizards (A detailed list is given on the inside back cover of this issue).

Many species of reptiles including endangered species like the Indian python (*Python molurus*) and the reticulated python (*Python reticulatus*) have been captively bred in the Snake Park. The offspring, surplus to the Park's requirements, have been either released into the wild or made available for exchange with other Zoos.

During the last four years, the old type cages made of wire mesh which used to house many of the snakes have been replaced with *pucca* constructions with glass frontage. The modernisation of the Snake Park during this period has been facilitated by the financial assistance received from the Central Zoo Authority and the Animal Welfare Board. A notable addition during this period was the aquarium for sea snakes and turtles.

For the education of the public, display boards have been put up at strategic locations in the Park giving valuable information, in a reader - friendly style, about the descriptions and habits of the reptiles. Information has also been furnished to dispel erroneous notions about snakes and also giving scientific advice on treatment of snake bite.

A museum of preserved specimens of reptiles and amphibians is an added attraction.

The Snake Park has a good library of literature on snakes and other reptiles.

Semi-scientific popular books and other materials on snakes and other reptiles are displayed at the Snake Park and are on sale.

As part of its endeavour to make knowledge about snakes and about the activities of the Snake Park accessible to a large audience, the Snake Park started a periodical newsletter in May 1976 (named as *Hamadryad* in 1977). The *Hamadryad* owed a great deal to the efforts of Zahida, wife of Romulus Whitaker. The name of the journal was changed to *Cobra* in 1990. (*Hamadryad* is now the name of the journal of the Centre for Herpetology, Madras Crocodile Bank Trust). *Cobra,* a quarterly, publishes articles of scientific, semi-scientific and popular nature on snakes and other reptiles and amphibians.

The Snake Park has undertaken a few reptile surveys in Tamil Nadu and outside on the request of interested parties. A noteworthy survey was of the area surrounding the Indira Sagar dam in Madhya Pradesh undertaken in October-November 1990 on the request of the Friends of Nature Society, an NGO selected by the World Bank for study of the environmental impact of the Indira Sagar dam.

With the financial assistance received from the Ministry for Human Resource Development, Government of India, through the C.P.R. Environmental Education Centre,

Plate. 1

The aquarium for sea snakes and turtles, Chennai Snake Park - a partial view

The aquarium for sea snakes and turtles, Chennai Snake Park - outside view

Plate. 2

Literature etc on reptiles, for sale at the Chennai Snake Park

Preserved specimens of reptiles, at the Chennai Snake Park - a partial view

Plate. 3

The venomous snakes - Chennai Snake Park - a partial view

The non-venomous snakes - Chennai Snake Park - a partial view

Plate. 4

The environmental awareness programme on reptiles - Teacher trainees in session

A demonstration in progress - Chennai Snake Park

Chennai, an awareness programme was commenced in 1997 for giving lecture demonstrationsn on snakes by scientists of the Snake Park in schools in four neighbouring taluks of Chengelpet District. During the last one-and-a-half years, eighty schools have been covered under this programme. As a corollary to this, special training programmes have also been organised for school teachers at various centres and, so far, 231 teachers have participated in this. The Snake Park also arranges talk shows in schools, colleges and other institutions in Chennai.

The Snake Park also provides facilities including monthly stipends to those desirous of doing research on reptiles either for obtaining doctorates from Universities or for other reasons.

The Snake Park attracts over seven lakhs of visitors in a year, of whom one-fifth are children.

Except for part of the capital works funded by outside agencies and the school education programme which is fully funded by the Goverment of India, the entire expenditure on the Snake Park is taken care of by the gate collections. The gate fee is revised from time to time and currently stands at Rs.three for adult and Re.one for child.

During its first twenty years, the Snake Park owed its success to the efforts of the then - Trustees Romulus Whitaker (who was also the Director of the Snake Park), A.N. Jagannatha Rao (who was also the Honorary Secretary of the Trust), M.V. Rajendran (the noted ophiologist), M.Krishnan (the eminent naturalist - writer and wildlife photographer), R.S. Pillai (of the Zoological Survey of India) and Harry Miller (the well-known photo-journalist). The present Chairman of the Trust (B.Vijayaraghavan), the present Hon. Secretary of the Trust (R.J. Ranjit Daniels) and most of the present Trustees have been in position since 1994.

Promotion of environmental awareness among all sections of the public has become an area of primary concern in today's context of the serious dangers faced by the environment and by many animal species in particular. Zoos are no longer looked upon as locations for mere sight-seeing or recreation. Zoos have now become an effective agency for the education of the public, for making them alive to the diverse species that inhabit this planet with whom man has to learn to co-exist in peace if his own welfare, and even survival as a species, has to be ensured. This is more so in the case of snakes about which many false beliefs prevail even among educated persons and which can be dispelled only by centres like Snake Parks. The public, the young and the old alike, have to be made aware not only of the many fascinating aspects of snakes but also of their crucial ecological role. It is a matter of considerable pride and satisfaction for the Chennai Snake Park that it has rendered singular service in this regard during the last over twentyfive years of its existence.

REPTILE FAUNA OF SIRUVANI HILLS, NILGIRI BIOSPHERE RESERVE, TAMIL NADU.

P. Kannan and **C. Venkatraman**

Salim Ali Centre for Ornithology & Natural History
Anaikatty (PO) Coimbatore - 641 108.

Reptiles are distributed in a wide variety of habitat ranging from rainforest to desert and found in various niches such as rock crevices, tree bark and leaf litter. Many Indian reptiles are rare and have restricted distribution while others are very common and found throughout the country.

The Nilgiri Biosphere Reserve (NBR) is the home for many endemic species of Western Ghats. Among the 285 species of vertebrates endemic to the Western Ghats, 156 (55%) are found in the NBR (Daniels, 1993). This includes 60 species of reptiles of which 7 species are endemic to this reserve. Published information on the herpetofoauna of NBR is scanty. Very few works have been carried out on this line (Daniels, 1993; Bhupathy & Kannan, 1997). Considerable number of works are available on plants and birds pertaining to Siruvani foothills (Subramanian,1959; 1966; Venkatraman & Gokula, 1996). The present work was carried out from 1994 to 96 to prepare a checklist of reptiles found in the foothills. Some of the common species were recorded from fringes of the forest. Species were identified by their morphological characters with the help of Fauna of British India series on reptiles and amphibians (Smith, 1935; 1943).

Study Area

Siruvani foothills are situated about 30 km west of Coimbatore city and in continuation of the Western Ghats lying north of Palghat gap. The study area comes under the core area of Nilgiri Biosphere Reserve & lies between 10°56' and 10°58' N and 76°42' and 76°44'E. The elevation of this area is between 625 to 650 m above sea level and the aspect is easterly. Temperature at the foot hills ranges from 24°C to 38°C and the annual mean humidity is 51%. The area receives both Southwest and Northeast monsoon and rainfall during Southwest monsoon is heavy (May-August). The annual mean rainfall is about 1800 mm. The river Noyyal passes through the area. The vegetation of the study area is of Southern Tropical Moist Deciduous (Champion and Seth, 1968) and it merges with Southern Tropical Evergreen Forests at higher elevations in Muthikolam area of Kerala state and the lower area mixes with scrub forests.

Checklist of Reptiles

A total of 40 species of reptiles were recorded which included 18 lizards, 21 snakes and one turtle. Out of which 5 species namely, *Draco dussumieri*, *Calotes elliotti, Calotes grandisquamis, Ahaetulla pulverulenta* and *Trimeresurus malabaricus* are endemic to Western Ghats (Smith, 1935,1943). Some of the common species such as the fan-throated lizard (*Sitana ponticeriana*), three-lined grass skink (*Mabuya trivittata*), saw-scaled viper (*Echis carinatus*) and olive keelback water snake (*Atritium schistosum*) were recorded from the boundary of the forest. The brown vine snake (*Ahaetulla pulverulenta*) and the king cobra (*Ophiophagus hannah*) are reported for the first time from Siruvani hills.

Class : Reptilia
Order : Testudines
Family : Bataguridae

1. *Melanochelys trijuga* (Schweigger,1812) - Indian black turtle

Order : Squamata
Sub order : Sauria
Family : Gekkonidae

2. *Cnemaspis indica* (Gray,1846) - Indian day gecko
3. *Hemidactylus maculatus* Dum. & Bibr., 1836 - Rock gecko
4. *H. brookii* Gray, 1845 - Spotted house gecko
5. *H. frenatus* Dum & Bibr., 1836 - Asian house gecko
6. *H. leschenaultii* Dum. & Bibr., 1836 - Bark gecko

Family : Agamidae

7. *Calotes calotes* (Linnaeus, 1758) - Common green forest lizard
8. *C.elliotti* Gunther, 1864 - Elliot's forest lizard*
9. *C.grandisquamis* Gunther,1875 - Large scaled forest lizard*
10. *C. rouxi* Dum. & Bibr., 1837 - Roux's forest lizard
11. *C. versicolor* (Daudin, 1802) - Indian garden lizard
12. *Draco dussumieri* Dum & Bibr., 1837 - Southern flying lizard*
13. *Psammophilus dorsalis* (Gray,1831) - Southern Indian rock lizard
14. *Sitana ponticeriana* Cuvier, 1844 - Fanthroated lizard

Family: Chameleonidae

15. *Chamaeleo zeylanicus* Laurenti, 1768 - Indian chamaeleon

Family: Scincidae

16. *Mabuya carinata* (Schneider, 1801) - Common skink
17. *Mabuya trivittata* (Hardwicki & Grey, 1827) - Three lined grass skink
18. *Lygosoma punctatus* (Gmelin, 1799) - Spotted supple skink

Family: Varanidae

19. *Varanus bengalensis* (Daudin,1802) - Common monitor lizard

Order: Squamata
Sub order: Serpentes
Family: Typhlopidae

20. *Ramphotyphlops braminus* (Daudin,1803) - Brahminy worm snake

Family: Boidae

21. *Eryx conicus* (Schneider, 1801) - Common sand boa
22. *Eryx johni* (Russel,1801) - Red sand boa
23. *Python molurus* (Linnnaeus,1758) - The Indian rock python

Family: Colubridae

24. *Ahaetulla nasutus* (Anderson,1758) - Common vine snake
25. *Ahaetulla pulverulenta* (Dum. & Bibr, 1854) - Brown vine snake*
26. *Amphiesma stolata* (Linnaeus, 1758) - Buffstriped keel back
27. *Atretium schistosum* (Daudin, 1803) - Olivaceous keel back water snake
28. *Chrysopelea ornata* (Shaw,1802) - Ornate flying snake
29. *Dendrelaphis tristis* (Daudin, 1803) - Common bronze back tree snake
30. *Macropisthodon plumbicolor* (Cantor,1839) - Green keelback
31. *Oligodon arnensis* (Shaw,1802) - Banded kukri snake
32. *Ptyas mucosus* (Linnaeus, 1758) - Indian rat snake
33. *Xenochrophis piscator* (Schneider,1799) - Checkered keelback water snake

Family: Elapidae

34. *Bungarus caeruleus* (Schneider, 1801) - Common Indian krait
35. *Naja naja* (Linnaeus, 1758) - Common cobra
36. *Ophiophagus hannah* (Cantor, 1836) - King cobra

Family: Viperidae

37. *Echis carinatus* (Schneider, 1801) - Indian sawscaled viper
38. *Hypnale hypnale* (Merrem,1820) - Hump-nosed pit viper
39. *Trimeresurus malabaricus* (Jerdon,1853) - Malabar pit viper*
40. *Vipera russelli* (Shaw & Nodder,1797) - Russell's viper

* Species endemic to the Western Ghats

Acknowledgement

We are grateful to Dr.S. Bhupathy, Scientist, SACON, for his encouragement and comments.

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BIODIVERSITY OF THE AMPHIBIAN FAUNA OF TAMIL NADU

M.S. Ravichandran

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Amphibian fauna of India consists of 201 species belonging to 9 families (Inger and Dutta, 1986; Pillai, 1986, Das, 1990). Of these 46 species belonging to 5 families have earlier been reported from Tamil Nadu. Recently an additional 15 species were found to exist in Tamil Nadu (Ravichandran, 1992). The areas of their occurrence include the eastern slopes of the Western Ghats, parts of the Eastern Ghats and the plains, all spread over 23 districts. Thus altogether 61 species belonging to 5 families are so far known from Tamil Nadu, constituting 30.3% of the Indian Amphibian fauna. Considering the very long geological history of amphibian evolution, it is natural to expect rich biodiversity in this group. In this paper, while giving the taxonomic list of species occurring in Tamil Nadu, an attempt has been made to segregate them on the basis of form, function and adaptation to various ecological niches.

Tamil Nadu can be divided into two regions (i) the eastern coastal plains and (ii) the hilly region along the north and the west. The coastal plain is sub-divided into (a) the Coromandel plain comprising the districts of Chingelpet, South Arcot and North Arcot, (b) the alluvial plain of the Cauvery delta extending over Thanjavur and parts of Tiruchirappali districts and (c) the dry Southern Plains in Madurai, Ramanathapuram, Viruthunagar, Kanniyakumari, Sivagangai and Tirunelveli Districts.

The Western Ghats are situated at a distance varying from 80 to 160 km. from the sea. The Western Ghats are a steep and rugged mass averaging 1220 m. above the sea level and rising to 2695m. at its highest point. The Palghat gap about 25 km. in width is a major break in this great mountain stretch. To the south of Palghat pass is the Anamalai hills and on its eastern side is the Palani hills. The slopes of the Western Ghats are covered with deciduous, semi-deciduous and moist evergreen forests.The Nilgiris and the Anamalai are the hill groups with maximum height. Some of the important hill ranges of Eastern Ghats in Tamil Nadu are Sheveroys, Pachaimalai, Kollimalai and the Javadi hills.

On the basis of their habitat preferences, the 61 species belonging to 16 genera represented in Tamil Nadu were found distributed in the following two ecological zones.

1. Forests and high altitudes upto 2200m and 2. Plains and lower altitudes (upto 240m.). Species that show special habits as that of being arboreal or living in burrows have been highlighted.

Systematic list of the Amphibian Fauna recorded from Tamil Nadu.

No	Classification	Forests	Maximum altitude in mts.(approx)	Plains	Arboreal	Burrows
	Order: ANURA **Family: BUFONIDAE** Gray **Genus:: *BUFO*** Laurenti					
1	*Bufo fergusonii* Boulenger	+	950	+	-	-
2	*Bufo melanostictus* Schneider	+	2000	+	-	-
3	*Bufo microtympanum* Boulenger	+	2000	-	-	-
	Family: MICROHYLIDAE Gunther					
	Genus: *KALOULA* Gray					
4	*Kaloula pulchra* Gray	+	900	+	-	-
	Genus: *MELANOBATRACHUS* Beddome					
5**	*Melanobatrachus indicus* Beddome	+	1300	-	-	-
	Genus: *MICROHYLA* Tshudi					
6	*Microhyla ornata* (Dumeril and Bibron)	+	950	+	-	-
7	*Microhyla rubra* (Jerdon)	+	1100	-	-	+
	Genus: *RAMANELLA* Rao and Ramanna					
8**	*Ramanella anamalaiensis* Rao	+	Not recorded	-	-	-
9**	*Ramanella montana* (Jerdon)	+	1040	-	-	-
10**	*Ramanella triangularis* (Gunther)	+	1000	+	-	-
11	*Ramanella variegata* (Stoliczka)	-	-	+	-	-
	Genus: *UPERODON* Dumerill& Bibron					
12	*Uperodon systoma* (Schneider)	+	1100	+	-	-
	Family: **RANIDAE** Gray					
	Genus: *MICRIXALUS* Boulenger					
13**	*Micrixalus fuscus* (Boulenger)	+	1900	-	-	-
14**	*Micrixalus nudis* Pillai	+	1000	-	-	-
15**	*Micrixalus opisthorhodus* (Gunther)	+	2000	-	-	-
16**	*Micrixalus silvaticus* (Boulenger)	+	2100	-	-	-
17**	*Micrixalus gadgili* Pillai & Pattabiraman	+	1450	-	-	-

No	Classification	Forests	Maximum altitude in mts.(approx)	Plains	Arboreal	Burrows
	Genus:*NANNOBATRACHUS* Boulenger					
18**	*Nannobatrachus beddomii* Boulenger	+	900	-	-	-
	Genus: *NYCTIBATRACHUS* Boulenger					
19**	*Nyctibatrachus aliciae* Inger, Shaffer,Koshy & Bakde	+	1100	-	-	-
20**	*Nyctibatrachus deccanensis* Dubois	+	1130	-	-	-
21**	*Nyctibatrachus major* Boulenger	+	900	-	-	-
	Genus : *RANA* Linnaeus					
22	*Rana aurantiaca* Boulenger	+	1100	-	+	+
23**	*Rana beddomii* (Gunther)	+	1800	-	-	-
24**	*Rana brachytarsus* (Gunther)	+	950	-	-	-
25**	*Rana brevipalmata* Peters	+	2000	-	-	-
26.	*Rana crassa* Jerdon	-	-	+	-	+
27**	*Rana curtipes* Jerdon	+	1800	-	-	-
28.	*Rana cyanophlyctis* Schneider	+	2000	+	-	-
29**	*Rana diplosticta* (Gunther)	+	1200	-	-	-
30.	*Rana hexadacytla* Lesson	-	-	+	-	-
31*.	*Rana keralensis* Dubois	+	950	-	-	-
32*.	*Rana leithii* Boulenger	+	900	-	-	-
33**	*Rana leptodactyla* Boulenger	+	900	-	-	-
34.	*Rana limnocharis* Boie	+	1800	+	-	-
35*.	*Rana malabarica* Tschudi	+	950	-	+	-
36**	*Rana murthii* Pillai	+	950	-	-	-
37.	*Rana temporalis* (Gunther)	+	1000	-	-	-
38.	*Rana tigerina* Daudin	+	950	+	-	-
	Genus: *TOMOPTERNA* **Dumeril & Bibron**					
39.	*Tomopterna breviceps* (Schneider)	+	600	+	-	+
40*.	*Tomopterna dobsonii* (Boulenger)	+	350	+	-	+
41*.	*Tomopterna rolandae* Dubois	-	-	+	-	+
42**	*Tomopterna rufescens* (Jerdon)	+	450	-	-	-
	Family: RHACOPHORIDAE **Hoffman**					
	Genus : *PHILAUTUS* Gistel					
43**.	*Philautus chalazodes* (Gunther)	+	2000	-	+	-
44**	*Philautus charius* Rao	+	700	-	+	-
45.	*Philautus femoralis* (Gunther)	+	2200	-	+	-
46**	*Philautus glandulosus* (Jerdon)	+	2000	-	-	-

No	Classification	Forests	Maximum altitude in mts.(approx)	Plains	Arboreal	Burrows
47.	*Philautus leucorhinus* (Lichtenstein & Martens)	+	2000	-	+	-
48**	*Philautus pulcherrimus* (Ahl)	+	1100	-	+	-
49**	*Philautus signatus* (Boulenger)	+	2000	-	+	-
50	*Philautus variabilis* (Gunther)	+	2150	-	+	-
	Genus: *POLYPEDATES* Tschudi					
51	*Polypedates cruciger* Blyth	+	370	-	+	-
52.	*Polypedates maculatus* (Gray)	+	950	+	+	-
	Genus: *RHACOPHORUS* Kuhl & van Hasselt					
53**	*Rhacophorus calcadensis* Ahl.	+	1000	-	-	-
54**	*Rhacophorus malabaricus* Jerdon	+	1100	-	+	-
55.	*Rhacophorus pleurostictus* (Gunther)	+	850	-	+	-
	Order : GYMNOPHIONA					
	Family: ICHTHYOPHIDAE Taylor					
	Genus: *ICHTHYOPHIS* Fitzinger					
56**	*Ichthyophis beddomei* Peters	+	700	-	-	Subterranean
57**	*Ichthyophis longicephalus* Pillai	+	1200	-	-	Subterranean
58**	*Ichthyophis peninsularis* Taylor	+	950	-	-	Subterranean
59**	*Ichthyophis tricolor* Annandale	+	1100	-	-	Subterranean
	Genus: *URAEOTYPHLUS* Peters					
60**	*Uraeotyphlus malabaricus* (Beddome)	+	1800	-	-	Subterranean
61**	*Uraeotyphlus oxyurus* (Dumeril & Bibron)	+	1900	-	-	Subterranean

* Endemic to India ** Endemic to the Western Ghats
\+ Reported - Not reported.

Discussion

Amphibians exhibit a wide range of adaptive radiation suited to their habitats and modes of life viz., burrowing , aquatic, semi-aquatic, terrestrial, arboreal and subterranean. But they are, however, restricted to moist habitats only, owing to their sensitive skin, which has to remain moist for normal gas exchange. Amphibians thrive well in temperatures ranging from 20 to 30°C and relative humidity from 50 to 75%. Hence they are considered indicators

of pollution and disturbance to the habitat as they are the first to disappear from a changing habitat (Daniels, 1991).

Tamil Nadu with its varied ecological zones harbours about 30% of the amphibian species known from India. About 42% of the Indian amphibian endemics are confined to the Western Ghats of which 23% comprising 47 species are restricted in their distribution to its southern ranges. All these 47 species are represented in the fauna known from Tamil Nadu. Temperature and humidity being the limiting factors in the distribution of amphibians it is observed from the present studies that Tamil Nadu owes its rich amphibian diversity to its forests in the higher elevations along the eastern slopes of the Western Ghats which provides congenial habitats for three-fourth of its faunal representation. In the plains only 16 species are found. As for the biodiversity of the amphibian fauna it is the highest in the tropical and moist deciduous forest. Habitat destructions due to deforestation, removal of litter, pollution of rivers from pesticides used in rubber and tea plantations and even air pollution is taking a heavy toll of amphibian life, which owing to their wide ranging habitats are not safe anywhere, whether on land or in water.

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ROLE OF ZOOS IN THE CONSERVATION OF REPTILES IN INDIA

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The history of the zoo movement in India goes back to 1854 when the first zoo of the country was opened by Raja Rajendra Mullick Bahadur in his private residential mansion called "Marble Palace" in the centre of Calcutta. There were hardly 15 zoos in the country upto 1947. The major breakthrough in the establishment of zoos in the country took place only after Independence. There were 47 zoos including only one reptile park (Chennai Snake Park) in 1975. As per the recent list of Indian zoos published in "Indian Zoo Year Book Vol-II" there are 231 zoos (Large Zoos - 15, Medium Zoos - 16, Small Zoos - 25 and Mini Zoos - 175) spread in all the States and Union Territories except Chandigarh, Pondicherry and Lakshdeep Islands. These include 9 snake parks including two subsidiary units of Calcutta Snake Park and 7 other reptile zoos.

The zoos were originally set-up purely for recreation and enjoyment purposes. But the concept of zoo management has changed rapidly during the last few decades. With the alarming decline of wild animals in their natural habitats, the modern zoos are now involved in their conservation movement through captive breeding, rehabilitation of species, visitor education programme and research activities in addition to recreation.

In the past though some of the older zoos were exhibiting a few specimens of some of the larger reptiles like crocodiles, Indian python etc., more stress was given on exhibition of mammals and birds rather than reptiles. This apathy for exhibition of reptiles in captivity was mainly due to ignorance about identification, biology, behaviour and captive management of reptiles along with the fear psychosis prevailing among the public as well as the zoo personnel as all reptiles specially snakes were considered as "deadly & dangerous". The reptile keeping in Indian Zoos gained momentum around 1970s with the opening of Nellai Snake Park, Palayamkottai (1969) and Chennai Snake Park (1972) both in Tamil Nadu. This was followed by the opening of Madras Crocodile Bank (1976), Calcutta Snake Park (1977) and the Snake Parks at Pune (1985) and Chinchwas (1990). With the initiation of Crocodile Conservation projects in many States of India since 1975-76, several centres were established throughout the country for captive breeding, artificial hatching of wild laid eggs, and rearing of three species of Indian crocodilians. Some of these centres are still there as recognised zoos.

Besides, most of the large, medium, small and even some mini zoos are having separate reptiles sections with many attractive nature simulating enclosures. This could be

possible due to the development of our knowledge about the biology and upkeep of reptiles in captivity in recent years.

Captive breeding

Captive breeding is one of the most important objectives of keeping reptiles in captivity. Many modern Indian Zoos are successful in breeding several species of reptiles in recent years by providing them their natural environment while housing, providing suitable diet, health care and proper day to day management. Captive breeding programmes can help to replace the zoo stock, can be able to supply to other needy zoos of the country and abroad and to restock the dwindling population in the wild through reintroduction. Further this can also provide valuable information on the reproductive biology of reptiles.

One of the earliest record of breeding of Indian mugger crocodile was at Ahmedabad Zoo in 1960. Since then many zoos were able to breed all the three species of Indian crocodilians and the exotic spectacled caiman crocodile (*Caiman crocodilus crocodilus*). The other species of exotic crocodilians bred at the Madras Crocodile Bank are *Crocodylus moreletti* and *Crocodylus siamensis*.

Mugger crocodile (*Crocodylus palustris*) has been bred extenstively in many Indian Zoos such as Jaipur, Vadodara, National, Madras Crocodile Bank, Chennai Snake Park, Nandankanan, Hyderabad, Visakhpatnam, Jodhpur, Bikaner, Lucknow, Kanpur, Mysore, Sundarvan (Gujarat), Borivli, Tikerpara, Kapilash Zoos (Orissa) and others.

The salt-water crocodile (*Crocodylus porosus*) has been bred successfully at Madras Crocodile Bank in 1983. Later, it has bred at Nandakanan Zoo, Kukrail Rehabilitation centre (Uttar Pradesh) and Visakhpatnam Zoo. Earlier this species has bred in captiviy at Crocodile Rearing Centre, Bhagabatpur (West Bengal) in 1982.

The Gharial (*Gavialis gangeticus*) has been bred at Nandankanan Zoo for the first time in 1980 and subsequently breeding of this species has been recorded at Madras Crocodile Bank, Mysore Zoo, Bannerghatta Zoo, Jaipur Zoo and Kukrail Gharial Rehabilitation Centre.

Among snakes the Indian python (*Python molurus*) appears to have bred for the first time at Jaipur Zoo as reported in 1965. Since then many zoos notably Chennai Snake Park, Madras Crocodile Bank, Pune Snake Park, Calcutta Snake Park, Nandankanan Zoo, Vandalur Zoo (Chennai), Sundarvan Zoo (Gujarat), Vadodara Zoo, etc. could breed this species of snake.

Only three zoos (Calcutta Snake Park, Madras Crocodile Bank and Chennai Snake Park) were sucessful in breeding King cobra (*Ophiophagus hannah*) . Important contributions in breeding several species of snakes in captivity were made by zoos such as Chennai Snake Park, Madras Crocodile Bank, Pune Snake park, Calcutta Snake Park and Vadodara Zoo. The list of Snakes bred in one or more of the above zoos is as follows:

1. Reticulated python *(Python reticulatus)*
2. Indian cobra *(Naja naja naja)*
3. Common krait *(Bungarus caeruleus)*
4. Russell's viper *(Vipera russelli)*
5. Sawscaled viper *(Echis carinatus)*
6. Rat snake *(Ptyas mucosus)*
7. Trinket snake *(Elaphe helena)*
8. Red sand boa *(Eryx johni)*
9. Common sand boa *(Eryx conicus)*
10. Common wolf snake *(Lycodon aulicus)*
11. Green keelback *(Macropisthodon plumbicolor)*
12. Common cat snake *(Boiga trigonata)*
13. Checkered keelback *(Xenochrophis piscator)*
14. Vine snake *(Ahaetulla nasutus)*
15. Striped keelback *(Amphiesma stolata)*
16. Bamboo pit viper *(Trimeresurus gramineus)*
17. Wart snake *(Acrochordus granulatus)*
18. Flying snake *(Chrysopelea ornata)*
19. Bronzeback tree snake *(Dendrelaphis tristis)*
20. Olive keelback water snake *(Atretium schistosum)*
21. Hump-nosed pit viper *(Hypnale hypnale)*

The water monitor (*Varanus salvator*), the largest among Indian lizards has been bred at Ahmedabad Zoo, Madras Crocodile Bank and Nandankanan Zoo. The other species of lizards bred in Indian Zoos are common Indian monitor (*Varanus bengalensis*), Indian chameleon (*Chemaeleo zeylanicus*), common garden lizard (*Calotes versicolor*), Tucktoo (*Gecko gecko*) and Forest calotes (*Calotes rouxi*). Among exotic lizards, South American Iguana (*Iguana iguana*) has been bred at Chennai Snake Park and Madras Crocodile Bank.

The captive breeding programme for freshwater turtles and tortoises was started in 1982 at Madras Crocodile Bank. The land tortoises (*Geochelone elegans*) has been successfully bred at Junagarh Zoo, Rajkot Zoo, Vadodara Zoo, Visakhapatnam Zoo, Hyderabad Zoo Chennai Snake Park and Madras Crocodile Bank. The Travancore tortoise (*Indotestudo forstenii*) has been bred at Pune Snake Park and Madras Crocodile Bank.

The Indian pond terrapin (*Melanochelys trijuga*) has been bred at Chennai Snake Park, Madras crocodile Bank and Hyderabad Zoo. The Indian flapshell turtle (*Lissemys punctata*) has been bred at Madras Crocodile Bank, Vadodara and Rajkot Zoos. The Ganges soft-shell turtle (*Aspideretes gangeticus*) has been bred at Vadodara Zoo and Madras Crocodile Bank whereas Indian roofed turtle (*Kachuga tecta*) has been bred at Vadodara Zoo.

Rehabilitation of species

The Indian zoos during the last two decades have been playing an important role in rehabilitation of some of the Indian reptiles, specially crocodilians, to replenish the declining population in their natural habitats. Upto the end of 1994 around 3865 captive bred and/or raised gharials of over one metre length have been released in twelve rivers of the country. The main Zoos involved under this programme are Nandankanan Zoo, Gharial rehabilitation Centres at Kukrail (U.P) and Tikarpara (Orissa). Similarly captive bred and /or reared salt water crocodile of Crocodile Rearing Centre at Dangmal (Orissa) and Bhagabatpur (W.B) have been rehabilitated in Bhitarkanika and Sundarban areas respectively. Under rehabilitation of mugger crocodile programme Hyderabad Zoo, Visakhapatnam Zoo, Junagarh Zoo, Nandankanan Zoo, Bannerghatta Zoo, Madras Crocodile Bank and many other Crocodile Rearing Centres have participated. Several hundred specimens of this species have been released into the wild. The Nandankanan Zoo alone has contributed (captive bred) 381 gharials and 51 mugger crocodiles for reintroduction into wild.

On the occasion of the first meeting of IUCN/ SSC Snake specialist Group held at Chennai during November, 1982 a few Indian pythons bred at Chennai Snake Park have been reintroduced in Mudumalai Wildlife Sanctuary (Tamil Nadu). The Vadodara Zoo is reparing for release of zoo bred Indian pythons in its natural habitat after getting permission from the concerned authorities.

The zoo bred star tortoises of Hyderabad Zoo have already been reintroduced into their habitat and the Vadodara Zoo is in the process of releasing them into nature. So far no Indian Zoo has taken part in reintroduction programme of lizards.

Visitors education programme

Each zoo is attracting large number of visitors of all ages, sexes, religion, rich and poor, urban and rural speaking different languages, illiterate and literate with different levels of education every day, thanks to the increasing interest of the people in nature and wild animals. This diversity of zoo visitors is seldom seen in other institutions.

About 50 million people visit the zoos in India. The popularity of reptiles in zoos can be seen from the number of visitors that visited one of the reptile zoos, the Chennai Snake Park during the past ten years for which figures are available.

Year	No. of visitors	Year	No. of Visitors
1988	923598	1993	753021
1989	966780	1994	743239
1990	977415	1995	819755
1991	913835	1996	669570
1992	894474	1997	738130

Most of the visitors to reptiles exhibits in zoos show keen interest to know about them. Among the zoo exhibits, reptiles are least known to the common visitors. The zoos can take advantage of the daily visit of such a large number of visitors with a bent of mind to know something about the curious reptiles. The living reptiles in zoos can form the basis of zoo visitors education programme. Ignorance about these interesting group of animals coupled with superstitious beliefs, myths and fear psychosis among public is mainly responsible for their lack of interest in reptile conservation. The zoos can play a vital role in removing the misconceptions about reptiles from the minds of people and imparting knowledge about reptiles and the need for their conservation for the benefit of mankind.

Attempts are being made to orient people visiting the zoos specially the reptile zoos for creating awareness for conservation of reptiles through easily available resources and resource persons. Because of the diversity of zoo visitors, great skill, creativity and inventiveness is required for zoo education keeping in view the target groups such as children, school students, college and university students, villagers, etc.

The zoo keepers looking after reptiles during the course of routine work come in direct contact with visitors daily and come across a number of enquiries from them, thus they serve as primary educators. The zoo supervisory staff and guides conducting the visit of tourists also educate the public they come in contact. These resource persons have to be trained suitably keeping in mind the varied target groups of people they are likely to reach or interact. The training programme should include the reptiles in general, their biology, their useful role in the ecosystem, threat status and the need for their conservation.

The interested members of youth association, clubs and NGOs may be encouraged to take up short-term training programme on reptiles in zoos so that they can serve as resource persons to educate the public in their areas to achieve our goal of zoo education.

Display of sign boards depicting salient features of popular and scientific informations about the reptile exhibits in many languages including local language will help in enriching the knowledge of visitors about reptiles. Some of the zoos are arranging special talks either inside the zoo or by visiting educational and other institutions in the outskirts of zoo through audio-visual aid specially for school and college students about identification of reptiles, their biology, status and the need for their conservation. For the more serious visitors like students of zoology, in addition to the live reptiles, dead preserved specimens and the reference books in the library help them in their scientific pursuits.

As a part of the reptile education programme, popular scientific literature, picture post cards, stickers, reptile toys, T-shirts etc., conveying the message of reptile conservation in English/ Hindi/ local language may be distributed to the interested public either free of cost or on sale as is being done at Chennai Snake Park and Madras Crocodile Bank.

Systematic zoo visitors' education programme specially on reptiles is being carried out in some of the large zoos and reptiles zoos such as Chennai Snake Park, Madras Crocodile Bank, Calcutta Snake Park and Pune Snake Park.

Research activities

One of the mandates of a modern zoo is research. Too little is known of our precious herpetofauna. The modern zoo specially the reptile zoos provide a living laboratory for basic as well as applied research on behaviour, biology, management, diseases and parasites which are difficult to study in the wild.

Wildlife research specially on reptiles in Indian zoos is in its infancy. However, with the opening of special reptile zoos and implementation of Crocodile Conservation Project around 1970s, many zoos with limited resources at their disposal are involved in reptile research since last two decades. The professional human resources in zoos are limited and so reptile research is carried out either independently by a few zoo professionals or in collaboration with researchers of nearby universities and educational/research institutions. In addition to carrying out research on captive reptiles, many zoos such as Chennai Snake Park, Madras Crocodile Bank, Pune Snake Park, Vadodara Zoo, Nandankanan Zoo, etc., also serve as centres for carrying out research on free-living reptiles of the respective regions as facilities like resource persons, identification of species, library, etc., are easily available.

The research findings will be very useful in improving the methods of scientific reptile keeping in captivity so that they can be displayed with better health for longer periods. Besides, the findings can be utilised for conservation of free-living reptiles e.g. conservation of Indian crocodilians.

Some of the zoos have successfully implemented special research projects e.g. "Haematological studies on reptiles", "Studies on Chameleons", etc., at Chennai Snake Park; "Studies on mugger crocodile - multiple clutch production, nest parameters and temperature dependent sex determination" at Madras Crocodile Bank; "Breeding of three spceies of Indian crocodilians in captivity" at Nandankanan zoo, etc.

A number of research papers on reptiles of Indian zoos have been published in leading journals of the country and abroad. It appears from the available publications, that extensive studies on breeding biology in captivity of all the three species of crocodilians, some species of snakes (Indian python, Reticulated python, etc.) turtles and tortoises (Indian pond terrapin, Indian flapshell turtle, land tortoises, etc.), and a few lizards (water monitor, Indian chameleon, etc.) have been carried out in Indian zoos. Studies on feeding habits, management, skin shedding, cannibalism, congenital anomalies, etc., have also been made involving some of the species. The Chennai Snake Park appears to be the only zoo engaged

in studies on diseases and parasites of snakes. It is hoped that in the years to come, more studies on different aspects of reptile life, management, health care, diseases and parasites covering more number of reptile species will be taken up in zoos.

The need for scientific exchange of information and research findings of Indian zoos was felt since long. To meet this requirement a "*Wildlife Bulletin of the Indian Board for Wildlife*" covering some information on zoos was brought out in 1965 for the first time but it was discontinued later on. Another quarterly publication titled " *Indian Zoo Bulletin*" was started in October 1973 from National Zoological Park, New Delhi and it is being published even now though very irregularly. They contained very meager information on reptiles of zoos. To fill up this gap the Chennai Snake Park brought out a biannual newsletter titled *"Newsletter of the Madras Snake Park"* for the first time in May,1976 exclusively devoted to reptiles. This newsletter was renamed as *"Hamadryad"* from the fourth issue brought out in 1977. This is being published now from Madras Crocodile Bank since May, 1985. This publication (*Hamadryad*) is now the leading biannual research journal on reptiles from India.

The Chennai Snake Park has started publishing a quarterly newsletter titled *"Cobra"* since July-September,1990 and it publishes research/popular/informative articles and notes on reptiles from all parts of the country.

The Herpetological Society of India, based at Pune Snake Park is bringing out a biannual journal titled *"Herpeton"* since January, 1988 on all aspects of reptiles. The fourth periodical titled *"Herpetile"* - newsletter of Calcutta Snake Park is being published biannually since 1997.

With the publication of these journals/newsletters from Indian reptile zoos, the herpetologists, naturalists and young scientists are encouraged to pursue their scientific studies on Indian herpetofauna both in captivity and in the wild and to publish their observations/research findings in these periodicals.

At present no Indian zoo is displaying frogs and toads. It is gratifying to note that more recently in 1998 a booklet titled "Captive care of common Indian frogs and toads" authored by B.K.Gupta was published by Coimbatore Zoological park and Conservation Centre with funding support from Jersey Wildlife Preservation Trust, United Kingdom. This booklet is likely to encourage the zoos for starting the display of amphibians in their collection.

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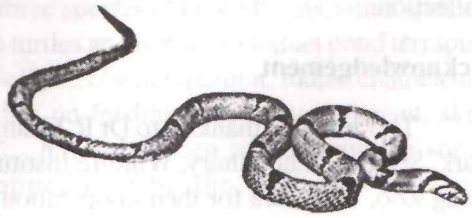

REHABILITATION OF CROCODILIANS IN ORISSA

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Orissa is the only state in the country having all the three species of Indian crocodilians (Gharial, Saltwater crocodile and Mugger or Marsh crocodile) in the wild. The preliminary survey carried out in the state by a FAO/UNDP consultant during the period from 8th to 15th June, 1974 indicated that all the three species of crocodilians were rapidly dwindling in their natural habitats (FAO,1974). The report further suggested to initiate a special project for conservation of the crocodililians and their habitats in Orissa. Accordingly, a scheme for conservation and study of these crocodilians was prepared and implemented by the wildlife wing of the state forest department with financial assistance from government of India. The technical expertise for this project was provided by FAO/UNDP consultant, Dr. H.R.Bustard since 1975-76. The main objective of the project was to 'rear and rehabilitate' the endangered crocodilians, as it was realised that unless the existing small wild population of these crocodilians was strengthened by release of captive-reared specimens into the wild, recovery of the seriously depleted population would either not occur or would be delayed.

Three Research and Conservation Centres were established for the three species in three different locations within their natural habitats. The programme envisaged the collection of wild-laid eggs of the crocodilians, incubation under artificial conditions, rearing upto a size of over one metre and then releasing into their natural habitats. Besides, one more centre was established at the Nandakanan Zoological Park (the park lies within the geographical range of these species) with an aim to breed in captivity all the three species of crocodilians of Orissa.

Sufficient care was taken for selection of release site, timing of release and marking of specimens released. The location with least disturbances of any kind and far away from

human habitations, where they were known to occur earlier were selected for release. The time of release selected was several months prior to onset of monsoon in order to ensure that the crocodilians have adequate time to become familiar with the habitat before annual floods. All the crocodilians selected for release were tail-scute clipped in a definite battern for subsequent recognition after about a year of release, sexing, and during monitoring/ capture/death. The size selected was always over one metre in length presuming that they will be able to protect themselves from most of the potential enemies as well as they can adjust with the changed environment. Size and health of the crocodilians for release are some of the important parameters as the release of yearlings from captivity to the wild involves change from the limited surroundings of pool to a vast area of water body. Due attention was paid for maintaining the desired sex ratio (1male:3females) in the released population.

The project was successful in achieving all its objective in captive breeding, rearing and rehabilitating the crocodilians in nature. This paper intends to discuss in brief the success of the rehabilitation programme of these three species in Orissa.

1. Gharial (*Gavialis gangeticus*)

The river Mahanadi and its tributaries form the southernmost limit of distribution of gharial. A protected area, named as Satkosia Gorgen Wildlife Sanctuary, having an area of 795.52 sq.km. encompassing about 30 km long prime gharial habitat of river Mahanadi was notified during May, 1976, specially for the conservation of this endangered species. It was ascertained from the 1974 survery report that there were only five gharials (2 males and 3 females) in the river Mahanadi. A Gharial Reasearch and Conservation Centre was established at Tikarapada inside the sanctuary on the bank of river Mahanadi during 1975-76.

Taking advantage of the availability of three subadults (one male and two females) at the Nandankanan Zoological Park, an attempt was made to breed this species by constructing a nature simulating breeding pool in the park during 1975-76. The species was successfully bred for the first time in captivity in 1980 and since then the species is breeding regularly (Acharjyo *et al.*, 1996). The first record of rehabilitation of this species took place on 09.04.77 when three juvenile gharials of over one metre size were released into the river Mahanadi at Tikarpada inside the sanctuary. These were hatched and reared at Tikarapada Centre. Upto March 1998, 681 gharial juveniles including 381, bred and reared at Nandankanan Zoological Park, have been rehabilitated in selected suitable sites of the river Mahanadi inside the sanctuary. Their movements and survival are being monitored. But the results are not encouraging. There are no reports of the breeding of the reintroduced gharials in their natural habitat.

2. Saltwater crocodile (*Crocodylus porosus*)

The mangrove ecosystem of Bhitarkanika is one of the most promising natural habitats of this species in India. The whole of Bhitarkanika comprising of 672.00 sq.km was notified as Bhitarkanika Wildlife sanctuary in April 1975 to give complete protection to this species as well as other endangered species.

The results of a detailed survey carried out in the creeks and rivers of Bhitarkanika Wildlife Sanctuary during December 1976 and January 1977 period for the implementation of the rehabilitation programme indicated the presence of 29 adults, 6 sub-adults and 61 juveniles (Kar and Bustard 1989). A Research and Conservation Centre for this species was established at Dangmal, in one of the islands within the sanctuary since July, 1975. This species has bred twice during 1985 and 1986 at the Nandankanan Zoological Park. No further breeding could take place due to the sudden death of the female in April 1987. The first release of this species into the wild inside the sanctuary was carried on 25 April, 1977. So far 1722 captive reared juveniles, all hatched and reared at Dangmal Centre have been released in phases into suitable selected creeks away from human habitations. The released crocodiles are being monitored regularly. Monitoring results reveal that these released crocodiles have well established inside the sanctuary and several specimens of the reintroduced crocodiles have started breeding in the wild.

3. Mugger crocodile (*Crocodylus palustris*)

The occurrence of this species in the rivers of Brahmani, Baitarani, Mahanadi, Sileru, hill streams and rivers of Similipal and several reservoirs sitiuated at different places of Orissa has been recorded. Similipal Wildlife Sanctuary having an area of 2200 sq km was notified in December, 1979. This Sanctuary is famous for the endangered tigers, elephants and several other species of wild fauna. A Research and Conservation Centre for Mugger crocodile was established at Ramatritha in Similipal Wildlife Sanctuary during 1979 (Dani *et al.*, 1991). The breeding programme of this species at Nandankanan Zoological park was taken up during 1978-79 and this species has successfully bred in the park (Acharjyo *et.al.*, 1996) upto the end of March 1998. Rehabilitation programme of this species with the release of 537 captive bred specimens was taken up at three sites in their natural habitats; hill streams of Similipal Wildlife Sanctuary (486 juveniles of Ramatirtha stock and 12 of Nandankanan Zoological Park bred stock), river Mahanadi of Satkosia Gorge Sanctuary (35 juveniles of Nandankanan Zoological Park stock) and at two waterbodies inside Chandaka-Dampara Wildlife Sanctuary (4 juveniles of Nandankanan Zoological Park stock). Monitoring results indicate that the rehabilitated Muggers have been well established and started breeding in one of the sites of their natural habitats inside Similipal Wildlife Sanctuary.

The result of the rehabilitation programme of crocodilians in Orissa indicate that the reintroduced saltwater crocodiles and mugger crocodiles have successfully established in their habitats as evidenced from their breeding results. However, the results of rehabilitation of gharials is not encouraging since there are no reports of their breeding in the wild. It is felt that long term monitoring alongwith the protection measures is needed till the proper establishment of the population of a species. Necessary intervention on the basis of monitoring results and periodic evaluation of the project may help in overcoming the problems of rehabilitation and survival of the crocodilians.

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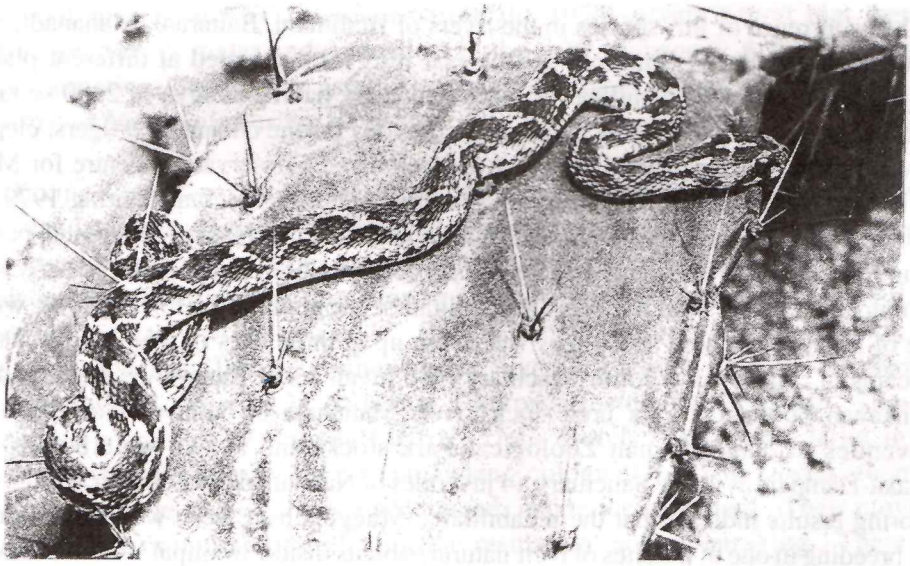

NESTING OF FRESHWATER TURTLE *KACHUGA SMITHII* INHABITING GHAGHRA RIVER SYSTEM IN FAIZABAD DISTRICT OF EASTERN UTTAR PRADESH

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Investigations on the nesting ecology and related behavioural pattern of Asiatic freshwater turtles in general and those of India in particular have been widely neglected. This has been very critically put forth by Yadav (1983 & 1992). Both freshwater and marine species of turtles are unique in their nesting as they seem to be exhibitionists especially females while laying (Yadav. 1994). According to Dodd (1985) the nesting behaviour in marine turtles are far better studied and explored than any other activities shown by marine turtles. Likewise, nesting and other activities of freshwater turtles are lesser known than those of marine turtles. Therefore it was planned to make a complete exploration of the diversity of behavioral patterns involved in the nesting of freshwater turtle *Kachuga smithii* inhabiting the Ghaghra river system. The study was conducted during the period 1989 and 1990. The results were also confirmed in our further studies in recent years (unpublished). The obervations have been analysed and disscussed.

Materials And Methods

Regular visits were made to the natural abode of the freshwater turtle *Kachuga smithii,* along the river banks and water pockets of Ghaghra river system of Faizabad district. Observations were made mainly for two years *i.e.* 1989 and 1990, during the months of October and November . Different parameters such as temperature of water, nesting soil/ sand, temperature of nest at about 15 cm of depth, distance of the nest from the edge of water (from which females emerge), clutch size, morphometric measurements of the eggs and their physical characteristics were recorded. The data were analysed and inferences drawn.

Observations and Results

Observations relating to different reproductive behaviour like behaviour prior to nesting season, searching of proper nesting site, nest excavation, laying, filling and finally return of laying female towards the main abode were made. Related observations were recorded each day.

Table.1: Details of nest location & clutch size observed during the year 1989 (Number of observations = 17).

Sl.No	Attribute	Range	Mean
1	Atmospheric temperature (in degrees C)	28 - 32	29.7
2	Water temperature (in degrees C)	24 - 26	24.8
3	Distance from edge of water (in feet)	11 - 22	16.8
4	Diameter of pit (in cm)	8 - 15	12.23
5	Depth of pit (in cm)	25 - 28	26.23
6	Nature of soil	Pure sandy	—
7	Temperature of soil at 15 cm depth (in degrees C)	26 - 27	26.18
8	Clutch size	5 - 8	6.58
9	Egg length (in mm)	40 - 45	42.76
10	Egg width (in mm)	25 - 27	25.94
11	Egg weight (in gm)	11.55 - 15.01	13.17

Table.2: Details of nest location & clutch size observed during the year 1990 (Number of observations = 16).

Sl.No	Attribute	Range	Mean
1	Atmospheric temperature (in degrees C)	28 - 32	30.0
2	Water temperature (in degrees C)	24 - 26	24.8
3	Distance from edge of water (in feet)	10 - 20	14.87
4	Diameter of pit (in cm)	9 - 15	12.06
5	Depth of pit (in cm)	24 - 28	26.18
6	Nature of soil	Pure sandy	—
7	Temperature of soil at 15 cm depth (in degrees C)	25 - 27	26.12
8	Clutch size	4 - 9	6.68
9	Egg length (in mm)	42 - 45	43.5
10	Egg width (in mm)	24 - 27	25.68
11	Egg weight (in gm)	12.45 - 14.75	13.38

Sexual dimorphism in *Kachuga smithii* is not evident externally and therefore it is very difficult to identify the sex at first glance. Courtship and mating have been seen during the month of July and August in the afternoon. The males start sniffing the cloacal region of

the females. This act is accompanied by creaking noises, vocalization and also moving of head vertically by both sexes. After this the male starts inserting its penis into the cloacal opening of the female through caudal probing. The gravid females fully laden with eggs, start searching for a suitable nesting site after rains. They have been noticed coming out of water during the afternoon. It has been noticed that natural vegetation of plants-*Tamarix devica* (Jhau) is a safe reserve for laying females in the area. The females with eggs become heavy in weight and that is why they seem to be sluggish in movement during the onward laying journey.

The gravid females start excavating a pit after searching a suitable nesting site and also being self-assured of its safety as well as the eggs. Generally, the laying takes place within a territory of 5-15 m from the water. The pit is prepared and dug within 8 - 10 minutes. The pit is 10-15 cm wide 20-28 cm deep, having the shape of *surahi* with mouth narrower than its bottom. The superficial sand of the pit remains dry while it is gradually moist towards the bottom of the pit, i.e., at depths of 10-15 cm. The female turtle sits on the mouth of the pit and leans its body-tail region directing to the hole of the pit. Laying of eggs is evident by the trembling of body. After laying, the female starts filling the pit by throwing the sand into the pit by the hind legs and by smoothening or stamping by the hind legs.

Morphometric measurement of eggs have been made and presented in the tables 1-2. Eggs were obtained from the nesting site of *Kachuga smithii* in the 3rd and 4th weeks of October-1989 and 1990. The nesting season is often extended upto early November. The atmospheric temperature ranges from 28-31°C water temperature ranges from 24-26°C. Distance of nest from the edge of water ranges from 3-4 m, the diameter of the pit varies from 8-15 cm of the depth varies from 24-28 cm. The physical nature of the nest soil is pure sandy. The temperature of the nest varies from 25-27°C at the depth of 15 cm of the pit. The turtles are annual breeder. The clutch size has been worked out in the range of 4-9 eggs per female.

The eggs of *Kachuga smithii* are smooth, hard, brittle and whitish in appearance. The egg length ranges from 40 - 45 mm and width from 25 - 27 mm. Egg weight varies from 11.55 to 15.01 gm. The eggs are eliptical or conical in shape which is very much suited for the safe adjustment, packing and filling during laying/nesting by the female.

Discussion

No sexual dimorphism is evident in the freshwater turtle, *Kachuga smithii* just as in most of other freshwater species of turtles (Bury,1979), although, a unique pattern of larger tails in males and broader plus larger body size in females are common characters in turtles (Auffenberg,1964, a & b). Workers such as Jackson and Davis (1972), & Ehrenfeld (1979) have reported similar process of sniffing touching, smelling and caudal probing of females by males. Extensive survey pertaining to the ecological and different behavioral patterns such as nest selection, conditions for nesting, preparation of pit in nest site, digging of egg cavity, egg laying, filling, stamping and return of female have been done by Ehrenfeld (1979). He has further suggested that females probably smell the nest site sand for its quality. This behaviour has also been observed in the case of *Kachuga smithii*. Most turtles use both fore and hind limbs in scraping, scratching, filling & throwing the sand over the mouth of the pit like *Kachuga*

smithii (Yadav,1983). Similar phenomenon has been studied in *Chrysemys picta belli* (Legler,1954) and in *Podocnemis unifilis* (Foote,1978). It has been also observed that the females after laying urinate over the nest just to avoid predation of eggs (Patterson,1971). Moll (1979), Ewert (1979) and Bury (1979) have extensively reviewed the literature pertaining to the reproductive pontential, clutch size etc., in "Turtles Perspectives and Research". Our observations for *Kachuga smithii* are in accordance with the findings of White and Murphy (1973) in *Chelydra serpentina*.

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STATUS OF CROCODILES AND FRESHWATER TURTLES IN THE CHAMBAL RIVER AND GANGA RIVER : A COMPARATIVE ANALYSIS

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The Ganges river system in India is considered as the most productive and important river system. The species diversity in different rivers of the Ganges river system is almost similar with minor changes. The major vertebrate species in these rivers are two species of mammals (dolphin & otter), more than 100 species of wetland birds, two species of crocodiles (mugger & gharial), more than 12 species of freshwater turtles and large number of fishes. For biodiversity conservation majority of the rivers like Chambal, Yamuna, Ken, Son, Ghagra, Girwa and Ramganga are partially protected (Table.1).

Table.1. Salient features of the study areas in the Chambal river and Ganga river.

S. No	Features	Ganga river	Chambal river
1	River status	Main river	Major Tributary of Yamuna river (Ganges river system)
2	Study area	Rishikesh - Kanpur	Pali - Pachhnada
3	River length under study	Approx. 645 km	Approx. 400 km
4	Territory	Rajasthan, Madhya Pradesh & Uttar Pradesh	Uttar Pradesh
5	Major cities & Towns (within 12 km from the river bank)	Rishikesh, Haridwar, Garmukteswar, Anupsahar, Narora, Farrukhabad, Kanpur	Nil
6	Districts	Dehradun, Haridwar, Bijnor, Gaziabad, Bulundsahar, Badaun, Farrukhabad, Kanpur	Morena, Bhind (M.P) Sawai Madhopur, Dholpur (Rajasthan) Agra, Itawah (U.P.)
7	Barrages/Dams	Rishikesh, Haridwar, Bijnor and Narora	Nil
8	Tributaries	Sushwa, Song, Bananga, Malin Sonali, Mohawa, Sol, Ramganga, Isan, Kalinadi, Kalyani rivers.	Kuno, Kunwari, Aasun, Sindhi, Pahuj
9	Human activities	Community bathing at religious ghats, Cremation & Post-cremation activities, agriculture, fishing, discharge of domestic & Industrial pollutants, water regulation	Agriculture, sand collection, bathing, cattle washing, illegal fishing.
10	Conservation status	Unprotected area (small stretch is passing through Chilla Sanctuary between Rishikesh and Haridwar)	Protected area (Sanctuary)

The aquatic fauna in the Protected rivers is richer than in the unprotected rivers. The conservation status of crocodiles and freshwater turtles in the Ganga river and in the Chambal river is discussed in this paper.

Study area

Chambal river:

The Chambal river flows through the states of Madhya Pradesh, Uttar Pradesh and Rajasthan between the parallels of latitude 25° 52' N and 29° 23' N and longitude 76° 28' E and 79° 01' E. It is a deep and fast river, flowing from south-west to north-east. After originating from the Vindhyan Range in Madhya Pradesh the river runs through Rajasthan. From Pali (Chambal and Parbati river confluence) it borders Madhya Pradesh and Rajasthan and from Rheo upto Barecha it borders Madhya Pradesh and Uttar Pradesh. Down Barecha, the river flows entirely through Uttar Pradesh until it joins Yamuna at Bareh. There are a series of three dams at Gandhi Sagar (Madhya Pradesh), Rana Pratap Sagar and Jawahar Sagar and a barrage at Kota (Rajasthan).

The average annual discharge of the river is about 4193 million cubic metres from its large catchment area of 22,533 sq.km. River gauging indicates that the annual run off varies from a minimum of 1450 million cubic metres during drought years to 10,900 million cubic metres in good years. During monsoon the river floods naturally and high extent of erosion and deposition of soil take place.

A major portion the Chambal river is declared as National Chambal Sanctuary for the protection of the gharial and other aquatic animals like mugger, freshwater turtles, wetland birds, dolphins and others.

Ganga river:

The Ganga rises at 7010 meters in Gangotri, Uttar Kashi District, U.P, India, on the southern slopes of the Himalayan range. It flows through three different states - Uttar Pradesh, Bihar and West Bengal covering a distance of 2525 km before it joins the Bay of Bengal. During its long course it embraces many small torrents and tributaries of varied origin.

The present study has been carried out in the Ganga river in a stretch between Rishikesh and Kanpur in Uttar Pradesh. The total length of the river under study is 645 km. All the way from Rishikesh to Kanpur most of the ghats have religious importance. Large number of pilgrims take holy bath, do cremation and post cremation activities and thus become a major source of pollution to the river.

In the study area large number of factories like IDPL, BHEL, sugar, chemicals, fertilizers, engineering, cotton and tanneries are situated on the banks of the river. The discharge from these industries enter the Ganga river directly or indirectly and pollute the river to a considerable extent.

The natural flow of the Ganga river has been checked due to construction of barrages up-stream. These barrages are constructed either for power generation or for irrigation. A series of barrages have been constructed at Rishikesh, Haridwar, Bijnor and Narora. Among them the barrage at Rishikesh was specially constructed to supply water to the Chilla Power station. The river waters at Narora were divereted both for irrigation (Lower Ganga Canal) and for Atomic Power Plant located at Narora. Other two barrages at Haridwar and Bijnor are meant for irrigation through Upper Ganga canal and Madhya Ganga Canal, respectively.

Species diversity:

The list of crocodiles and freshwater turtles identified from the Ganga river and Chambal river is given in the Table.2. Both the freshwater crocodiles, mugger and gharial are present in the Chambal and Ganga river. A total of 12 species of freshwater turtles in 7 genera are present in the Ganga river. In the Chambal river 7 species of freshwater turtles are present.

Table.2. List of freshwater turtles and crocodiles in the Chambal river and Ganga river

Freshwater turtles		Crocodiles	
Chambal river	**Ganga river**	**Chambal river**	**Ganga river**
Hardella thurjii	*Geoclemys hamiltonii*	*Crocodylus palustris*	*Crocodylus palustris*
Kachuga kachuga	*Hardella thurjii*	*Gavialis gangeticus*	*Gavialis gangeticus*
Kachuga dhongoka	*Kachuga kachuga*		
Kachuga tentoria	*Kachuga dhongoka*		
Lissemys punctata	*Kachuga smithii*		
Aspideretes gangeticus	*Kachuga tecta*		
Chitra indica	*Kachuga tentoria*		
	Melanochelys trijuga		
	Lissemys punctata		
	Aspideretes gangeticus		
	Aspideretes hurum		
	Chitra indica		

Management goals:

The aquatic reptiles (crocodiles & turtles) in the Chambal river are protected as the river is under the management of National Chambal Sanctuary. Sightings of crocodiles in the Ganga river are very rare, but they are plenty in the Chambal river. Under the 'grow and release' programme large number of captive reared gharial have been released in the Chambal river. The population estimates revealed that the gharial population in the Chambal river has been recovering over the past decade from an earlier declining status. New nesting sites of gharial have been established in the highly protected Chambal sanctuary. Occurrence of large number of crocodiles and freshwater turtles in the Chambal river is due to the protection given to the habitats by the State Forest Departments. The situation in the Ganga river is completely different. Large scale fishing, a major threat for aquatic animals, is going on in the river. In addition the river is used for many purposes including releasing of pollutants, which makes the river unsuitable for the aquatic animals. There are no protected areas in the Ganga river between Rishikesh and Kanpur. Aquatic life in some stretches in the Ganga river is protected as these stretches receive protection from the religious people on the river ghats. However, these areas are quite meager. Looking into the various problems it is concluded that unless urgent and strict measures are taken to protect the animals in the Ganga river most of the turtle species in this river will soon become extinct. The crocodiles are almost extinct from the Ganga river.

Acknowledgements

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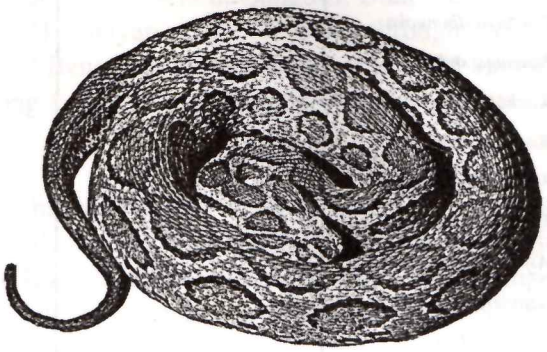

A SURVEY OF SALTWATER CROCODILE (*CROCODYLUS POROSUS*) NESTS IN THE BHITARKANIKA WILDLIFE SANCTUARY, ORISSA.

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The rarity of Saltwater crocodile *(Crocodylus porosus)* in India was apparent by late 1960s. By early 1970s *C. porosus* was locally extinct in south Indian states of Kerala, Tamil Nadu and Andhra Pradesh and their distribution was restricted to Bhitarkanika in Orissa, Sunderbans in West Bengal and Andaman & Nicobar Islands (Bustard and Choudhury 1981). Daniel and Hussain (1975), based on field work during 1973 recorded the continued existence of the Bhitarkanika population of *C.porosus*. Bustard (1974) strongly recommended Bhitarkanika to be declared a sanctuary and highlighted the need to protect the mangroves with a total ban on fishing within the area. Following the recommendations of Bustard (1974) and De Ward (1975), Government of Orissa declared Bhitarkanika a wildlife sanctuary in April 1975. This was followed by a complete ban on fishing and felling of mangroves throughout the sanctuary. In 1975 Government of Orissa set up saltwater crocodile research and conservation programme.

Survey of *C.porosus* in Bhitarkanika during 1976 revealed the presence of only 35 adult crocodiles (Kar and Bustard 1989). Over the last 20 years more than 1,000 crocodiles have been released back to the area and Bhitarkanika now holds one of the largest populations of *C.porosus* in the country. The present study aims to look at the status of nesting *C.porosus* in Bhitarkanika.

Study area

Bhitarkanika Wildlife Sanctuary, comprising an area of 176 sq.km is located in the deltaic region of Brahmini and Baitarani rivers in the Kendrapara district, Orissa. The habitat consists of deltaic mangrove swamps. Vegetation in the sanctuary is characterized by pure formations of tree species such as *Avicennia officinalis*, *Excoecaria agallocha*, *Heritiera fomes*, *Ceriops tagal* and *Phoenix paludosa*. Annual rainfall averages 1600 mm and the temperature varies from a minimum of 10°C in winter to a maximum of 40°C in summer. Besides the saltwater crocodile, other major reptiles of the sanctuary include water monitor lizard (*Varanus salvator*), king cobra (*Ophiophagus hannah*) and python (*Python molurus bivittatus*).

The present survey of *C. porosus* nests was carried out in the four forest blocks of the Sanctuary namely the Bhitarkanika, Dangamala, North Mahisamada and South Mahisamada.

Methods

C. porosus constructs a mound nest inside the forest. Nest mounds were intensively searched in the above mentioned four forest blocks of the Sanctuary during May and July 1997. Majority of the creeks in these four forest blocks were covered by a country boat to look for crocodile tracks. Upon sighting a track, spoor marks of the crocodile were examined inside the forest to ascertain the place of nesting. Besides this direct search for nests, honey collectors inside the Sanctuary were interviewed about the occurrence of crocodile nests. Upon receiving information from honey collectors, the place was verified for further data collection.

After locating a nest, parameters such as size of the crocodile, surrounding vegetation cover, materials used for nesting, distance from the nearest permanent source of water and canopy cover over the nest were noted down. Nests were classified into two categories, active and predated. Presence of crocodile near the nest mound was considered to be active. In case of predated nests, the nest constituents were found scattered and the crocodile had abandoned the nest site.

Results and Discussion

In total 35 nests were located during the survey. A maximum of 25 nests were located in the Dangamala forest block, followed by seven in Bhitarkanika, two in North Mahisamada and one in South Mahisamada forest block. Size of the nesting females varied from 6 - 14 feet. 57% of nesting females were of 10 - 12 feet size class (n = 35, Fig.1)

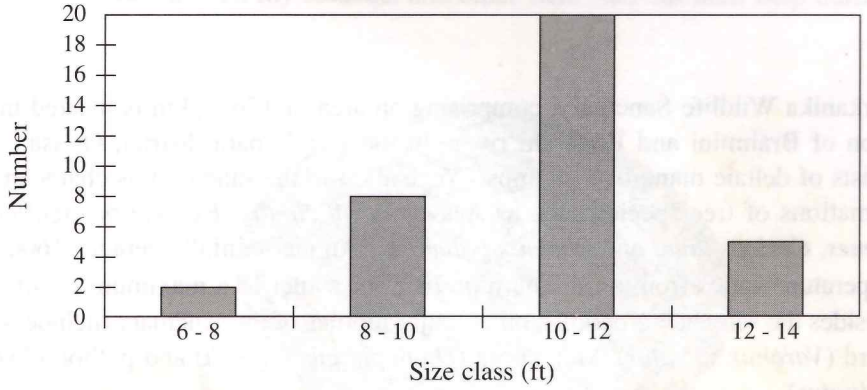

Fig.1 Size class of the nesting females recorded during the survey

Time of Nesting

Nesting of *C. porosus* at Bhitarkanika is primarily a wet season activity. *C. porosus* nests at Bhitarkanika were first located at the end of the dry season and continued throughout the wet season. The earliest nest as recorded on 19 May 1997 and latest on 15 July 1997. Observation on this seasonality of *C. porosus* nesting confirms that of other studies (Kar 1981, Lang 1980).

Nest site selection and nest constituents

Except for one nest, remaining 34 nests were located in the mangrove vegetation. Only one nest was located in the non-mangrove habitat of Bhitarkanika forest block. Except two nests, rest of the 35 nests were located in the bushes of *Phoenix paludosa*. The nests were composed of *Phoenix* leaves, twigs and mud. Nests were located close to the permanent source of water i.e. creeks or rivers. 65.4% of the 26 nests quantified for this purpose were within 50m from the permanent source of water (Fig.2). 64.5% of the nests had 100% exposure and were exposed to direct sunlight throughout the day (n = 31, Fig.3).

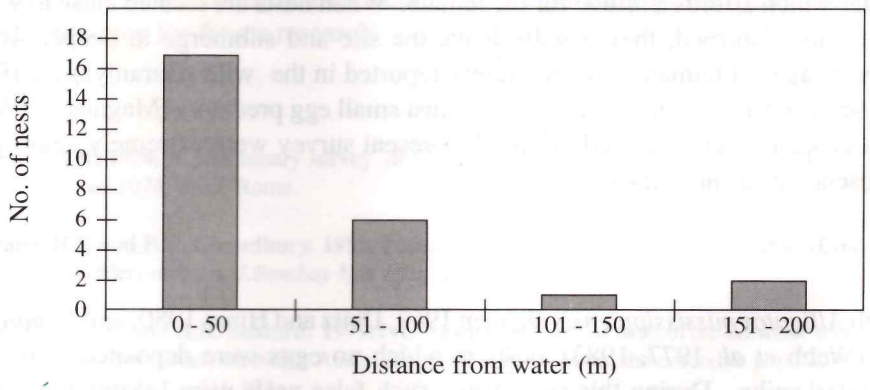

Fig.2. Location of *C. porosus* nests with respect to permanent source of water

When information in the literature on *C. porosus* nests, nest sites and nesting habitats (Deraniyagala 1939; Webb 1977; Webb *et al*; 1977 and 1983, Graham 1981, Kar 1981) is combined with the present study, it becomes apparent that when *C. porosus* occupy wetlands containing a variety of vegetation communities, nests are usually non-randomly distributed among these communities. Nesting tends to be restricted to specific and often easily recognizable communities or habitats. In Bhitarkanika presence of *Phoenix paludosa* bushes inside the mangrove forest was a major determinant for *C. porosus* nesting.

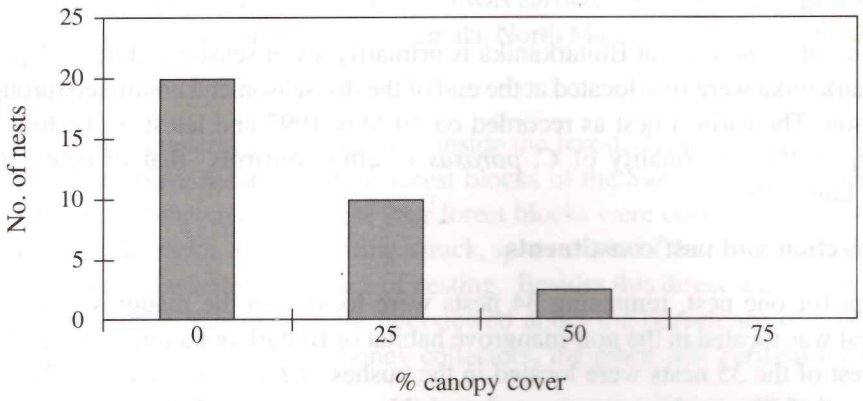

Fig. 3. Frequency of *C. porosus* nests in relation to canopy cover

As emphasised by Graham (1981), most nest sites are within 50 m from the permanent source of water which affords a refuge for the female. When nests are located close to water and if females are disturbed, they usually leave the site and submerge in deeper water. Defence of nests against humans has been rarely reported in the wild (Deraniyagala 1939; Webb *et al.* 1983) and are commonly directed against small egg predators (Magnuson 1982). However, six crocodiles encountered during the present survey were extremely aggressive to human presence near their nests.

False Nests

As with *Alligator mississippiensis* (Joanen 1969; Deitz and Hines 1980) and *C. porosus* in Australia (Webb *et al.* 1977, 1983), nests in which no eggs were deposited were also located in Bhitarkanika. During this survey two such false nests were located with three shallow heaps of nest material within 30 m of the completed nests.

Nest Predation

Nine of the 35 nests located during the present survey were found to be predated. Predation on the nests took place at the begining of the nesting season and prior to the onset of monsoon. During the begining of nesting season the area surrounding the nest mound was dry and water was not available in the pit near the nest , thus forcing the crocodile to retreat in the nearby permanent source of water. It was during this period the nests got predated . All the nests were predated by water monitor, which makes a small incison into the nest and predates on the eggs of *C. porosus*. Similar instance of predation on *C. porosus*

nests by water monitor and wild pigs in North Andaman Islands has been reported by Choudhury and Bustard (1979).

Nest Survey - Its implications for management

The size of the *C. porosus* population in the mangrove swamps of Bhitarkanika is difficult to estimate. Spot light counts in heavily vegetated areas have limited application. Spot light count may be suitable for monitoring short term trends or gross density changes in areas of open water, but have limited application on overall population estimation. They do not account for the population in the heavily vegetated areas away from the main rivers or creeks, and do not distinguish between mature and immature animals, and between males and females. Moreover, in the light of limited data available on movement of larger *C. porosus* (Webb and Messel 1978) , they are difficult to interpret.

Surveys based on nests, on the other hand, are intimately related to the breeding population, are independent of whether or not an area is accessible by boat and gives a better insight into the recruitment rate in a natural population. Devising a method for conducting and interpreting nest counts for *C. porosus* would therefore seem a very worthwhile area for future research.

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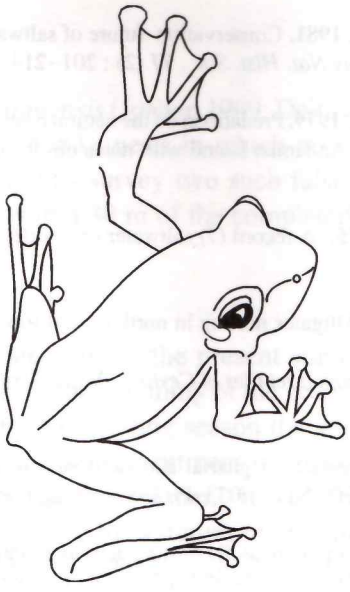

AMPHIBIAN RESOURCES OF KERALA

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Studies on the amphibian fauna of Kerala date back to 1890 AD, when Boulenger published *"The Fauna of British India-Reptilia and Batrachia"*. Since then, many papers including the amphibian fauna of Kerala were published (Ferguson, 1904: Rao,1915: Mc Cann, 1932; Daniel, 1963, 1975; Pillai 1978, 1981; Pillai and Pattabiraman, 1981; Inger *et al.* 1984; Inger and Dutta, 1986, Daniel and Sekar, 1989, Andrews and Sanil 1995 a,b; Sanil, 1996; Sanil and Leelamma Alex,1995, Nair and Easa,1997, Sreekumar and Balakrishnan , 1997).

In India, 206 amphibian species have been described so far (Sekar, 1996). Half of these are found in the Western Ghats, another one third or so in the eastern Himalayas and the rest distributed throughout the country, including the Andaman and Nicobar islands.

Among the three orders of amphibians, two orders viz, Apoda and Anura are found in Kerala, represented by 87 species (Table 1). There might be every possibility of finding a few more species of amphibians, especially in the deep forests which have not been explored yet. Systematic investigations on some undescribed amphibians collected from Western Ghats are in progress (Indraneil Das, per. com). Due to the inadequate collection and study, our knowledge about the ecology and natural history of known species is limited.

The faunal list of Kerala includes 9 bufonids, 10 microhylids, 36 ranids, 19 rhacophorids and 13 caecilians. Among them 7 bufonids, 1 microhylid, 18 ranids, 13 rhacophorids and 9 caecilians are known only from Kerala. Most of them are rare and some species are known only from their type locality. One species called Malabar tree toad *(Pedostibes tuberculosus)* has been listed as endangered. Another species *(Melanobatrachus indicus)* was thought to be extinct, but rediscovered recently (Karthikeyan Vasudevan, 1996).

Habitat

Amphibians live in water, on trees, under rocks and in damp areas. Those which live in water can also spend considerable time on land. These are poikilothermic and undergo aestivation and hibernation during summer and winter seasons respectively. These are stenothermic animals which cannot survive under the conditions of severe temperature changes. During aestivation/hibernation, all the metabolic activities are minimised and the animals utilise the stored food.

Amphibians use various waterbodies for spawning during the breeding season. They breed mostly in still waters and some species breed in running waters also. The apodans generally lay their eggs in damp burrows. Among the Anura, even the dry skinned toads need water or damp earth to breed. Tree frogs lay their eggs in water filled ditches and hollows . The damp environment is required because their eggs and embryos must extract oxygen and food from the surrounding water and at the same time excrete waste material directly into it.

Potential threats to their survival and conservation

Amphibians play a vital role in the ecological balance. It is known that most amphibian species survive in forests. Amphibians are a group particularly sensitive to disturbances in their habitats (Rabb, 1990). So, deforestation in any type of forest in any region would directly affect the population and the population decline would create several changes in the ecosystem.

Injudicious application of agrochemical and other pollutants in the aquatic medium is another cause of concern. This reduces the hatching potential of frog eggs. Farmers are using a variety of fertilizers and insecticides in their fields to control insect pests. Since some of the frogs breed in agricultral areas, their eggs and tadpoles come in direct contact with these chemicals. Sublethal effects of pesticides on the frogs are also well documented. Another cause of damage is by the modification of the breeding grounds. Large scale urbanization and resultant habitat destruction of this century naturally have wiped out many breeding sites and we have no idea how many species may have become extinct/rare and endangered in this process. Frogs are considered as a natural enemy of a number of agricultural pests (Andrews and Sanil, 1995). Thus frogs are the potential biological control agents for preventing undue growth of insect population and their breeding grounds. Over the last few years the amphibian population has been reported to be declining in a number of geographical locations throughout the world and disappearing from their natural habitat (Blaustein and Wake, 1995). It is generally accepted that the primary cause of amphibian declines is anthropogenic habitat modification or destruction.

Another problem is the excessive removal of the species having economic importance. India was the biggest frogleg exporting country in the world (Subba Rao, 1993). During the 1980s every year, 3000 tonnes of froglegs were being exported (Table 2) to west Europe and that means killing of 50-60 million frogs a year added to the great number of frogs that are killed for research and educational purposes. It is estimated that the return from the frogleg export was approximately 30 crores of rupees during 1984-86. The average annual net trade of *Rana hexadactyla* alone from India during 1983-86 was 338777 Kg + 286184 specimens (Sanil George,1995 b). As in other frogleg exporting countries, the export of froglegs from India was based on wild hunting and capture of the Ranid species . Government of India banned the export in 1986. However, illegal hunting of *R. hexadactyla* and *R. tigerina* is being practised widely in Kerala. "Five star" toddy shops and hotels in some regions of Kerala offer dishes prepared from froglegs. Selective collections of large frogs may reduce the breeding potential because most of the large frogs are gravid females. This may definitely accelerate the depletion of the species in the wild.

Another important factor which reduces the population of frogs, is the collection of specimens for biology teaching in colleges and schools. In Kerala hundreds of thousands of frogs are being caught and killed yearly for dissection in these educational institutions and this will definitely lead to the depletion of frogs, especially *Rana hexadactyla* and *Rana tigerina*. At present there is no effort being made to culture frogs for this purpose.

Vial (1991) stated that amphibian declines were not consistent at all locations nor among all species, but their magnitude is undeniable. So to properly study these problems and to take serious conservation steps, a survey on amphibian fauna in Kerala is warranted.

Table 1: List of Amphibians of Kerala

(Based on the published reports so far. Taxonomy of amphibians have been revised recently. However, the basis for this revision is not yet clear. So the new names are not included in this list species marked with asterisk are endemic).

Anura

Bufonidae

* 1. *Ansonia rubigina* Pillai & Pattabiraman, 1981
* 2. *Bufo beddomii* Gunther, 1875.
3. *Bufo fergusonii* Boulenger, 1892.
* 4. *Bufo hololius* Schneider, 1799
5. *Bufo melanostictus* Schneider 1799.
* 6. *Bufo microtympanum* Boulenger, 1982.
* 7. *Bufo parietalis* Boulenger, 1882.

* 8. *Bufo silentvalleyensis* Pillai, 1981.
9. *Pedostibes tuberculosus* Gunther, 1875.

Microhylidae

10. *Kaloula pulchra* Gray, 1831.
11. *Melanobatrachus indicus* Beddome, 1878.
12. *Microhyla ornata* (Dumeril & Bibron, 1841.
13. *Microhyla rubra* (Jerdon 1854)
* 14. *Ramanella anamalaiensis* Rao, 1937.
15. *Ramanella montana* (Jerdon, 1854)
16. *Ramanella triangularis* (Gunther, 1875)
17. *Ramanella variegata* (Stoliczka, 1872).
18. *Uperodon systoma* (Schneider, 1799)
19. *Uperodon globulosum* Gunther, 1864.

Ranidae

* 20. *Micrixalus fuscus* (Boulenger, 1882)
* 21. *Micrixalus nudis* Pillai, 1978.
* 22. *Micrixalus opisthorhodus* (Gunther, 1868)
* 23. *Micrixalus saxicolus* (Jerdon, 1853)
24. *Micrixalus silvaticus* (Boulenger, 1882)
* 25. *Micrixalus thampii* Pillai , 1981.
26. *Nannobatrachus beddomii* Boulenger, 1882.
* 27. *Nyctibatrachus aliciae* Inger, Shaffer, Koshy & Bakde, 1984.
* 28. *Nyctibatrachus deccanensis* Dubois, 1984.
* 29. *Nyctibatrachus major* Boulenger, 1882
* 30. *Nyctibatrachus minor* Inger, Shaffer, Koshy & Bakde, 1984.
31. *Rana aurantiaca* Boulenger, 1904.
32. *Rana beddomi* (Gunther, 1875.
* 33. *Rana brachytarsus* (Gunther, 1875)
34. *Rana brevipalmata* Peters, 1871
35. *Rana crassa* Jerdon, 1853.
36. *Rana curtipes* Jerdon, 1853
37. *Rana cyanophlyctis* (Schneider, 1799).
* 38. *Rana diplosticta* (Gunther, 1875)
39. *Rana hexadactyla* Lesson 1834
* 40. *Rana keralensis* Dubois, 1980
41. *Rana leithii* Boulenger 1888
* 42. *Rana leptodactyla* Boulenger, 1882
43. *Rana limnocharis* Boie, 1835
44. *Rana malabarica* Tschudi. 1838

* 45. *Rana murthii* Pillai, 1979
* 46. *Rana nilagirica* Boulenger, 1883.
47. *Rana phrynoderma* Jerdon, 1853.
* 48. *Rana semipalmata* Boulenger, 1882.
49. *Rana temporalis* Gunther, 1864.
50. *Rana tigerina* Daudin 1803.
* 51. *Rana travancorica* Annandale, 1910
52. *Tomopterna breviceps* (Schneider, 1799)
* 53. *Tomopterna parambikulamana* (Rao, 1937)
54. *Tomopterna rolandae* Dubois, 1983
55. *Tomopterna rufescens* (Jerdon, 1854)

Rhacophoridae

* 56. *Philautus beddomii* (Gunther, 1875)
* 57. *Philautus chalazodes* (Gunther, 1865)
58. *Philautus charius* Rao 1937
* 59. *Philautus femoralis* (Gunther, 1864)
* 60. *Phillautus flaviventris* (Boulenger, 1882
61. *Phillautus glandulosus* (Jerdon, 1953)
* 62. *Philautus leucorhinus* Lichtenstein & Martens, 1856
* 63. *Philautus noblei* (Ahl.1922)
* 64. *Philautus parkeri* (Ahl 1927)
* 65. *Philautus pulcherrimus* (Ahl 1927)
* 66. *Philautus signatus* (Boulenger, 1882)
* 67. *Philautus temporalis* (Gunther, 1864)
* 68. *Philautus travancoricus* (Boulenger, 1891
69. *Philautus variabilis* (Gunther, 1858)
70. *Polypedatus maculatus* (Gray, 1834)
* 71. *Rhacophorus calcadensis* Ahl, 1927
* 72. *Rhacophorus lateralis* Boulenger, 1883
73. *Rhacophorus malabaricus* (Jerdon 1870)
74. *Rhacophorus pleurostictus* (Gunther, 1864)

Gymnophiona

Ichthyophidae

75. *Ichthyophis beddomei* Peters, 1879
* 76. *Ichthyophis longicephalus* Pillai, 1986
* 77. *Ichthyophis malabarensis* Taylor, 1960
78. *Ichthyophis peninsularis* Taylor, 1960
79. *Ichthyophis sikkimensis* Taylor, 1960
80. *Ichthyophis subterrestris* Taylor, 1960

* 81. *Ichthyophis tricolor* Annandale, 1909
* 82. *Uraeotyphlus malabaricus* Beddome 1870
* 83. *Uraeotyphlus menoni* Annandale 1913
* 84. *Uraeotyphlus narayani* Seshachar, 1939
* 85. *Uraeotyphlus oxyurus* (Dumeril & Bibron. 1841)

Caecilidae

* 86. *Gegeneophis carnosus* Beddome, 1870
* 87. *Gegeneophis ramaswamii* Taylor, 1964

Editor's note: Many Kerala 'endemics' are now known from the Western Ghats of Tamil Nadu and Karnataka.

Table 2
Item-wise and Country-wise exports of frozen froglegs from India (1981 - 82 to 1984-85)
Q : Quantity in Kgs; V:Value in Rs.

Countries		1984-85	1983-84	1982-83	1981-82
Algeria	Q	—	31053	—	—
	V	—	830400	—	—
Australia	Q	—	—	—	58858
	V	—	—	—	1794348
Belgium	Q	564110	158110	171693	272137
	V	17435845	4896235	4475916	8597400
Canada	Q	—	12577	—	62552
	V	—	215281	—	2159332
Denmark	Q	—	—	—	3565
	V	—	—	—	124689
Germany	Q	9003	4265	51492	104640
	V	234999	96404	1016528	2945772
France	Q	3033395	402871	180505	780415
	V	6887186	12965952	5128043	22233707
Italy	Q	78425	37952	10112	20940
	V	1422474	1100665	262222	513758
Japan	Q	16278	143926	52841	29881
	V	514822	4000493	1254566	2014084
Mexico	Q	21942	1419	2018	-
	V	662969	26137	92681	-

Countries		1984-85	1983-84	1982-83	1981-82
Netherlands	Q	628237	656200	708478	1397273
	V	17449299	17973672	17678979	38129579
Oman	Q	13112	-	-	-
	V	355700	-	-	-
Quatar	Q	-	-	613	-
	V	-	-	22282	-
Saudi Arabia	Q	-	12600	-	16511
UAE	Q	-	72408	460	7395
	V	-	656050	13854	178615
USA	Q	1031373	7221110	662220	1297969
	V	29199979	19285168	15959119	33075211
UK	Q	112279	172459	55856	3081
	V	358536	462396	1287805	51535
Total	Q	27781154	2427950	1896288	4065223
	V	7748713	66836110	47191995	112007346

(Source: Subba Rao, 1993)

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HEALTH CARE OF REPTILES IN CAPTIVE CONDITION

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The varied artificial habitats which are created for the captive housing and display of reptiles may often contribute to high incidence of diseases and injuries observed in these animals.

Further, the study of diseases of reptiles is still in its infancy. There is a need for further research, and the gaps in our knowledge can be filled up by the experience of the park keeper, and his interaction with other park people, and recording of such information systematically over the years.

An attempt is made here to summarise our experience in the Chennai Snake Park over a period of four years, as well as the experience of our colleagues in other parks in our country and abroad, which has been either recorded or published.

Materials and Methods

The habitat requirement of reptilian fauna may be aquatic, terrestrial, surface or subterranean and sometimes arboreal. The varied artificial habitats created for the captive housing and display of these reptiles often contribute to the incidence of disease or injuries.

Further, the confinement in captivity, many times under artificial conditions, may impose a variable amount of stress, and often leads to behavioural alteration, with serious consequences. The successful maintenance and reproduction of a captive population of animals is dependent upon the keeper's awareness of the habitat requirements of each individual in that population.

The Chennai Snake Park established in 1972 has 27 species of snakes, both land and freshwater, four species of sea snakes, three species of monitor lizards, seven species of crocodiles indigenous and exotic, four species of freshwater and land turtles apart from the chameleon and the green iguana.

Over the years, by experience gained as well as by consultation with experts in the field, the design of the enclosures for housing these reptiles have been improved or modified to suit the needs of the individual species.

This has enabled the manager of the park to bestow better care and attention to individual species and take prompt remedial measures as and when necessary.

This park is further benefited by the employment of a band of skilled keepers who belong to the Irula Community who are traditionally snake catchers and their field knowledge in the art of handling or in the behaviour of various reptiles is of great help to the manager in the day to day management of various species of snakes and other reptiles.

Two of the trustees of the park are retired zoo and wildlife veterinarians and they take the responsibility for the health care of the exhibits in the park.

The normal health problems of the reptilian fauna in a park can be broadly classified as follows:

1. Traumatic and physical Diseases
2. Nutritional or diabetic disorders
3. Infectious Diseases and Neoplasms

I. Traumatic and Physical Diseases:

Some of the traumatic and physical problems encountered in various species in the Chennai Snake Park include lacerated wounds, maggot infested wounds, injury to the eye, multiple abscesses, necrosis of the tail, strangulation, internal haemorrhage, cannibalism, intussusception, broken fangs, mouth rot or stomatitis, prolapse or paraphymosis and necrosis of the penis, dysecdysis etc.

Some other parks have in addition, experienced such conditions as snare and tong wounds, thermal burns, drowning or immersion injuries and several acute skin conditions.

The reptiles kept as a group such as crocodiles, pythons, monitor lizards and iguanas exhibited lacerated wounds, strangulation, internal haemorrhage due to competition for food or aggressive behaviour by mates during courtship.

Misadventures during mating particularly in the monitor lizard, (*Varanus spp*), wolf snake (*Lycodon aulicus*) and one rat snake (*Ptyas mucosus*) resulted in paraphymosis or prolapse of penis. One case of necrosis of penis had resulted in the death of the animal (wolf snake).

Cannibalism was observed in pythons during feeding and as a result of competition led to the accidental swallowing of one of the mates by the order of the same species.

Many of the lacerated wounds led to maggot infestation of the injuries. Necrosis of the tail, particularly the tips, was observed in reticulated python (*Python reticulatus*) and one common monitor lizard (*Varanus spp*) due to accidental injuries.

One of the female reticulated pythons which, after laying a clutch of eggs, while molting experienced the condition of 'dysecdysis' - otherwise known as difficulty in moulting or fragmented moulting. As the snake was incubating its eggs, it was off feed leading to emaciation and thereby experienced difficulty in moulting. As she had abandoned the eggs during this process, it was shifted to another cage. Forcible handling aggravated the condition resulting in severe injury in extensive patches to the newly forming skin in the subdermal layer. Prolonged period of veterinary care, supplemented by nutritious diet at short intervals could restore the snake back to normalcy. The injuries have healed, leading to the formation of a normal skin.

Regular veterinary care in cases of injuries had helped in curing almost all the affected animals. In one of the muggers (*Crocodylus palustris*), the left fore leg had to be amputated due to the severity of an injury caused during a fight with another crocodile. This animal had recovered totally and the loss of a limb by amputation has not impaired its movement.

In a female iguana, intussusception or telescoping of a portion of the intestines was observed, when attacked by the male of the species. This condition had led to the death of the animal.

'Mouth rot' or ulcerative stomatitis had been experienced in the Snake Park in a rat snake, cobra and monocellate cobra and common sand boa. This condition had been responsible for the death of many snakes in various parks.

Injuries to the mouth, particularly when caused by striking against the glass or wire partition, predispose to this disease. These injuries may get infected subsequently by bacteria. Two organisms viz. *Aeromonas hydrophilia* and *Bacillus flaviscens* had been identified as common causal agents. The infection leads to the inflammation of the jaw bone and oral cavity with subsequent ulceration. Death is mainly due to inanition. Prompt attention to the affected snake, isolation from other snakes to prevent spread of infection and regular veterinary care can help to save the snake. Mortality rate had been high among snakes affected with 'mouth rot'

II. Nutritional or Dietetic Disorders

In a park, if there is a regular system of feeding with proper choice of food to meet the individual needs, nutritional disorders seldom occur.

Our experience in the park also revealed that when a wild exhibit was introduced in the park, the sooner the reptile acclimatises itself to the feeding regime, the better the chances of its survival. Temperature of the environment can also exert a most dramatic effect. Occasionally, it may lead to conditions such as anoerexia, torpidity of the liver etc.

Similarly, raising siblings, feeding them continuously a specific variety of diet had also led to deficiency syndrome, such as impaired growth, ulceration of mouth, skeletal deformity etc. This has been particularly noticed in crocodile siblings. Prompt remedial measures, such as feeding with vitamins and mineral supplements had brought improvement in these animals.

Intestinal obstruction, intestinal catarrh are some of the other common gastrointestinal disorders met with.

III. Infectious diseases, neoplasms

Diseases due to infective agents, parasites etc. are of great importance in reptiles. Relatively little is known about the natural bacterial and viral ecology in association with reptiles. However research findings have identified several ecto and endoparasties, apart from a few baterial and fungal infections afflicting the captive reared reptiles.

Very few viral infections, that too, some host specific infections, have been reported from some of the Western parks. Some of the research findings have listed out many bacterial infections caused by *Aeromonas*, *Enterobacter*, *Klebsiella*, *Pseudomonas*, *Proteus*, *Staphylo cocci*, *Escherichia* etc. Even *Tuberculous bacilli* has been isolated from some of the reptiles.

Infectious stomatitis or mouth rot in snakes had been found to be caused by injuries infected by organisms such as *Aeromonas*, or *Bacillus flaviscens*. Similarly, multiple abscesses caused by heavy tick infestation were also as a result of such infection particularly *Pseudomonas* and *Staphylococci.*

Pulmonary infections can be responsible for heavy mortality among reptiles. However very few cases of pulmonary infections have been observed among the exhibits in Chennai Snake Park.

Bacterial and fungal infections involving the eye in reptiles, have been reported. Blepheritis, abscesses in the eye lids have been observed in many of the parks. In the Chennai Snake Park only one case of blepheritis following trauma had been observed in a mugger (*Crocodylus palustris*).

Occassional cutaneous fungal infection which may be invasive had been reported elsewhere. This only reflects bad hygienic conditions in the enclosures.

Parasites: Tick infestation particularly among the various species of snakes is one of the major problems in this park. The snakes exhibited in the demonstration pit are the worst sufferers, compared to others kept in separate enclosures.

Several researchers, who had worked in our park had identified and listed out both endo and ectoparasites occuring in many of the reptilian fauna exhibited in the Chennai Snake Park.

Among the snakes, the rat snake (*Ptyas mucosus*), the Cobra (*Naja naja*) are known to suffer due to heavy tick infestation. A few numbers of reticulated python *(Python reticulatus*) also exhibited moderate infection. The species of ticks commonly reported belong to *Amblyomma* spp. and *Aponomma* spp.

Use of 'Ivermectin' - a broad spectrum anthelminthic as s/c injection at 0.5 to 0.75 mg/kg body wt. had been found to be very effective.

Use of conventional Acaricides with organophosphorous base has been discouraged due to their toxicity.

However, experimentally spraying with 0.15% Malathion in a few enclosures was tried with limited success. Similarly, application of Butox suspension was tried on a few species of snakes. Adult ticks could be eradicated but the application had no effect on the nymph stage of the tick.

A systematic deticking schedule is necessary for the park.

Among the endoparasites which had been identified from the study of the faecal samples collected from various species of reptiles in the park, many helminthic parasites both nematodes and cestodes were found to infect the reptilian fauna. However the infection had not been heavy as to cause morbidity or mortality. In all snake species mixed infection was predominant than single infection.

Parasitic ova of strongyloides sp. strongyles (*Kalicephalus spp*). Ascarids (*Ophidascaris spp*) have been isolated from these faecal samples.

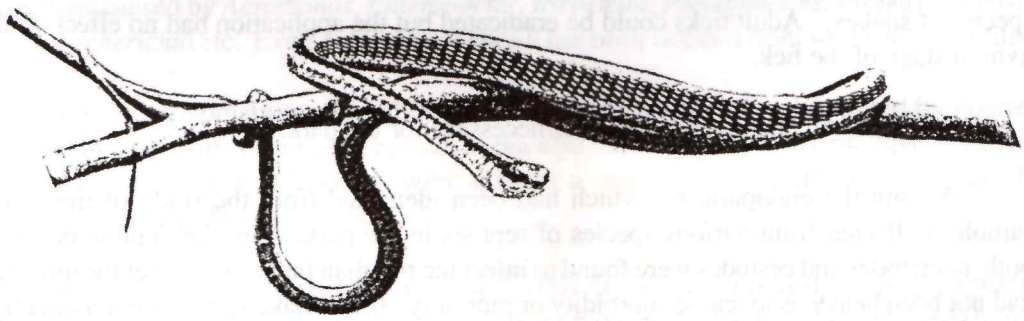
Apart from helminths, coccidian oocysts were also recorded in many of the reptilian species. A regular monitoring of the parasitic burden, deworming and deticking schedule is to be adopted in the Chennai Snake Park. This will be undertaken during the coming years.

Discussion

The Chennai Snake Park, over the years has strived to improve the management practices and to provide better hygienic conditions. This definitely has had a favourable impact on the health condition of the various exhibtis.

However, more work needs to be done with regard to incidence of bacterial, viral infections. Fortunately, incidence of epidemics or large scale mortality had not been experienced. This may lead to complacence which has to be avoided.

The park is being suitably equipped to improve the diagnostic techniques. Technical collaboration with research institutions. This may pave the way for the better understanding of various disease problems.



LIVING WITH SNAKES IN RISHI VALLEY

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Snakes fascinate most people and the predominant feeling it arouses in many is fear. There is, no doubt, reason to fear snakes, but it is equally important to analyse this fear to see whether it arises from the many 'hand-down' reactions of adults or due to some genuine fearful encounters with snakes. The ignorance of the services rendered by snakes seems to be prevalent more amongst the most 'educated' sections of society than any other. It is an indication of how education has taken them away from nature.

Rishi Valley is a picturesque scrubland, nestling a school amongst it. It is located near the town Madanapalle, in Andhra Pradesh. This habitat has a rich diversity of reptilian fauna amongst other species. Here, children and adults live together sharing the habitat with 'fearful' creatures like scorpions, spiders, and centipedes. Snakes however are the ones that fascinate everybody in this valley. Teaching biology, being interested in the diversity of life-forms and living here almost eight months a year, I have been able to see how we adults can either help children observe and respect the needs of other life-forms or create unnecessary paranoia in them. In addition, it has also given me a wonderful opportunity to study snakes.

Before I go on to giving you a few anecdotes of my encounter with snakes, let me give you a list of the snakes found in Rishi Valley. Rishi Valley has four large venomous snakes (the big four as they are commonly referred to), Russell's viper, sawscaled viper, Indian cobra and common krait. Besides these four, we also have one species of pit viper. Doubts have been recently raised about whether it is a bamboo pit viper or a green pit viper. There are fifteen species of non-venomous snakes to be seen. They belong to the following families:

Typhlopidae	-	one species
Boidae	-	two species.
Lycodontidae	-	three species
Natricidae	-	three species
Colubridae	-	six species

I have mentioned only those snakes that I have spotted and observed over the years. There are others who say that pythons have been seen here. Although the habitat is suitable for them, I am yet to see even a dead one, in the last seven years. Similarly, there is enough habitat for olivaceous keelback; but I have not seen them. I would like to add for the information of those who may use this information for documentation purpose, that I do not go actively searching for snakes. I study them when the opportunity arises.

Opportunity presents itself sometimes fairly regularly, because I have an army of observers to support me. My feelings of respect and admiration find resonance in many of the students who study here. When a snake is spotted, they not only immediately notify me, but also stand guard watching its movements and its activity. Their accuracy of observation always fascinates me. The older children help younger ones to overcome their fear and have a healthy respect for the snakes. This feeling has now spread to the gardeners and other workers who would otherwise kill the snakes. Although they still view the snake with alarm, and will refuse to even touch it when I hold it up to them, they have begun to understand that not all of the snakes are going to harm them.

Generally, I discourage picking up a snake; instead encourage watching its movements and allowing it to move away into the wilderness. Sometimes though, these creatures find themselves inadvertently in the living quarters of teachers or students. At such time we catch them to release them at safer places. Before that, however, the snake is usually seen by everyone, volleys of questions answered, and fears overcome.

One of the snakes that seems to have greatly benefited from this kind of exercise is the green keelback, *Macropisthodon plumbicolor*. For many years only the juvenile would be noticed and adults never seen. Many juveniles were killed too. In 1995, I spotted a full adult- a big one (at least for me), measuring nearly 3 ft. in length. Subsequently, in the last 2 years the adult keelback has been frequently sighted. During 1997-98, we had five of them. Because of its green colour, some mistook it for the pit-viper; the workers claimed it was a cobra, as it flattened its neck and raised its head like a cobra and so killing it was on a lot of people's mind. However, we could prevent that from happening. The docile snake, which always wanted to be left alone, helped educate people in the valley. The last few sighted were all only 1-1.5 ft. long.

The longest snake we have in the valley is the rat snake (*Ptyas mucosus.)* Different shades of body colouration have been seen. This snake, although well known to be non-venomous, is often killed. Unlike cobra, which raises its hood to frighten its opponents, the rat snake just bites to protect itself. This 'habit' coupled with its size and colouration resembling a cobra, has been its nemesis. Despite the vigilance of the majority of staff and student body, this snake sometimes still gets killed here. We can take some consolation from the fact that the killings are fewer now. One of these snakes which had inadvertently wandered

into the class room, even hissed when I tried to catch it. It was my first experience with a rat snake that hissed like a cobra. The famous 'combat dance' of these snakes has been witnessed by many in the valley. The pair involved were nearly six feet long, and the show went on for hours together.*

One of my most delightful moments has been to take out the sand boa from my pocket and show it to an interested audience. While the children come forward with eagerness, fear exhibited by some adults makes the little ones draw back with anxiety. But with the right advice they are able to observe the snake.

Bite from a vine snake once gave me swollen hands - looked exactly like the symptoms of a cobra bite. It took all my persuasive abilities to convince the doctor that a cobra had not bitten me. I felt quite foolish, being put on drips, kept under observation (by a caring and concerned doctor) and barely managing to get out without an anti-venom being administered. But the effect of snake bite did remain with me for a long time. The forefinger joint where it bit me, would pain each time I moved it.

There have been many experiences with snakes, both venomous and non-venomous ones. I have been able to convert each experience of mine into a shared one with the children. I have let them learn about these animals. Snakes have perhaps helped many a Rishi Valley student to understand that what we perceive as a danger is actually a form of self-defence for the animal; that we do not have to destroy the animal to preserve ourselves and that co-operation and not competition is the essence of living in harmony.

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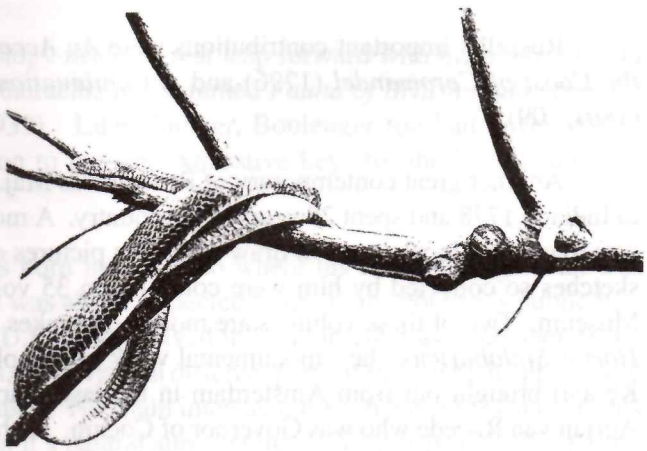
* See *Cobra* Vol.18 (Oct - Dec.94) pp. 20 & 21.
for an account of the 'combat dance'. - Ed



A HISTORY OF INDIAN OPHIOLOGY

B. Vijayaraghavan,
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The scientific study of the flora and fauna of India commenced only in the last quarter of the 18th century. It owes a great deal to the pioneering work of foreigners, mostly the British. No doubt, ancient India had some literature on these subjects but much of this was not scientific in the accepted sense of the term.

Just as Alan Octavian Hume (1829-1912) is described as the 'Father of Indian Ornithology', Dr.Patric Russell (1726-1805) has been described as the 'Father of Indian Ophiology'. Dr.Russell came to India in 1781 to work for the East India Company. In 1785 he was appointed botanist and naturalist to the East India Company. He took particular interest in the study of snakes though plants and fishes were also his concerns. His treatise *On the Peculiar Organs in the Mouth of Poisonous Snakes* was published by the Government of India in 1787. He conducted extensive experiments on the effect of snake poison on animals and birds and on the native remedies for snake bite, chiefly the 'Tanjore Pill' made from mercury, arsenic, pepper and some herb extracts.

In an article in the December 1935 issue of *Current Science*, Beni Charan Mahendra, an authority on Indian snakes, describes Russell as the first person in India to distinguish the harmless from the poisonous species. This has been repeated by Malcolm Smith, another well-known authority, in an article in the August 1952 issue of the *Journal of the Bombay Natural History Society* vol.50(4). It would be interesting to know from those who are familiar with our ancient treatises how far this claim is correct.

Russell's important contributions were *An Account of Indian Serpents collected on the Coast of Coromandel* (1796) and *A Continuation of an Account of Indian Serpents* (1801 - 09)

Another great contemporary of Russell was Maj.Gen. Thomas Hardwicke who came to India in 1778 and spent 25 years in the country. A most interesting assignment he took up was to employ local artists to draw and paint pictures of plants and animals. The valuable sketches so collected by him were compiled in 35 volumes and are now with the British Museum. Two of these volumes are mostly on snakes. One is reminded in this context of *Hortus Malabaricus,* the monumental work on the plant wealth of Malabar (now part of Kerala) brought out from Amsterdam in the last quarter of the 17th Century by Hendrik Adrian van Rheede who was Governor of Cochin. He had got the 794 excellent illustrations for this book executed by local artists of Cochin.

Francis Buchman-Hamilton, Brian Hodgson, James Emerson Tennant, Edward Blyth and W.T.Blanford were the other names of significance in Indian herpetology in general during the immediately following period. Incidentally, Hodgson and Blyth were among the founders of Indian ornithology. Blanford was the author of the bird volumes 3 and 4 (1895-1898) in the *Fauna of British India* series.

The uropeltid snakes have been little known because of their secretive habits. Col.R.H.Beddome (1830-1911) rendered yeoman service to Indian ophiology by his study of the uropeltids.

Joseph B. Fayrer (1824-1907) conducted extensive research on the poison apparatus of snakes and the effect of snake poison on animals and birds. His *Thanatophidia of India* published in 1874 was a major work. He was the first person to distinguish between the effect of the poison of the elapine snakes and the viperine species.

In 1864, Albert Gunther, through the Ray Society of Bengal, published the most extensive account of Indian herpetology till then. This was titled *The Reptiles of British India.* As many as 180 species of snakes had been described in this book. The interesting fact is that Gunther had never visited India and had based his authoritative work entirely on the collection of preserved specimens kept in the British Museum which had been received there from the East India Co. in 1860. Walter Elliot illustrated the book.

In 1878, Joseph Ewart, the Surgeon Major of the Bengal Army and Principal of the Calcutta Medical College' brought out a limited edition of a book bearing the rather curious title *The Poisonous Snakes of India. For the use of the officials and others residing in the Indian Empire.* An excellent reprint of the book was brought out in 1985 by Himalayan Books, New Delhi.

Systematics in Indian herpetology made a great leap forward with the publication in 1890 of the volume on reptiles and batrachia in the famed *Fauna of British India* series by George Albert Boulenger (1858-1937). Like Gunther, Boulenger too had never visited India. Boulenger was the first person to prepare exhaustive keys for the identification of Indian snakes.

Frank Wall (1868-1950) was born in Colombo where his father George Wall was managing a plantation company and was also a respected figure in the country's public life. Frank Wall studied medicine in the U.K. and arrived in India in 1894 as a member of the Indian Medical Service. For 30 years, he worked in different parts of India which opportunity he made abundant use of to study snakes. His main interest, unlike in the case of most of his predecessors, was the living snake in it's natural surroundings. Wall was a prolific writer.

His main publications were *Snakes of Ceylon* (1921) and *The Poisonous Terrestrial Snakes of our British Indian Dominions*. He contributed over 88 papers on Indian snakes to the *Journal of the Bombay Natural History Society*. His series on Indian snakes accompanied by beautiful colour plates appeared in the *Journal* between 1905 (Vol.16) and 1909 (Vol.26). It is a great pity that this was never published in book form. Malcolm Smith says in the preface to his volume on snakes in the *Fauna of British India* series, "Indian herpetologists owe Col.Wall a great debt of gratitude for his work on snakes. During his 30 years' service in the country, he infected others with his enthusiasm and love of the subject and it is due to him more than any other man that our knowledge of Indian snakes today is so complete".

Fr. Jean Ferdinand Caius (1877-1944), a distinguished bio-chemist of French origin, came to India in 1895 as a scholastic in the Society of Jesus. He joined the Madura Mission and was subsequently attached to St. Joseph's College, Trichirappalli, where he started a natural history museum. He was Professor of Chemistry in the College. Later, during 1922-24, he was Director of the Chemistry Department in St. Xaviers College, Bombay. He joined the Haffkine Institute in 1924 where he worked until his retirement in 1932. Fr. Caius conducted extensive studies on the poison apparatus of snakes and the remedies employed against snake poison. After long and laborious research on Ayurvedic and Unani drugs reputed to be specifics against snake bite, he came to the conclusion that they were completely ineffective. His published papers extend over a variety of subjects - medicinal plants, poisonous plants, chemistry of the human body, snake venom and anti-venom, chemotherapy of bubonic plague, scorpions and their venom and so on. (In a bibliography on Fr.Caius's works sent to me by Fr. K.M.Mathew, the well-known botanist and Director of the Rapinat Herbarium, Tiruchirapalli, there is mention of a book published in 1930 by Mhaskar K.S and Caius J.F. titled *Indian Plant Remedies used in Snake bite*. The book is in Sanskrit !)

Herbert Musgrave Phipson was with the Bombay Natural History Society from 1886 to 1906 and was the editor of the *Journal* of the Society from 1888 to 1904. His particular interest was in snakes and he contributed a great deal to their study. But, except for a few short notes, he published little of his own observations in the *Journal.*

Among the other noted ophiologists who worked in India during the closing years of the 19th Century and the beginning of the 20th Century were Dr.John Anderson, Lt. Col. Henry Godwin-Austen, Ferdinand Stoliczka and Harold Ferguson. Anderson, Godwin-Austen and Stoliczka are remembered for their contributions to Indian ornithology as well.

Charles Mc Cann (1899-1980) was born and educated in India. He was an outstanding field naturalist and was in the service of the Bombay Natural History Society from 1927 to 1947, first as a collector in the Mammal Survey, then as Assistant Curator and then as Joint Curator. Though his forte' was botany, he contributed over 200 papers to the Society's *Journal* on an extraordinary range of subjects based on careful field work. These included

papers on botany, monkeys, bats, birds, frogs, insects and snakes and other reptiles. He was the editor of the *Journal* from 1932 to 1939 and from 1943 to 1948.

A landmark in Indian ophiology was the publication of the volume on *serpentes* by Malcolm A. Smith. The manuscript had been completed in 1938 but the book came to be published only in 1943. This is, to this day, the most quoted reference book on Indian snakes. His *Monograph of the Sea Snakes* was another valuable contribution.

With the departure of the British from India in 1947, there was a lull in the study of snakes. This is in sharp contrast to the fact that other branches of natural history, particularly those relating to mammals, birds, fishes and plants, continued to receive a great deal of attention at the hands of Indian scientists and scientific organisations like the Zoological Survey of India, the Botanical Survey of India, the Asiatic Society of Bengal and the Bombay Natural History Society. This is not to convey that there were no contributions on the study of snakes after 1947 - but these were certainly not of the same intensity or spread as in the pre-1947 period, nor were they comparable to the contributions during the post-1947 period in other branches of natural history.

Among the early Indian ophiologists, the two names that deserve special mention are those of Beni Charan Mahendra and K.G.Gharpurey. Mahendra's *magnum opus* was the *Handbook of the Snakes of India, Ceylon, Burma, Bangladesh and Pakistan.* Mahendra was on the staff of St.John's College, Agra, and later became Head of the Department of Zoology at Birla College, Pilani (Rajasthan) and, still later, Head of the Department of Zoology, Agra College, Agra. The book, though published only in 1983, was the culmination of a project initiated in 1927. Mahendra had taken great pains to prepare exhaustive keys for the identification of Indian snakes which were an improvement on the only keys available at that time, those of Boulengar (1890) and Wall (1923). According to Mahendra, the keys were ready sometime about 1943 but their publication got abnormally delayed for various reasons. In the meantime, Malcolm Smith's volume on *serpentes* came out in 1943. Even though, consequently, Mahendra lost out in timing, his gain was that he could also take note of Smith's descriptions and the subsequent additions to our knowledge on Indian snakes before he finally brought out his book in 1983.

Boulenger's volume on snakes in the FBI series, published in 1890, contained 264 species inhabiting the Indian subcontinent. Malcolm Smith's volume in the FBI series described 389 species and 17 subspecies. But, he had extended the geographical area to cover the Indo-China sub region. Mahendra who had adopted the same geographical coverage as Boulenger, dropped from Malcolm Smith's list 70 species as not belonging to the Indian subcontinent but to the Indo-Chinese subregion and relegated 21 of Smith's species to synonymy or subspecific rank and, consequently, described 298 species as belonging to the Indian subcontinent.

K.G.Gharpurey's (1880-1956) *Snakes of India* (1935), later published as *Snakes of India and Pakistan,* was a popular scientific book that had been largely instrumental in ushering many Indians of the recent generations into a study of snakes and teaching them the rudiments of identification of snakes, their habits and their habitats. Gharpurey, like some of his British predecessors, belonged to the medical profession. He became interested in snakes mostly because of the heavy mortality from snakebite that used to come to his notice in the course of his professional work. Though the book had no original contributions to make and was based on the scientific literature already available at the time, it's popular style engaged the attention of even those not too keen to get acquainted with snakes, and made them converts. A major shortcoming of the book, however, was it's poor pictures, being photographs of preserved specimens.

It took another 30 years for the next popular scientific book on Indian snakes to appear. This was *Snakes of India* by P.J. Deoras. Deoras, who died in 1991, was in charge of the Entomology Department of the Haffkine Institute, Bombay, from where he retired in 1969. A distinctive feature of the book is that half of its 135 pages is devoted to general information on snakes and one whole chapter is on 'Snakes in Indian Culture'. The book is fairly well illustrated.

M.V. Rajendran (1916-1993) who started his life as a member of the faculty of St. Xavier's College, Palayamkottai, Tamilnadu, was an accomplished herpetologist. He is particularly remembered for his painstaking work on the uropeltid snakes on which comparatively little work of any significance had been done. Rajendran's studies in uropeltid snakes published in 1985 was an important contribution. He established a snake park at Palayamkottai. In 1967, he published a book on common Indian snakes in Tamil which was of great help in the popularisation of the study of snakes. Rajendran was a founder-trustee of the Madras Snake Park and was it's Director during 1979-80.

One name that stands out prominently, in the latter half of this century, in the study of Indian snakes and widespread dissemination of knowledge of our snakes and crocodilians is that of Romulus Whitaker (b.1943), a naturalised Indian of American origin. He had his early upbringing in India and, later, worked for two years in the Miami Serpentarium, Florida, under Bill Haast. He returned to India in 1967 and, after some initial work in Bombay on snakes and snake venom, moved over to Madras (now Chennai). In 1969, he established a snake park in Selaiyur village, on the outskirts of Madras. Later, with the active support of some environmentalists of Madras, he secured on lease a piece of forest land in Guindy in Madras city and set up the well-known Madras Snake Park (now Chennai Snake Park). This Zoo has completed over 25 yeas and has been responsible in a big way in generating public awareness on snakes and their ecological role.

In 1974, Whitaker set up the Madras Crocodile Bank at Mahabalipuram, a suburb of Chennai.

Whitaker played a pioneering role in organising the Irula Snake-Catchers' Cooperative Society at Mahabalipuram which has not only been a successful agency for extraction and supply of snake venom for the manufacture of anti-venin by the laboratories in the country but has also provided a sustainable source of livelihood for the Irula tribals, who have been weaned away from their traditional occupation of catching snakes for the, now illicit, trade in their skins which has taken a heavy toll of our snake population.

Whitaker's *Common Indian Snakes*, first published in 1978, and currently being revised by the author is, by far, the best and the least expensive introduction to the subject notwithstanding that it describes only 30 species. Of particular use to the layman is the detailed account of general facts on snakes that the book contains. He has contributed extensively to scientific journals and has also produced a few widely acclaimed documentary films on snakes.

Another useful book on Indian Snakes for the layman is *The Book of Indian Reptiles* (1983) by J.C. Daniel, long-time Curator and Hon. Secretary of the Bombay Natural History Society. The book covers not only snakes but also crocodiles, lizards and turtles and tortoises. Detailed descriptions are given of 49 species of snakes and the book has excellent coloured and monochromatic illustrations.

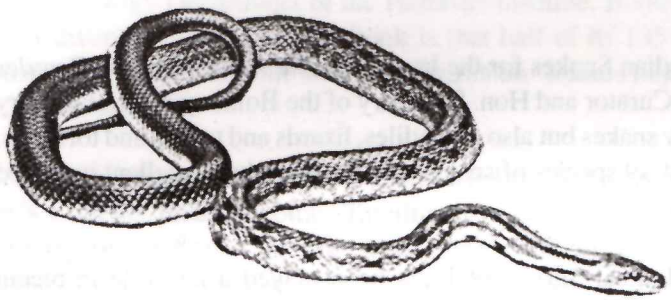
The scientists of the Zoological Survey of India have played a key role in recent decades in the collection and identification of Indian snakes. S.K. Talukdar, D.P.Sanyal, R.Mathew, R.C.Sharma and T.S.N.Murthy have made significant contributions to the taxonomic, distributional and ecological studies of Indian snakes. T.S.N. Murthy is the author of the *Snake Book of India* (1984).

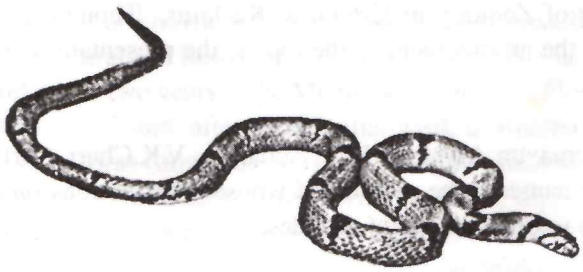
A book titled *Snakes in India* has very recently been published by B.D.Sharma, a professor of Zoology in Jammu & Kashmir. Though it contains an abundance of useful material, the arrangement of the topics, the presentation and the pictures leave much to be desired.

Humayun Abdulali, L.N. Acharjyo, V.K.Chari, Carl Gans and T.P.Vyas are some of the other names to be mentioned whose contributions on Indian snakes have appeared in scientific journals in recent decades.

In the preface to his *Snakes of Ceylon*, Frank Wall wrote : " The reader of these pages will soon discover that our knowledge of many of the species referred to is fragmentary or even nil and he will be in a position to know where he can furnish information that will

enable a later author to compile a better and more comprehensive work". Nearly eighty years later, today, we cannot say we have done enough to fill the voids. The contributions of any significance made by even professional ophiologists - not to mention amateurs - during this long period have been few and far between. As a hobby for laymen, ophiology, no doubt, stands no comparison with, say, ornithology, for various reasons. But the very fact that there are few who venture into this field gives those who enter abundant opportunities to explore and to discover.





REPTILE SPECIES ON DISPLAY AT THE CHENNAI SNAKE PARK
(As on 31.03.98)

1.	Marsh crocodile	(*Crocodylus palustris*)
2.	Gharial	(*Gavialis gangeticus*)
3.	Saltwater crocodile	(*Crocodylus porosus*)
4.	Morelett's crocodile	(*Crocodylus moreletti*)
5.	Spectacled cayman	(*Caiman crocodilus*)
6.	Siamese crocodile	(*Crocodylus siamensis*)
7.	African dwarf crocodile	(*Osteolaemus tetraspis*)
8.	Indian soft-shell turtle	(*Lissemys punctata*)
9.	Pond turtle	(*Melanochelys trijuga*)
10.	Aldabra tortoise	(*Geochelone gigantea*)
11.	Star tortoise	(*Geochelone elegans*)
12.	Common monitor	(*Varanus bengalensis*)
13.	Water monitor	(*Varanus salvator*)
14.	Yellow monitor	(*Varanus flavescens*)
15.	Chameleon	(*Chamaeleo zeylanicus*)
16.	Green iguana	(*Iguana iguana*)
17.	Common cobra	(*Naja naja naja*)
18.	Monocellate cobra	(*Naja naja kaouthia*)
19.	Black cobra	(*Naja naja oxiana*)
20.	Common krait	(*Bungarus caeruleus*)
21.	Banded krait	(*Bungarus fasciatus*)
22.	Russell's viper	(*Vipera russelli*)
23.	Saw-scaled viper	(*Echis carinatus*)
24.	Malabar pit viper	(*Trimeresurus malabaricus*)
25.	Bamboo pit viper	(*Trimeresurus gramineus*)
26.	Rat snake	(*Ptyas mucosus*)
27.	Green vine snake	(*Ahaetulla nasutus*)
28.	Bronze-back tree snake	(*Dendrelaphis tristis*)
29.	Flying snake	(*Chrysopelea ornata*)
30.	Banded racer	(*Argyrogena faciolatus*)
31.	Trinket snake	(*Elaphe helena*)
32.	Common kukri	(*Oligodon arnensis*)
33.	Wolf snake	(*Lycodon aulicus*)
34.	Cat snake	(*Boiga trigonata*)
35.	Checkered keel-back	(*Xenochrophis piscator*)
36.	Olive keel-back	(*Atretium schistosum*)
37.	Striped keel-back	(*Amphiesma stolata*)
38.	Green keel-back	(*Macropisthodon plumbicolor*)
39.	Common sand boa	(*Eryx conicus*)
40.	Red sand boa	(*Eryx johni*)
41.	Indian python	(*Python molurus*)
42.	Reticulated python	(*Python reticulatus*)
43.	Dog-faced water snake	(*Cerberus rhynchops*)
44.	Annulated sea snake	(*Hydrophis cyanocinctus*)
45.	Yellow sea snake	(*Hydrophis spiralis*)
46.	Hook-nosed sea snake	(*Enhydrina schistosa*)
47.	Narrow-headed sea snake	(*Microcephalophis gracilis*)

AIMS AND OBJECTIVES OF
CHENNAI SNAKE PARK TRUST

i) To maintain and display a captive collection of snakes and other reptiles as a means of education of the public.

ii) To undertake captive breeding of vulnerable species of snakes and other reptiles.

iii) To promote knowledge on snakes, and other reptiles and amphibians and dispel the erroneous beliefs about them.

iv) To aid and assist research on reptiles and amphibians.

v) To provide facilities for the identification and classification of snakes and other reptiles and amphibians and, for this pupose, maintain a museum of study collections.

vi) To maintain a library of books and other literature on reptiles and amphibians

vii) To publish scientific and semi- scientific literature on snakes and other reptiles and amphibians.

viii) To undertake survey on the distribution and status of snakes and other reptiles and amphibians.

ix) To provide consultancy services on snakes and other reptiles.

x) To provide a common forum for interaction among amateur scientists and friends of reptiles and amphibians.