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Cover

Balloon frog (*Uperodon globulosum*), an elusive and uncommon frog belonging to the family Microhylidae. It occurs in much of Central and Northern India. Insectivorous. Fossorial. Nocturnal. Also see article on page 7.

-- Photo: Satish Kumar Sharma

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POST COVID VISITOR'S ATTITUDE, EXPERIENCE AND FEEDBACK SURVEY IN CHENNAI SNAKE PARK

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Introduction

Zoos and aquariums with their unique resource of live animals, their expertise, and their links to field of biodiversity conservation are recognized as leaders and mentors in formal and informal education for wildlife conservation. The educational role of zoos and aquariums are socially, environmentally and culturally relevant, and by impacting people's behaviors and values, education will be seen as an important conservation activity (Anon., 2008). Teaching in a formal learning environment mainly focuses on gaining knowledge, and scarcely on the development of pro-environmental attitudes. Knowledge can also be gained in informal learning institutions, such as zoos, and their potential use in general public education should not be neglected.

Through direct and emotional interactions with wildlife at zoos, more than 600 million guests a year have a chance to evolve from spectators to participants of conservation (Foster, 2016). The planet is currently under intense stress, though unsustainable consumption carries on rising at an exponential rate. One explanation for this is ignorance, especially within developed nations. Governments and industry are under extensive pressure to increase awareness, if we are to achieve a sustainable future and prevent the loss of the natural world. Zoos with their high visitation numbers have a significant role to play in educating the public, which they declare as a main goal (Lancaster, 2013).

Study Area

The Chennai Snake Park (13.004'N, 80.238'E) is an Indian herpetological zoo that was started in 1972 with the principal aim of creating awareness amongst the general public and educating school children on reptiles and snakes in particular. Over the years it has been growing as a captive breeding center for reptiles in the State. Lots of renovation work was carried out for upgrading the park to make it a small zoo certified by the Central Zoo Authority of India in 1995. Lots of sign boards were placed at strategic points, enclosures were redesigned, an auditorium was constructed with audio visual equipment, a full-fledged education programme was carried out inside and outside the park, a museum of reptiles were constructed, publications of books and newsletter *COBRA* (Biannual) were published. This park is not only involved in educating the public and but also acts as a captive breeding center for reptiles. And in recent times (2021-22) many animals have been born here.

Methodology

A visitor's survey was conducted between July and November 2022 by way of oral interviews with visitors based on a questionnaire. The survey was conducted during 10:00AM–3:00PM. The questionnaire could broadly be classified into three types such as visitor attitude, visitor experience and visitor feedback. Interviews were conducted randomly taken from different age categories, the visitor community those we conducted the survey were students, teachers, parents with their children, native and foreign tourists, office goers and IT professionals etc.

Results

Visitor Attitude Survey

In total 31 visitors were interviewed in this survey in which 20 males and 11 females of different age categories participated. The language spoken by them were Tamil and English. Majority of them spoke Tamil and English and came from varied backgrounds such as students (31%), IT people and Engineers (31%), and the rest were other qualified Professionals (38%).

Each one of them spent 1-5 minutes in each enclosure observing the animal and reading the sign board of each individual's animals in exhibits. In these results we found that 68% of people consisting of 21 individuals were visiting the zoo for the first time. Majority of the people opined that the zoo is well- maintained, neat and clean such that they will recommend visiting it to their friends and neighbors.

And they also indicated that the zoo should try to keep the king cobra as it would be a major attraction for them and other visitors. Some responded that the albino python kept in the zoo is more attractive to them. Similarly, they said that venomous snakes such as cobras, Russell's viper and spitting cobra are also very attractive and informative to the public. Additionally, the walk-through iguana garden is also reckoned as well maintained and as acting an added attraction to the zoo.

Overall attitude was that 71% liked snakes and 29% liked crocodiles. Some felt that there should have been more species of snakes, crocodile, etc. Some others opined that the gharial enclosures could have been cleaner; cleansing being done more frequently / regularly. More visitors told that drinking water facility provided is not that adequate and could be improved further.

Visitor experience Survey

A sample of 33 visitors comprising 21 males and 12 females were surveyed. The surveyed visitors' ages ranged from 12 to 45 yrs. A total of 55% (N=18) are new comers and visiting the zoo for the first time and a total of 45 % (N=15) of people had visited the zoo many times. The newcomers came to know of the park by Internet (36%), Friends (18%), relatives (33%) as residents of Chennai (12%) and others (1%) (See Fig 3).

Observations on the individual's experience of landscape, using visitor direction, reading sign board were rated as `Excellent' (5.7%) `Very Good' (5%), `Good' (75%), `Okay' (12.5%) and `Poor' (5%) (Fig.1). Similarly, with regards to visitor experience in cleanliness and approach to amenities like rest room *etc.* the ratings were `Excellent' (2.5%) `Very Good' (5.7%), `Good' (65.8%), `Okay' (11.4%) and `Poor' (11.4%) (See Fig. 2).

Vast majority felt it is difficult for an animal to adapt from the wild to the zoo conditions. But still, visitors reckoned that the zoo has strived to provide a near-natural simulated conditions, such as habitat-specific wall posters, heat-lamp for warmth, water troughs / pools, tree branches and secluded retreat-sites and so on in most enclosures. A total of 25% of people remained in the park observing animals for ½ hour, 57% spent 1 hour and 18% spent 1 ½ hours in the park. Some new suggestions besides the previous ones were the need for a dinosaur statue, reduction / reuse of certain empty cages on some occasions and adding new conceptual enclosures like the walk-through Iguana garden.

Fig.1. Visitor experience overall park management

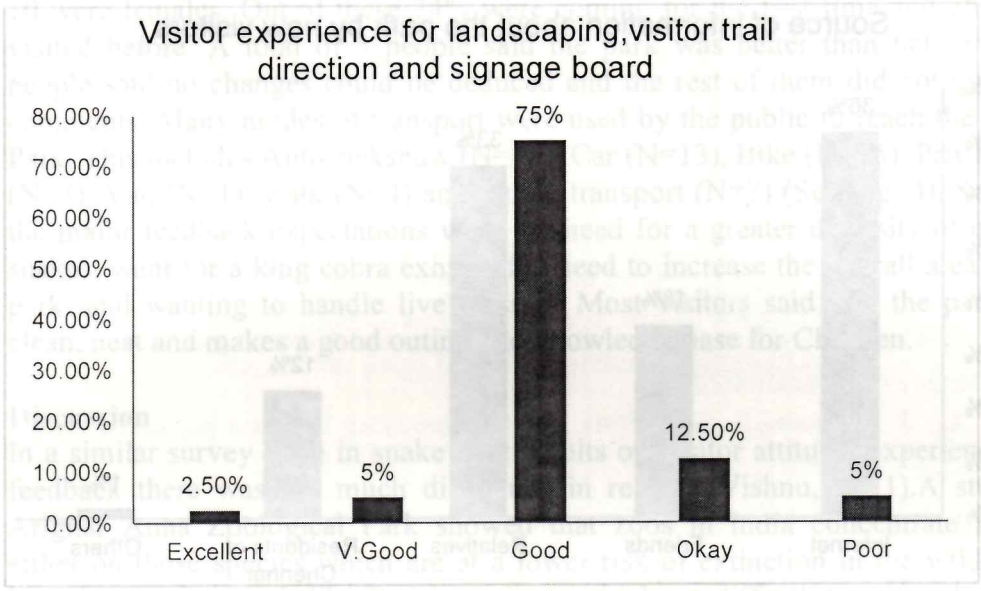


Fig.2. Visitor experience in amenities provided by zoo

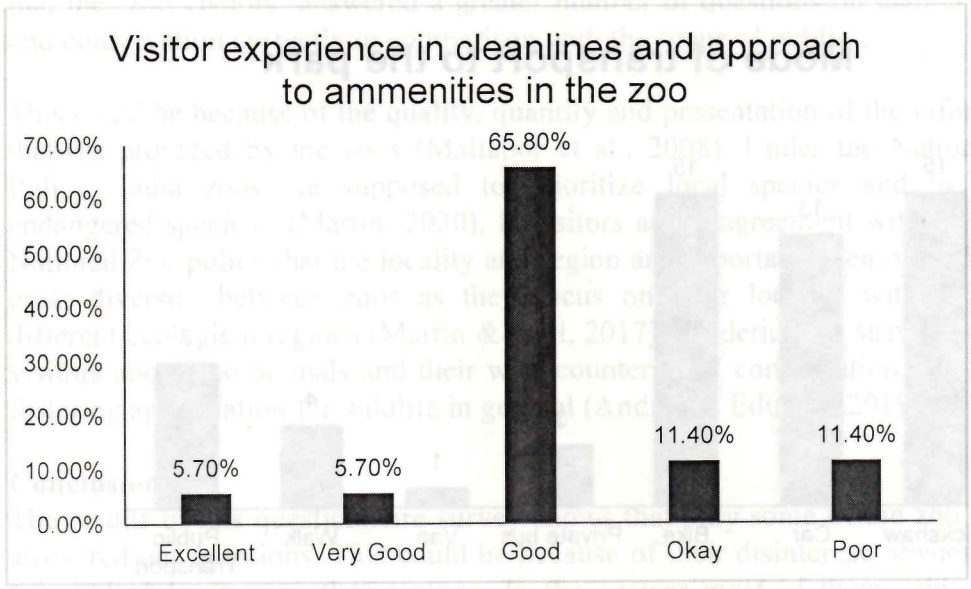


Fig.3. Source of information about the park by New visitors

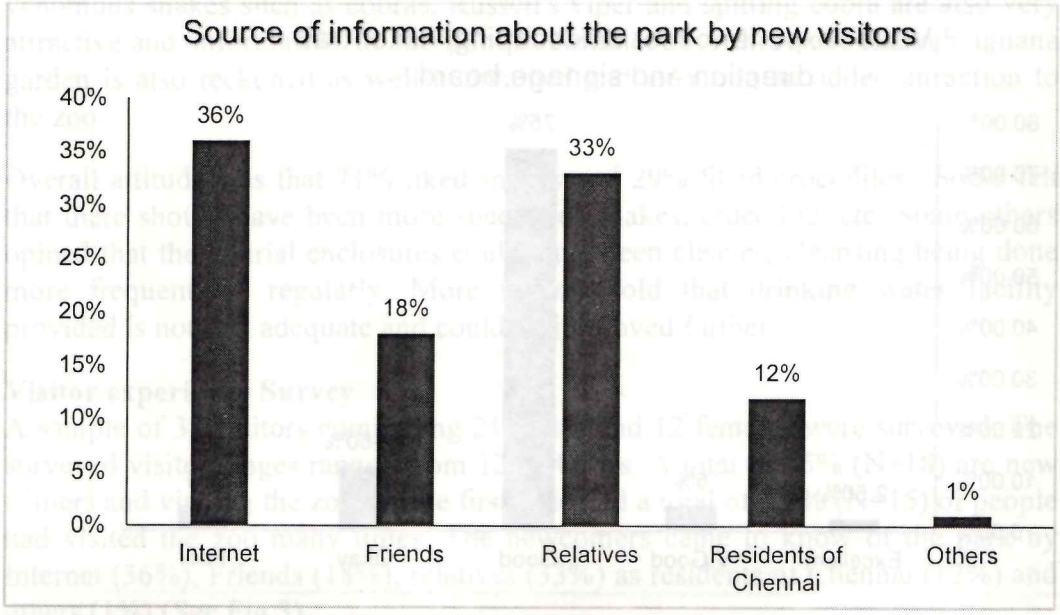
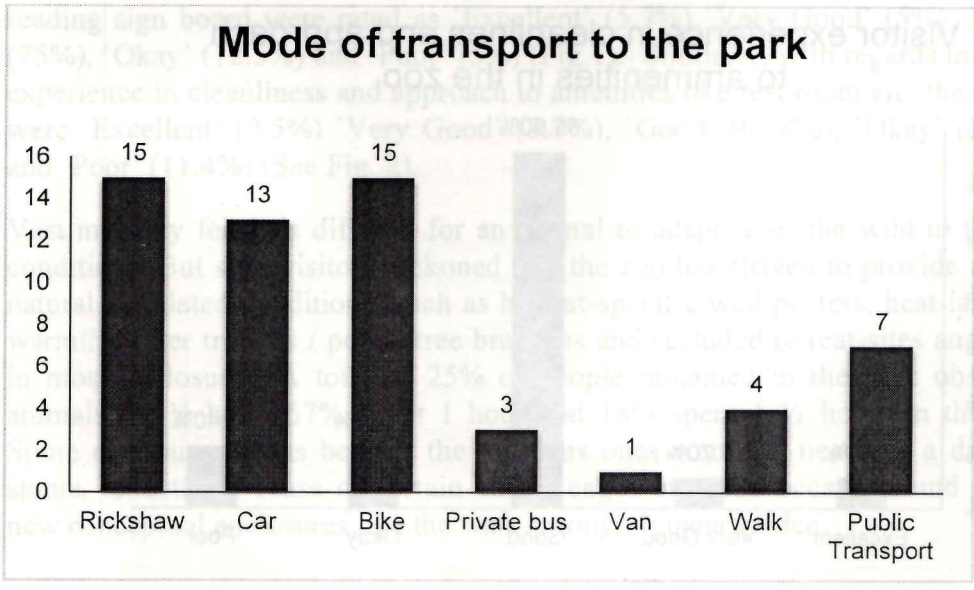


Fig.4. Showing the mode of transport by public to the park



Visitor feedback

For the Feedback survey 58 people were interviewed, of which 48 were males and 10 were females. Out of these 74% were coming for the first time and 26% had visited before. A total of 5 people said the park was better than before and 5 people said no changes could be deduced and the rest of them did not give any comments. Many modes of transport were used by the public to reach the Snake Park. This includes Auto-rickshaw (N=15), Car (N=13), Bike (N=15), Private Bus (N=3), Van (N=1), walk (N=4) and Public transport (N=7) (See Fig. 4). Some of the major feedback expectations were the need for a greater diversity of captive snakes, want for a king cobra exhibit, the need to increase the overall area of the park, and wanting to handle live reptiles. Most visitors said that the park was clean, neat and makes a good outing and knowledge base for Children.

Discussion

In a similar survey done in snake park results on visitor attitude, experience and feedback there was not much difference in results (Vishnu, 2021).A study in Arignar Anna Zoological Park showed that zoos in India concentrate largely either on those species which are at a lower risk of extinction in the wild or on large bodied mammals like *Panthera tigris*, which are difficult to reintroduce into the wild (Barat & Poyyamoli, 2000). The results of a survey in three zoos show that the 'zoo visitors' answered a greater number of questions on natural history and conservation correctly in comparison with the 'general public'.

This could be because of the quality, quantity and presentation of the information thatwas provided by the zoos (Mallapur et al., 2008). Under the National Zoo Policy, India zoos are supposed to prioritize local species and to protect endangered species. (Martin, 2020). If visitors are in agreement with the Indian National Zoo policy that the locality and region are important, then one might see great diversity between zoos as they focus on their locality within one the different ecological regions (Martin &Shell, 2017). Modern zoos strive to educate visitors about zoo animals and their wild counterparts' conservation needs while fostering appreciation for wildlife in general (Andrea & Eduardo,2019).

Conclusion

The results of this questionnaire survey shows that only some of the zoo visitors answered our questions. This could be because of their disinterest, shyness, busy time schedule among other reasons. In the answer most of them said that the

Albino python, spitting cobra and walk through Iguana garden is more attractive. On the other hand, some said that the king cobra could have been kept in the zoo which would be very attractive to the visitors. A study of Indian zoos has found that zoos can help educate the public and respondents believe that zoos could definitely help with protecting wild animals. Chennai Snake Park is an important zoo for wildlife conservation, environmental education and captive breeding of reptiles in India.

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RECENT RECORDS OF BALLOON FROG (*UPERODON GLOBULOSUM*) FROM CHITTORGARH, RAJASTHAN

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The Balloon Frog *Uperodon globulosum* (Günther, 1864) is a fossorial species, so far recorded from Assam, Bengal, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Odisha in India (Chanda, 2002; Daniel, 2002). While surveying herpetofauna, we saw a frog on July 21, 2020 at about 0700 hrs at outskirts of Begun town in Chittorgarh district of Rajasthan (cover image). It was a smooth-skinned, small-headed frog with rounded small snout and beady lateral eyes. A fold or skin across the shoulder just behind eyes was present. Its dorsal color was brownish- gray while belly was white with yellow tinge. Obviously it was in the breeding colors. Whitish-yellow small spots were scattered below the eyes, outer surface of fore and hindlegs and lower flanks. Its hind legs were short with two large shovel- shaped metatarsal tubercles. Toes were with rudimentary webs. Toes and finger tips were of whitish color. Anal region was granular. Besides hopping, it was also exhibiting 'walking' movement on the ground. On the basis of above described features, the frog was identified as Balloon Frog *Uperodon globulosum* (Günther, 1864). Recently this species had rather remained under-reported from the state of Rajasthan. Considering the location of occurrence of the frog as a center, the area falling within 100m radius was scanned minutely, but failed to locate more frogs. To confirm the species, wider area of same locality was visited from 2020 to 2022 many times in the different potential habitats. Findings are presented in Table 1.

Table 1: Records of *Uperodon globulosum* in Chittorgarh, Rajasthan

Date	Time (hrs)	Weather condition	Location	Habitat	No. of frogs	Activities noticed
21.7. 2020	0700	Rained in night	Begun-Gopalpura road 24°58'3665N, 75°0' 5074E	Green grasses along the road. Ground nut and maize farms are nearby	1	Sluggishly walking, across road. Blood like oozing in nostrils
29.7. 2020	2130	Heavy rains	Near Rooppura village	Rain water puddle. *Acacia nilotica, Phoenix sylvestris, Buteamonosperma, Ziziphusmauritiana, Lantana camara, Cassia tora* etc. vegetation present in and arround the water pool (appx. size 20x20m)	Many	Calling from pool
29.7. 2020	2200	Heavy rains	Near bank of Brahmini River	Scattered rain water puddle of varying size	Many	Calling from pool
30.7. 2020	1900	Clear weather	Outskirts of Rooppura village	Rain water puddle (appx. size 20x20m)	Absent	-
31.7. 2020	1900	Clear weather	Outskirts of Rooppura village	Rain water puddle (appx. size 20x20m)	Absent	-
5.8.2 020	2130	Rains in afternoon	Bag pachhli Khedi, 24°59'22.3"N , 75°03'12.3"E	Rain water puddle. *Acacia nilotica, Phoenix sylvestris, Lantana camara, Cassia tora* etc. vegetation present in and arround the water pool (appx. size 30x20m)	Many	Calling

18.7. 2021	2000	Cloudy day	Edge of Bassi wildlife sanctuary near Amalda out post	Depressions with water	Many	Calling
25.7. 2022	1600	Drizzling	Begun-Gopalpura road	Maize field with many scattered small water puddles (height of crop about 1')	Many	Calling
25.7. 2022	1630	Drizzling	Begun-Gopalpura road	Ground nut field with many scattered small water puddles (height of crop about 9")	Many	Calling
26.7. 2022	2030	Heavy rains	Begun-Nandwai road, 24°59'20.5"N , 75°00' 20.9"E	Maize field with many scattered small water puddles (height of crop about 1')	Many	Calling

After 1-2 heavy monsoonal rains, water puddles appear here and there and balloon frogs start to reach in the puddles for breeding activities. If rain is heavy, even they appear in the very first rain also. During this time, when farmers start maize and groundnut sowing in their fields in Begun area, many balloon frogs exposed due to the ploughing operation. Even many become wounded also. Soon both the sexes reach in the puddles having short grasses at the edge and scattered *Cassia tora*plants. Now males start calling sitting at the edge of the pool. Their call is loud *Oink- Oink- Oink* or *Konk-Konk-Konk*. A calling male produced 79 *Oink- Oink- Oink*calls within 187 seconds. A male has single vocal sac. While calling the inflated vocal sac protrude beyond the lower jaw.

Males can be heard well from the distance but when approached close by, they become silent. When a beam of light is thrown on them, they stop their calls. If it is cloudy or raining day time, call of males can be heard during day time also. It was notice that instead of big water bodies, this species prefers small

puddles with small herbaceous vegetation at shore lines and scattered inside also. Besides puddles,*U. globulosum* also heard from the maize and groundnut fields having good moisture and scattered temporary water puddles. While roaming in a maize field on 26.7.2022 we took weight of five individuals which is presented in Table 2.

Table 2: Body dimensions of five *U. globulosum* seen in a maize field

S.no.	Sex	S-V length (cm)	Weight (gm)
1.	Female	6.6	44.29
2.	Male	5.9	29.80
3.	Male	6.1	30.51
4.	Male	6.3	32.00
5.	Male	6.0	28.28

After taking weight, when the female was released, it took 270 seconds to sink in the loose soil completely. Males were fast in the movements than the female. Three species of Microhylidae family namely, *Microhyla ornata, Uperodon systoma* and *Uperodon taprobranicus*have been reported from Rajasthan (McCann, 1946; Mansukhani & Murthi, 1970; Mehra, 2010; Sharma, 1992 & 1995; Sharma et al., 2012). These reports revealed that *Uperodon globulosum* is hitherto unreported from the state, hence worth placing on records.

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A SURVEY OF HERPETOFAUNA OF CHITTORGARH DISTRICT, SOUTHERN RAJASTHAN, INDIA

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Abstract: We surveyed the herpetofauna of Chittorgarh district during 2020-22. The results reveal 39 species belonging to 5 orders, 9 families and 16 genera.Total 7 species under 3 families and 6 genera were amphibians, representing 20% of the total herpatofauna of the district. Thirty two species of reptiles were recorded. Among these, Squamata was the most dominant constituting 59.4% followed by order Testudines constituting 25.0%. Of the snakes, 4 species werevenomous. Our study indicates that Varanid lizards show a wide range of sighting incidences. Among amphibians Dicroglossidae stands as the largest family representing 4 species (8.58%) and among reptiles Colubridae is the largest family with 18 species (56.25%).

Key words: Amphibian, common, distribution, habitat, herpetofauna, status, reptilian, vulnerable.

Introduction

Chittorgarh District has an area of 7506.4 km², 2.19% (3, 42,239sq.km) of Rajasthan state and located at 24°13′N to 25.13'N and 74.04°E to 75.53°E with 330 to 487 m elevation range. Climate of district during summer is hot and highest day temperature is in between 27 ° C to 47° C.The average annual rainfall was 787.3±96.56. About 82% annual rainfall occurs during the monsoon season and 5-7 dry months occurs during the annual rainfall cycle. The forest of the district is deciduous type (Champion & Seth, 1968) with *Tectona grandis, Terminalia tomentosa, Terminalia arjuna, Boswellia serrata, Madhuca indica, Erahatia levis, Diospyros melanoxylon, Soymida febrifuga, Ficus religiosa, Ficus cordifolia, Cordia dichotoma, Aegle marmelos, Mangifera indica* and *Emblica officinalis*, being predominant. Patches of natural bunches of bamboo,

Dendrocalamus strictus are also found. Due to varied ecological conditions it is rich in flora and fauna.

The State has a long history of wildlife studies but majority of these were confined to higher vertebrates. Earlier , Lots of studies were carried out to explore amphibian biodiversity have been made in some selected areas of central Aravali hill region, some parts of desert and south eastern plateau regions (Sharma, 1995a,b, 1997; Dube and Sharma 2001; Dube 2002; Saxena, 1999; Sharma and Khan 2002; Khan 2004; Sharma, 2005; Sharma and Dube 2005) while some studies were carried out to explore reptilian fauna in southern Rajasthan (Bhatnagar and Mathur, 2009; Shalini and Pandey, 2007; Sharma,1995,1997, 2001, 2003 and 2007).

There are apparent declines and extinction of the herpetofaunal communities throughout the world (Gibbons *et al.*, 2000). The causes may include habitat loss and degradation, unsustainable use, invasive species, environmental pollution, disease and global climate change. Habitat loss appears to be the most serious threat to herpetofauna as they are the more affected than other vertebrates by serious human encroachment on their habitats (Capula, 1989 and Gibbons *et al.*, 2000). Habitat destruction, wetland draining and/or pollution represent actual threats to amphibian populations and their reproduction (Skinner and Zalewski, 1995 and Gabbay, 1998).

In light of the above backdrop the present study was taken up in Chittorgarh district during 2020 to 2022. A record of herpetofauna during field trips was carried out and maintained. This paper presents a checklist of herpetofauna of Chittorgarh district.

Methodology

A survey of herpetofauna in Chittorgarh district was made from June 2020 to 2022. The observations were done along the forest patches, streams, ditches, on road sides, inside rock cracks and crevices, near water bodies and so on. Observations were based on the number of sightings and occurrence, the status of a given species was assigned as common, very common, less common and rare.

According to IUCN categorization (2020) status herpetofauna were categorized. Species identification was done using Daniel (2002).

Results and Discussion

During the survey, total 39 species of Herpetofauna belonging to 9 families were documented (Table 1 and 2). Of these, 7 species are amphibians belonging to 3 families and remaining 32 species are reptiles belonging to 6 families. Among amphibians Dicroglossidae stands as the largest family representing 4 species (8.58%) and among reptiles Colubridae is the largest family with 18 species (56.25%).

Amphibians: The study catalogued the following frogs in Chittorgarh district. Total 7 species under 3 families and 6 genera, representing 20% of the total herpatofauna of this sanctuary (Table 1). Of these, Family Dicroglossidae is represented by 4 species, Bufonidae is represented by 2 species, Microhylidae represented by 1 species.

Reptiles: In the present study 32 reptilian species of 26 genera 4 families and 4 orders were recorded from (Table 2). The members of order Squamata were dominant by 19 species followed by Testudines with 8 species. A total of 6 reptilian families represented by 32 species were sighted. Species such as *Varanus bengalensis, Indotyphlops braminus, Lycodon aulicus, Fowlea piscator, Bungarus caeruleus* and *Naja naja* were common. *Python molurus, Dendrelaphis tristis* and *Amphiesma stolatum* were rare, followed by *Hemidactylus flaviviridis* thatwas common. *Eutropis carinata* was very common, followed by *Sitana spinaecephalus* was less common. *Chamaeleo zeylanicus* was rare, as was *Crocodylus palustris*.

Thirty two species were identified and recorded in the district. Among these order Squamata was most dominant constituting 59.4% followed by order Testudines constituting 25.0%. Of these 4 species wasVenomous. Our study indicates that Colubridsnakes show a wide range of distribution and composition.

Table1. Amphibians sighted in Chittorgarh, Rajasthan.

S. No.	Species	Relative abundance	WLPA 1972	IUCN a(2022)
1	*Hoplobatrachus tigerinus*	Common but data deficient	Sch-IV	LC
2	*Euphlyctis cyanophlyctis*	Common	Sch-IV	LC
3	*Minervarya agricola*	Common	Sch-IV	LC
4	*Sphaerotheca breviceps*	Common but data Deficient	Sch-IV	LC
5	*Duttaphrynus melanostictus*	Common/ Data Deficient		LC
6	*Duttaphrynus stomatictus*	Data Deficient		LC
7	*Microphyla ornata*	Uncommon/Data Deficient		LC

LC- Least concern

Table 2: Common Reptiles sighted in Chittorgarh, Rajasthan

S.No.	Common Name	Scientific Name	WPA Status
1	Mugger Crocodile	*Crocodylus palustris*	*(VU)* Schedule I
2	Indian Sawback Terrapin	*Kachuga tecta*	
3	Indian Mud Turtle	*Lissemys punctata*	Schedule I
4	Starred Tortoise	*Geochelone elegans*	
5	Northern House Gecko	*Hemidactylus flaviviridis*	
6	Murray's Gecko	*Hemidactylus murrayi*	
7	Sahgal's Hill Gecko	*Hemidactylus sahgali*	
8	Common Garden Lizard	*Calotes vultuosus*	
9	Indian Chamaeleon	*Chamaeleo zeylanicus*	
10	Fan-throated Lizard	*Sitana spinaecephalus*	
11	Common Skink	*Eutropis carinata*	
12	Little Skink	*Eutropis macularia*	
13	Snake Skink	*Riopa punctata*	
14	Jerdon's Snake-eye	*Ophisops jerdonii*	
15	Common Indian Monitor	*Varansu bengalensis*	
16	Blind Snake	*Indotyphlops braminus*	
17	Russell's Earth Boa	*Eryx conicus*	
18	John's Earth Boa	*Eryx johnii*	
19	Indian Rock Python	*Python molurus*	
20	Indian Trinket Snake	*Coelognathus helena*	
21	Rat Snake	*Ptyas mucosa*	

22	Russell's Kukri Snake	*Oligodon russellius*	
23	Indian Bronzeback	*Dendrelaphis tristis*	
24	Common Wolf snake	*Lycodon aulicus*	
25	Checkered Keelback	*Fowlea piscator*	
26	Buff striped keelback	*Amphiesma stolatum*	
27	Indian Cat Snake	*Boiga trigonata*	
28	Indian Vine Snake	*Ahaetulla oxyrhynca*	
29	Common Indian Krait	*Bungarus caeruleus*	V
30	Indian Cobra	*Naja naja*	V
31	Russell's Viper	*Daboia russelii*	V
32	Saw-scaled Viper	*Echis carinata*	V

Venomous (V)

Table 3: Threatened Reptilessighted in Chittorgarh, Rajasthan

S. No.	Common Name	Scientific Name	WPA Status
1	Mugger Crocodile	*Crocodylus palustris*	Schedule I
2	Indian Mud Turtle	*Lissemys punctata*	Schedule I
3	Common Indian Monitor	*Varanus bengalensis*	Schedule I
4	Indian Rock Python	*Python molurus*	Schedule I

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A PRELIMINARY, DIURNAL STUDY ON COMPARATIVE ETHOLOGY OF CAPTIVE ADULT & BABY GHARIALS (*GAVIALIS GANGETICUS*) IN CHENNAI SNAKE PARK

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Abstract: Gharials (*Gavialis gangeticus*) is one of the critically endangered Indian crocodilians. Despite many research done, gharial is still in need of research and conservation attention. We did a comparative observational study on the ethology of captive adult vs. subadult gharials that were housed separately in Chennai Snake Park, for 20 days. We scored all the activities of the gahrials and made data sheets by observing it directly. Through our observation, we were able to determine the various kinds of activities and behaviour of both the babies and adult gharials in the form of score sheet. This comparative study made us clear that the adults were very much energy conservative than the babies. Instead, the subadults' performance was very active and they spent most of the time in basking.

Keywords: Behaviour, Basking, Erect Snout, Blinking, Jaw Clasp, Gulping.

Introduction

The Gharial [*Gavialis gangeticus* (Gmelin)] is the most threatened crocodilian in South Asia. Though studies have been done in the past on its biology and natural history, the species is still today, far from being safe and stable. As much of the information on the feeding and habits of the Gharial are limited, a study on captive specimens in Nandankanan Biological Park, Orissa, is of some importance. Once a week the gharials were fed about 20 kg of live fish, mostly *Channa gachua* (Ham.), *Channa marulius* (Ham.), *Channa punctatus* (Bloch), *Channa striatus* (Bloch), *Heteropneustes fossilis* (Bloch), *Clarias batrachus* (Linn.) *Notopterus notopterus* (Pallas), usually in the evening. A fresh batch of

feed is determined by the number of surviving fish. *Heteropneustes fossilis* and *Anabas testudineus* are not favorites for the gharials, since they survive more. Generally they do not feed on dead fish. While feeding the gharial brings its entire snout above the water, it takes about 2 to 3 snaps of its jaw for the gharial to turn the fish head first into its mouth. They gulp entire fishes. These jerks of drifting gharials frequently synchronize with a comparable motion of their tails outside the water. At first fish fingerlings were fed to the gharials but they increased size as the gharials grew (Acharjyo et al. 1996).

Gharial have black dorsal and lateral markings on a base of light to dark brown; as in most reptiles has the same colour pattern as the dorsal surface. Proximally, the tail has a double crest of projecting scutes and, distally, a single crest. The black stripes on the tail in the region of the single crest extend onto the projecting scutes. In fifty-two specimens the number of scutes on the single crested region ranged from 21 to 24. These scutes were numbered serially from the proximal end, and the location of the black stripe on each scute was noted for each specimen. It was found that no two individuals had a similar sequential pattern of black stripes, and that the stripes on the first eight scutes were sufficient for the individual identification of all fifty-two gharial (Bustard et al., 1977). Singh & Bustard (1982) discussed about the development, structure, biometrical relationships of the gharial snout. During the developmental stages within the egg, snout is a papillated organ with the margins of the jaws fitting closely together. Following growth of the teeth, the margins separate from each other to accommodate the teeth. Tooth shedding is a regular feature. The relationship between the length of the snout and its breadth at the base has been used as a character separating the gharial from a superficially similar looking crocodile (Singh & Bustard, 1982).

Whitaker & Basu (1982), observed Gharials over a period of several years at wild locations and in captivity. Surveys were carried out to study the distribution, status and habitat of the species. Gharials are fish eaters, being specialized by head morphology and riverine habitat. Other than fish, frogs were taken by captive animals. Birds and rats were usually refused, though the literature includes mammals and birds, as well as reptiles in the gharial's diet. Basking and

swimming are common behaviors. One of the most thoroughly aquatic crocodilians, the adult gharial has weak front legs and does not 'high walk' or stand; locomotion on land is the 'forward slide'. Adult males with prominent 'gharas' (narial excrescence) are dominant in an apparent social hierarchy with females and immature males. Adults are tolerant of immature animals and are sociable, often basking in groups. Interaction with mugger (*Crocodylus palustris*) was observed. In India gharial nest in March and April, the dry season; the female lays 20-95 eggs in a hole 50-60 cm deep, dug with the hind feet in a riverside sand or silt bank, one to five meters from the waterline. Courtship was observed in captivity. Gharial rarely vocalize, the most common sound being a low growl when intimidated. Egg collection, the rearing of some 2000 juveniles and the release of three- and four-year-old in three newly gazetted sanctuaries, were carried out by the GOI/UNDP/ FAO project. Captive breeding was successful in India at Nandankanan Zoological Park and is being attempted at the Madras Crocodile Bank Trust (Kumar, 1988).

The gharial was on the verge of extinction in India by the middle of the 1970s. Since 1979, captive-raised gharials have been reintroduced in a number of protected regions as a conservation effort. Through the observation of 124 nests between 1987 and 1989, the reproductive success and hatchling survival in one of these managed populations were assessed. Surveys were conducted every other year between 1988 and 1992 to evaluate the rate of population growth along a 425 km section of the Chambal River, the National Chambal Sanctuary. 32.1 percent of eggs were lost between egg laying and hatching, mostly as a result of eggs being harmed during nest searches, predation, desiccation, and unidentified causes (Hussain, 1997).

Inland water environments have some of the most endangered species variety, and it is declining rapidly in many regions of the world. By recognising the range of the target species and taking into account all pertinent life cycle stages, this decline might be stopped. The Indus, Ganges, Brahmaputra, and Mahanadi river basins are home to the gharial, a prominent riverine species that is becoming increasingly scarce due to decreased water flow and fewer nesting beaches,

altered river morphology, and increased mortality in fishing nets. Despite these dangers, there is still insufficient scientific knowledge on the gharial's choice of habitat, which makes it difficult to take conservation action. Based on a research conducted in the National Chambal Sanctuary, India, this paper discusses the population situation, preferred basking locations, and preferred water depths of various size classes of gharials. The National Chambal Sanctuary recorded a 40% drop in the gharial population between 1992 and 2007. The recruitment class (of 120 cm), which largely derives from nests built in the wild, as well as sub-adults (4180 to 270 cm), which include both wild and reintroduced gharial, both showed a significant drop. Gharial enjoyed the sandy riverbanks and sandbars along the Chambal River for sunbathing. Gharials in their juvenile stages prefer water depths of 1-3 metres and 2-3 metres, respectively. Gharial favoured 44 m of water depth (containing sub-adults and adults). Gharial and other aquatic species are likely to be impacted by rising sand demands for construction projects, water abstraction for irrigation and energy production, and mortality in fishing nets. Therefore, action must be taken to maintain the minimum river flow required to support ecosystem processes (Hussain, 1999).

The Gharial Research and Conservation Unit raised 52 juvenile gharials in 1975. It was crucial to be able to identify each animal individually in order to provide them with the correct care and collect data from each. It was thought undesirable to mark these delicate young with paint or tags, so the method of individual identification described in this study was chosen instead. Like most reptiles, gharial have light to dark brown bases with black dorsal and lateral markings that are especially noticeable in the young. The tail bears the same colour pattern on its sides as the dorsal surface and is laterally compressed. The tail features a single crest distally and a double crest of protruding scutes close (Singh & Bustard, 1982).

Materials and Methods

Study Animal: Gahrial (*Gavialis gangeticus*) is a crocodilian native to Indian subcontinent. It is critically endangered. Its slender, thin jaws are used to grab fish, and males develop a huge, bulbous growth on the tip of their nose known as

a "ghara." The common name "gharial" for the species is derived from the name "ghara," which refers to a traditional Indian pot. Only gharials have such a clear distinction between males and females among all crocodile species. The Indian subcontinent originally had a vast population of these big crocodiles, but they are currently only found in up to five severely fragmented and diminished populations dispersed over India and Nepal. Sadly, there are numerous challenges to the survival of these rare crocodiles. Gharials cannot move easily to different waterways since they cannot walk on land as much as other crocodilians, and damming rivers throughout their range is dramatically changing their habitat. Theirs habitat for nesting and basking is being significantly impacted by increased agricultural and grazing pressure. Both the shortage of prey due to overfishing and the unintentional capture of adults and subadults in gill nets are effects of fishing pressure on gharials. Additionally sought for their "ghara," penises, and fat for use in traditional medicine, gharials are harassed by neighborhood fishermen. Last but not least, indigenous tribes gather gharial eggs for nourishment. IUCN Red List classifies the gharial as Critically Endangered due to catastrophic population reductions that have seen the population drop by much to 98 percent since the 1940s. Less than 250 mature individuals are believed to still exist in the wild today (Daniel, 2002; Das, 2002; Whitaker, 2007 and references therein).

Study Area: The Chennai Snake Park (Madras Snake Park as it was known till 1997) is a small zoo (1 acre) recognized by the Central Zoo Authority of India. At present, the snake park has 35 species of reptiles counting to some 300 animals in all. Some species of reptiles, including endangered species like the gharial are 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.

Sampling Methods: We extensively observed four hours a day and this continued for 6 days. Since there are three enclosures we divided ourselves into three groups to observe three enclosures where the gharial babies and adult gharials are kept under captivity. The details regarding each enclosure is given in this dissertation. The sampling method we used for Gharial observation was Ad libitum sampling and Time constraint sampling. Ad libitum sampling is an extensive, uncontrolled and raw sampling method, in which the direct observation

of the animal was made and readings were noted. It is an extremely labour intensive method. We divided among ourselves into three groups and observed Gharials in three different enclosures. It is a time-consuming method. This method is used for observing both states and events. It is used to generate the ethogram and record some rare and significant behaviour. Another method of sampling used was Time constraint method, in which the start and end time was chosen by the observer. Five different time periods from morning till evening was taken with a duration of one hour each.

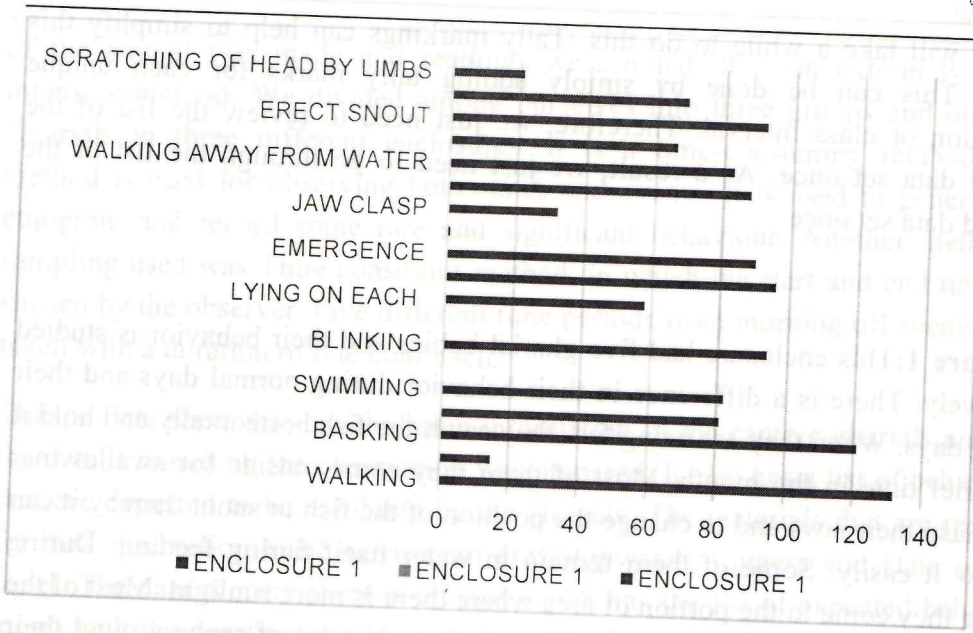
Thus, a data sheet that has the basic information of the captive gharials and also the details regarding the observation was prepared. It also has a list of behaviours that are expected to be exhibited by the gharials. The materials that are required for this observation to be carried out are: Stopwatch, Camera and Data scoring sheet. The data scoring sheet is created which has the list of expected behaviors along with the duration and frequency of such behaviors is noted down. Scoring these data in this sheet helps us to carry out various statistical functions for understanding their behavior.

Usually to keep track of these data tally marks are used for scoring. It is a type of numeral that is utilized for counting. Tally marks are often written as a collection or set of five lines. Each of the fifth lines crosses the first four vertical lines diagonally, from the top of the first line to the bottom of the fourth line, while the first four lines are drawn vertically. Assume we are given raw data or random numbers and asked to generate a frequency distribution. We may have to choose between individual observations or class intervals in this situation. In order to count the subsequent observations or class intervals, we must repeatedly cross-check the complete list if we count all instances of a particular data value or class interval in one go. As a result, finishing this will take a long time. By using tally marks, this can be made less complicated. Simply adding tally marks for each distinct observation or class in Assume that we are required to create a frequency distribution from raw data or random values. In this case, we may have to pick between individual observations and class intervals. If we count all instances of a given data value or class interval in one go, we must repeatedly cross-check the entire list in order to count the subsequent observations or class intervals. As a

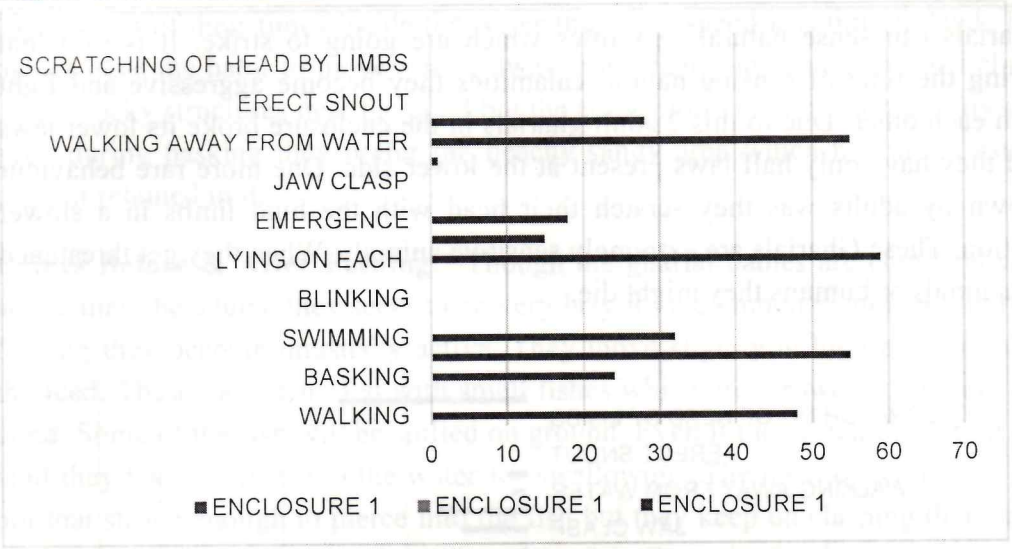
result, it will take a while to do this. Tally markings can help to simplify this process. This can be done by simply adding tally marks for each unique observation or class interval. Therefore, we just need to review the list of the supplied data set once. As a result, we just need to go through the list of the provided data set once.

Results

Enclosure 1: This enclosure had five gharial babies and their behavior is studied extensively. There is a difference in their behavior during normal days and their feeding days. When they are being fed, they catch the fish horizontally and hold it for a brief time in the mouth. Most of them may come outside for swallowing. They clasp their jaws and to change the position of the fish in snout thereby it can swallow it easily. Some of them remain in water itself during feeding. During basking they come to the portion of area where there is more sunlight. Most of the time during basking, they face east. Though there is a lot of space around their pond, they prefer to stay in a single corner of the pond because that place has less tree cover and so they receive good sunlight in that area. Hence during basking only that particular region will be found crowded. While basking they usually prefer to lie on each other and we can also observe each individual trying to lie upon each other. While they are resting they are frequently disturbed by insects and flies. To avoid their disturbance they frequently shake their head but among the five babies two babies use their hind limbs to scratch their head` They engulf stones and use them as gastroliths for digestion. During basking they close their eyes at times. They can close one eye at the same time open another eye .Their eyes are protected with a third eyelid, a membranous covering. When they submerge in water they close their eyes with this third eyelid and opens when it emerges. Another different behavior found in this enclosure is these babies try to climb the rocky structure near their pond.



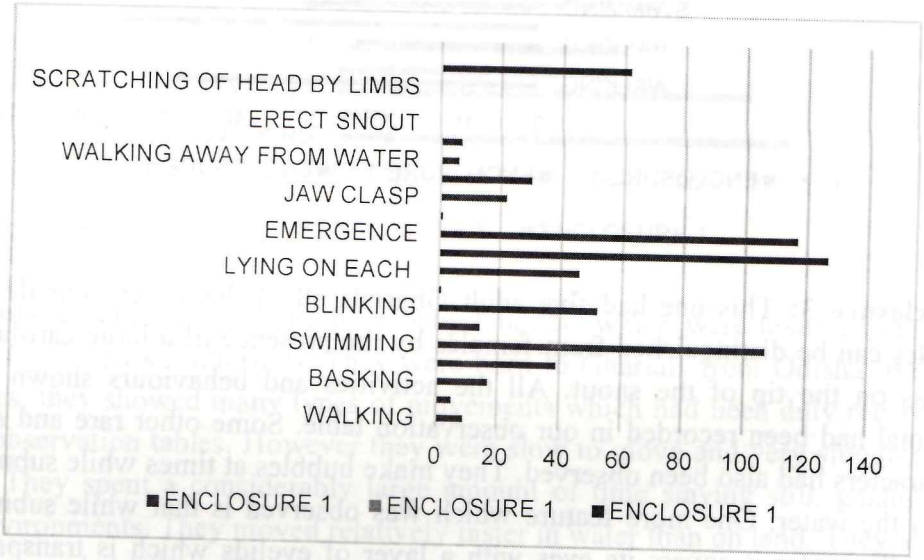
Enclosure 2: This one had the born baby Gharials which were taken extensive care of by the park authorities. They were born to Gharials from Odisha. Being juveniles, they showed many types of movements which had been duly recorded in our observation tables. However they were slow to move and very sluggish in nature. They spent a considerably large amount of time staying still, gazing at their environments. They moved relatively faster in water than on land. They even showed rare behaviors like blinking and making noises at times. They were frequent in gasping in the afternoon. They seemed completely oblivious of our presence near them as they carried out their routine movements in the enclosure. They were fed with fish which they ate hurriedly. They did not share any food with their siblings and rather competed for it. They showed no preference per se for any shade or sunny places. They often climbed to the top of a rock in the enclosure to gasp and/or stay still. At times they kept their body submerged in water with mouths outside, and were often seen lying on each other outside water. They showed no preference to stay with any one sibling and showed vey less interactive movements. They are excellent swimmers.



Enclosure 3: This one had five adult Gharials all of them were female. Adult males can be distinguished from females by the presence of a large cartilaginous mass on the tip of the snout. All the activities and behaviours shown by the animal had been recorded in our observation table. Some other rare and specific characters had also been observed. They make bubbles at times while submerging into the water. One more feature which was observed is that while submerging into the water it covers its eyes with a layer of eyelids which is transparent in nature. At times it is found to blink only one of its eyes. Gharials spend most of it's time in water than on land. When compared to crocodiles which can walk on land using their limbs, Gharials use their belly to slide on land and their limbs are like flippers which helps them to swim easily. Gharials are swift swimmers, much faster than crocodiles. Gharials are social animals. Mostly they are seen lying on each other and they don't fight much.

Gharials are piscivorous animals, which means they feed mostly on fishes. During the day of feeding they seem to be very active and often they give buzzing sounds after catching and eating the fish. Exclusively on the feeding day they are found submerged completely inside the water for the whole day and they come out rarely.

Gharials can sense natural calamities which are going to strike. It is said that during the time of sensing natural calamities they become aggressive and fight with each other. Due to this 2 adult gharials in the enclosure broke its lower jaws and they have only half jaws present at the lower side. One more rare behaviour shown by adults was they scratch their head with the hind limbs in a slower motion. These Gharials are extremely sensitive animals. When they get threatened by animals or humans they might die.



Like many other reptiles, gharials are also very conscious in exhibiting reduced motion because they need to conserve their energy as an adaptation to their slow metabolic rate. Thus several details have been inferred from our six days of observation in the three enclosures.

Babies vs. Adults: The observational data found in the score sheet of all three enclosures clearly states various differences between the babies and adults. The adults are very energy conservative thus they rarely involve in huge movements whereas the gharial babies in the first and second are comparatively more active than adults. If basking is considered it is clearly evident that the babies spend more time outside the water for basking. On the other hand the adults prefer to

spend most of their times inside the water thus they spend less time in land. The babies have the habit to move a little away from their pond and even they climb on the rocky structures near the pond but the adults don't exhibit such activity and even during basking they prefer the beachy sandy area which has the moisture content retained in it.

Babies Before & After Feeding: Though the gharial babies are comparatively active than the adults, they seem to be very lazy for a common visitor. But during feeding they become unusually active. They move slightly in high pace towards the feed. These babies are fed with small fishes which are thrown mostly into the pond. Some of the fish will be spilled on ground. Even if they catch the fish in the land they take the fish into the water for swallowing. The teeth of the babies are not that strong enough to pierce into the fish but they keep on clasping their jaws so that they can change the orientation of the fish. Once the fish lies parallel to the snout then it is swallowed in. When the data sheet of gharial babies is analyzed we can also interpret some vital information. After feeding they spend more duration in gasping so that they can reduce the temperature of their body. They spend more time in the banks than the water. During feeding they spend time in water only during swallowing and remaining time they spend in basking.

Adults Before & After Feeding: Gharials are reptiles who have a very low metabolic rate. The gharials in Chennai snake park are kept in enclosures and they are provided a satisfying meal once a week. The Adults are quite active on the day of the feed. The zookeepers alert the gharials before their feeding time. The gharials are able to identify the zookeepers' voice and they show moments in their swimming behaviour, they make bubbles before getting submerged in the water, they exhibit more time in their swimming behaviour.

During the feeding time, the Adult gharials are aware of the zookeeper entering their enclosure. When the zookeepers provide them with their feed they wait for their feed to fall into the water and they gulp up the fish provided for them. Roughly around 10 kg of fish is provided every week. The gharials feed on the fish and sometimes when they are satisfied with the feed they leave some of the fish. These fish are fed the next day.

Another behaviour that was observed during the day of feeding is that after feeding the gharials remain submerged in the water for longer periods of time. They are not seen on the surface of the water but rather inside the water. This submergence in the water is observed for two days after the day of feeding. After few days, from the time of feeding, the gharials move on to their usual behaviours of basking, gasping, swimming around their enclosure.

The behavioural study on Gharials helped us in gaining knowledge about the critically endangered species which have a clear distinction between the males and the females, as we did a comparative behavioural study on the adult and the baby gharials, it also gave us the clear idea of the behavioural repertoire that are regularly exhibited by the individual in zoos. From the above observations and the data collected we suggest that babies are more active and they spend most of the time outside the water in basking and climb on the rocky structures, whereas the adults do not exhibit these kind of activities instead they only prefer being in water, than spending time in land.

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