

REVIEW OF THE REINTRODUCTION PROGRAMME OF THE MUGGER CROCODILE *CROCODYLUS PALUSTRIS* IN NEYYAR RESERVOIR, INDIA

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Human-crocodile conflicts created by Mugger crocodiles *Crocodylus palustris* were studied 18 years after a reintroduction to the Neyyar Wildlife Sanctuary, Kerala, India. Twenty-nine Mugger crocodiles were reintroduced into the reservoir in the year 1983 and crocodile attacks on livestock were reported from 1985. During the initial period of the study, 21 to 25 Mugger crocodiles were estimated but only 10 to 16 crocodiles were recorded towards the end of the period as nine were removed from the reservoir to reduce the conflict. Fishes provided sufficient prey, but food in the form of large mammals was inadequate. Twenty-nine crocodile attacks on humans were reported prior to the study and six occurred later, including two fatalities. The attacks occurred over 26 km of shoreline and followed previous patterns of attack behaviour in crocodiles. Larger crocodiles were more often involved with attacks than small crocodiles. About 2808 houses exist in a narrow belt near the lake shore. As local people utilised the reservoir for various purposes they did not support the conservation of crocodiles in the present circumstances. The case study indicated the failure of the reintroduction programme of Mugger crocodile in the Neyyar Reservoir.

Key words: crocodylian, human-wildlife conflict, prey availability, reintroduction, reptile

INTRODUCTION

Crocodylians have benefited from protection and strict control measures. As a result, crocodylian populations have increased and ranges have expanded back into historically occupied areas. This has also brought about an increase in the number of large crocodiles, and thus increasing conflicts between crocodiles and people and their livestock. In the Indian subcontinent, three species of crocodiles occur, the gharial (*Gavialis gangeticus*), the saltwater crocodile (*Crocodylus porosus*) and Mugger crocodile (*Crocodylus palustris*). The Mugger crocodile is distributed in most parts of India except Jammu and Kashmir and some northern Indian States (Whitaker & Daniel, 1978).

Thirty-six Mugger crocodiles were reintroduced into the reservoir of the Neyyar Wildlife Sanctuary in 1983 as a part of the crocodile conservation project launched in the State of Kerala with the joint effort of the Government of India, U.N.D.P. and F.A.O. of the United Nations. Crocodiles were present but rare in the Neyyar river system before the reintroduction programme, but the future of the population was bleak due to the animosity of the local population. From 1985 onwards, the crocodiles started attacking local inhabitants along the bank of the reservoir and many people were injured in the process. Further reintroductions of Mugger crocodile in the reservoir were stopped. As human-crocodile conflicts increased, a study was initiated in the year 2000 to evaluate the reintroduction program.

Early literature on crocodiles in India mainly dealt with the biology of the species and documentation of folk-

lore (D'Abreu, 1915; McCann, 1935; Dharam, 1947). De Vos (1982) prepared a manual on crocodile conservation and management in India, which formed the basis for crocodile conservation in India. Ross *et al.* (2000) discussed the problems of success in crocodile conservation. After the reintroduction program of crocodiles into the wild, many reports have appeared based on the programme from India. Acharjyo (1978) reported on the return of Mugger crocodile to the wild. Similarly, many authors reported on aspects such as conservation (Bustard, 1975; Chaudhury & Bustard, 1975), sexing of crocodiles in captivity (Kar & Bustard, 1979), growth of captive crocodiles (Krishnamurthy & Bhaskaran, 1979; Krishnamurthy, 1980; Bustard & Chaudhury, 1980; 1981), attacks on domestic livestock and man (Kar & Bustard, 1981; 1983), food requirement and movement (Singh, 1984a,b; Rao & Chaudhury, 1992) and other issues (Sagar & Singh, 1993; Kumar *et al.* 1999; Pillai, 1999). However, no detailed study was carried on human-crocodile conflicts created by the reintroduced crocodiles or evaluated any of the reintroduction programmes.

The objectives of this study were to evaluate the reintroduction programme by assessing the present population status of crocodiles in the Neyyar Reservoir, to study and characterize the circumstances under which crocodiles attacked humans and to assess the response of the local community towards crocodile conservation.

STUDY AREA

The Neyyar Wildlife Sanctuary, declared in 1958, is situated in the Thiruvananthapuram District in Kerala State, India (Fig. 1). The extent of the sanctuary is 128 km² and lies between 8° 17' and 8° 53' N latitudes and

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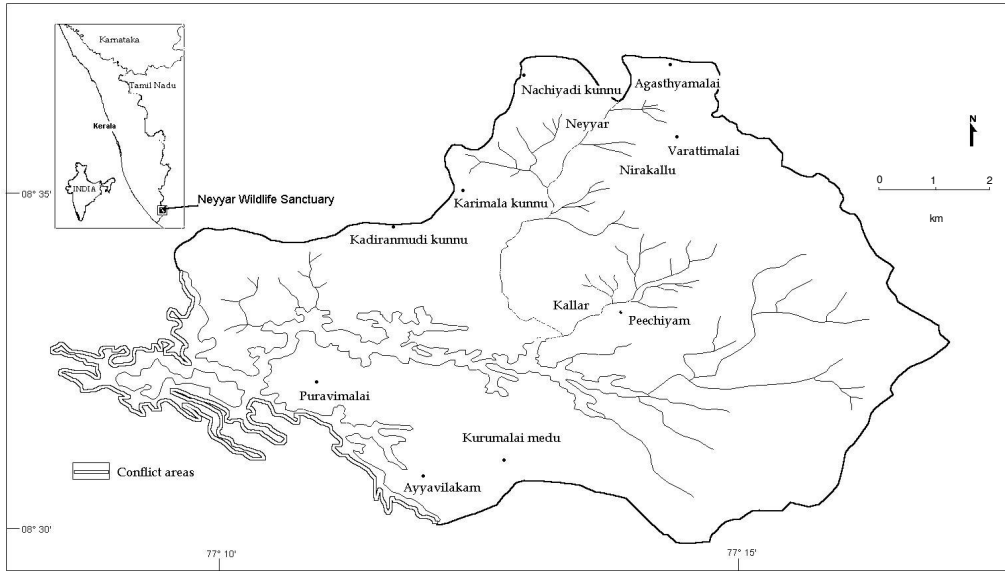


FIG 1. Neyyar Wildlife Sanctuary showing human-crocodile conflict areas

between $76^{\circ} 40'$ and $77^{\circ} 17'$ E longitudes, and is situated at the southern tip of the Western Ghats. A dam was built in the Neyyar River in the early 1940s for the purpose of irrigation and the area of the reservoir is 8.45 km^2 . The entire sanctuary area is rugged with undulating terrain and many rivers, streams and their tributaries and the total shoreline length is 107 km.

The major vegetation types in the sanctuary are west coast tropical evergreen, southern hilltop tropical evergreen, west coast semi-evergreen and southern moist mixed deciduous forests (Champion & Seth, 1968). The climate is tropical with heavy rainfall and high temperature and both south-west and north-east monsoons are prevalent, although maximum precipitation is derived from the north-east monsoon during the month of September. Temperatures vary from 16°C to 35°C and water level in the reservoir varies during different months. Except for the months of March to June, the water level was above 80 m and lowest level of water was found during the month of May.

MATERIALS AND METHODS

POPULATION ASSESSMENT

Population counts were made in the whole reservoir by direct sightings and by indirect evidence by walking along the banks of the reservoir and from boats including all the rivers and creeks. Crocodiles above 1.6 m in size were categorised as adults and those between 1.2 m and 1.6 m as subadults (Arumugam & Andrews, 1993). In each month, all the areas of the reservoir were visited and direct and indirect sighting of crocodiles were recorded. Indirect evidence was the presence of footprints, and body and tail imprints on the bank of the reservoir. A total count census (night and daytime count) was done in the month of March 2001 with the help of the staff of Kerala Forest Department and volunteers. Night counts were made using searchlights from a rowing boat and the light reflecting from the eyes of the crocodile helped to detect the animal.

ASSESSMENT OF PREY AVAILABILITY

Fishes. Fish samples were collected using gill nets of varying mesh sizes ($2 \times 2 \text{ cm}$ and $5 \times 5 \text{ cm}$), from representative locations on different days, closer to the area, where human-crocodile conflicts were reported. Since there is no regular fishing activity in the reservoir, random catches were made in order to get an estimate of possible catch during a year. The large mesh sized net was 100 m long, whereas the short mesh sized net measured 150 m. Gill nets were spread across the reservoir at 1800 hr and fishes were collected at 0600 hr. Cast nets were not employed because this method was not prevalent in the area. The number of *Catla catla* and *Labio rohita* fingerlings released into the reservoir was collected from the Deputy Director, Department of Fisheries, Thiruvananthapuram. The amount of fish caught in a day by the unauthorised fishing was also estimated by assessing the quantity of fish transported in a day by illegal catchers from the reservoir.

Mammals. Availability of wild mammals in the forest was assessed using indirect methods by identifying scats, pellets and spoor. Fifteen transects of 100 m length were searched for indirect evidence of smaller mammals in each month. Transects were placed at different localities in the sanctuary distributed all around the reservoir. During the fieldwork whenever an animal was sighted, it was identified and details of species and number were recorded. Diet of the crocodiles was studied by examining the scats collected from the reservoir banks. Even though the sample was small, some inferences can be made. Scats were soaked in water for 48 hr and separated using sieves and then the animal parts identified.

HUMAN CROCODILE CONFLICTS

Information on human-crocodile conflicts in the Neyyar Wildlife Sanctuary was quantified by interviewing the victims and by visiting the site where the attack occurred. All the applications filed in the Office of the

Assistant Wildlife Warden, at Neyyar were scrutinised for details and the fifteen human-crocodile encounters that were serious and occurred before the study were assessed in detail after visiting the victims. In addition, a detailed structured questionnaire survey was also carried out on the socio-economic aspects of the local people within 800 m from the reservoir. The questionnaire consisted of 34 questions with sub divisions *viz.* identification details, profile of respondent, dependence of reservoir, conflict with crocodile, source of drinking water, details of attack, house and infrastructure and 150 families were sampled for the survey.

POPULATION PRESSURE ON THE RESERVOIR

The dependence of local people on the reservoir for drinking water, bathing, washing clothes etc., was assessed from 0600 hr to 2000 hr in each month by direct observation. The number of people engaged in different activities in the reservoir was counted by walking through the banks of the reservoir during different times. An assessment of the number of houses near the reservoir in the selected sample portions was also carried out. Ten stretches of 1 km each were selected systematically along the bank and the number of houses in each stretch was assessed within a distance of 400 m from the reservoir to the families were also ascertained from the survey.

RESULTS

STATUS OF THE CROCODILE POPULATION

Based on sightings, the number of Mugger crocodiles in the sanctuary was estimated as 25 to 35 animals during January 2001. In the total count census, 12 Mugger crocodiles were found adjoining human habitations and two animals in the interior areas. An adult with 10 juveniles was recorded in the month of May 2000. Most of the crocodiles sighted were adults of more than 3 m in length and only a few subadults were recorded. Crocodile eggs were found in the sanctuary during the breeding season of 2000 and 2001. However, during 2002, no eggs were recorded. Even though hatchling and juveniles were recorded in May 2000, no hatchlings or juveniles were recorded in 2001 and 2002.

TABLE 1. Number of crocodiles recorded in the Neyyar Reservoir during May 2000 to December 2001.

Months	No. of crocodiles	Size class
May 2000	5	Adult
	8	Hatchlings
October 2000	2	Adult
November 2000	2	Adult
December 2000	3	Adult
January 2001	2	Adult
February 2001	1	Adult
March 2001	14	Adult
May 2001	4	Adult
June 2001	4	Adult
July 2001	1	Adult
August 2001	5	Adult
	1	Subadult
September 2001	1	Subadult
	3	Adult
October 2001	2	Subadult
December 2001	2	Subadult

The results indicated that sightings of Mugger crocodile were low and there was no significant difference in sightings of them between wet season (June-December) and dry season (January-May; $t=0.80$, $P=0.45$, $df=8$). Apart from the adults, only eight hatchlings and one subadult were recorded. Detailed sighting records of Mugger crocodile in each month are given in Table 1. Nine faecal samples of Mugger crocodiles were collected from the bank, which provided indirect evidence of crocodiles in certain areas and helped in the estimation of the population. After the two casualties in January 2001 and August 2001, nine large Mugger crocodiles were caught from the reservoir and four died for various reasons. All these Muggers except one were more than 3 m in length. Taking this into consideration, it was estimated that only 10 to 16 Mugger crocodiles were left in the wild at the end of the study period. Some crocodiles might have been poached when the two human casualties occurred.

TABLE 2. Summary of fish sampling from the Neyyar Reservoir.

Sl. No.	Station	No. of days sampled	Total fish caught (g)	Daily average (g)	Estimated annual catch (kg)
1	Safari park	3	4120	1373	501
2	Aruvipuram	3	8500	2833	1034
3	Mullayar	3	12,410	4137	1510
4	Kombai	4	16,000	4000	1460
5	Kottamanpuram	4	5650	1413	516
6	Boat landing	3	4750	1583	578
7	Puravimalai	2	950	475	173
8	Karumankulam	1	0	0	0
Total		23	52,380	2277	5772

PREY AVAILABILITY

Abundance of fish. Twelve species of fishes were collected from the reservoir. Most of the larger fishes collected were in the range of 1-2 kg. These were *Labio rohita*, *Catla catla*, *Cirrhina mrigala*, *Channa striatus*, *Wallago attu*, *Oreochromis mossambicus*, *Etrophus suratensis*, *Barbus* sp., *Puntius thomassi*, *Puntius filamentus*, *Puntius sarana* and *Cyprinus carpio*.

Neyyar Reservoir is a protected area and no regular fishing is allowed. Hence, there is no information available on the fishery potential of this reservoir. However, the Department of Fisheries, Kerala has been stocking fish hatchlings here, mainly large carp under the Indo-German project. The most recent stocking was done in 1995-1996 and 1996-1997. According to data supplied by the Department, during 1995-1996 16,38,050 fingerlings and in 1996-1997 5,39,542 fingerlings were introduced respectively. Crocodiles are known to prefer scaleless variety of fishes. *Wallago attu* is a scaleless variety which was found only rarely in the samples. Species of fish that are abundant in the reservoir are *Catla catla* and *Oreochromis mossambicus* both of which possess scales.

An estimated catch of 5772 kg of fish can be obtained from the reservoir (Table 2). In addition to this, we determined by enquiry that almost everyday local and tribal people catch fish from the reservoir for their own consumption or for local sale. Details were not available as these are unauthorised catches. However, from the information obtained through oral enquiry, these people catch anything between 1 to 12 kg per day. Based on the data gathered from the locals, an estimated average catch of 4 kg is caught per day, making a total of 1460 kg per year. This information was gathered on the same days on which the sample surveys were made. Hence, it may be added to the total catch and a grand total arrived at as 7232 kg of fish per year. Evidently, the potential catch may be several times this as the estimate is based on a small sample size.

Abundance of mammals. An attempt was made to assess the abundance of mammals on the banks of the reservoir. Sambar deer (*Cervus unicolor*) and bonnet macaque (*Macaca radiata*) were recorded on many occasions. An incident of a Mugger crocodile attacking a sambar and another incident of a Mugger crocodile attempting to catch a bonnet macaque were reported. Indirect evidence on the presence of sambar, wild boar

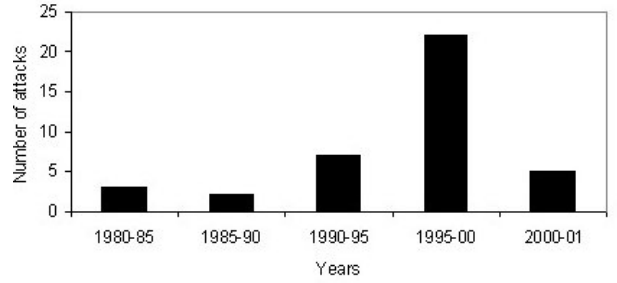


FIG. 2. Number of crocodile attacks in different years.

(*Sus scrofa*) and bonnet macaque were also obtained from the line transects.

Line transect direct counting was not attempted as sightings of large herbivores were very few. Crocodile scat analysis revealed the presence of sambar hairs in two samples. No other food materials could be identified from the scats. Other than wild animals, crocodiles were feeding on livestock and domestic animals, namely stray dogs, small cows, goats, buffalo calves, domestic fowl, ducks and cats. Apart from fishes and mammals, crocodiles are known to feed on birds. Only few species of aquatic birds were recorded from the reservoir and migratory ducks were absent. The little cormorant (*Phalacrocorax niger*) was the most abundant bird species in the reservoir and ten to twenty birds were seen in a flock. No predation on little cormorants by crocodiles was recorded in this study. Apart from little cormorant, darter (*Anhinga rufa*) and little egret (*Egretta garzetta*) were also seen rarely in the reservoir.

HUMAN-CROCODILE CONFLICTS

Past attacks on humans. Crocodile attacks were reported from 1985 onwards, and before the beginning of the study, 30 incidents were recorded. Among these, more than 15 were serious attacks on humans, involving ten men and five women (Fig. 2). A woman was attacked twice causing severe injury to body and hand and in another incident, a woman lost her forearm. Similarly, many victims survived crocodile attacks and live with serious deformities. All other victims were severely injured and hospitalised for periods varying from one to six months. Most of the attacks were on the legs and the attacks happened when the victims were in knee-deep water for bathing or for washing clothes. Two peaks of attacks were noticed, one in the morning hours and the other in the evening. The age of the victims ranged from

TABLE 3. Crocodile attacks on humans during the study.

Date of attack	Name of person	Age	Time of attack	Compensation received (Rs.)	Activity of the victim
10.10.2000	Ms. Rosamma	60	08.00 am	Hospital expenses	Washing (Lost hand)
2.1.2001	Ms. Rajamma	57	06.30 am	50,000	Washing (Killed)
7.5.2001	Ms. Chinnamma	40	09.00 am	Nil	Bathing (Lost basket)
16.5.2001	Mr. Surendran	42	08.30 am	Hospital expenses	Bathing
16.8.2001	Mr. James	56	06.00 am	50,000	Washing face (Killed)
29.9.2001	Mr. Ajesh	20	08.30 pm	Nil	Bathing

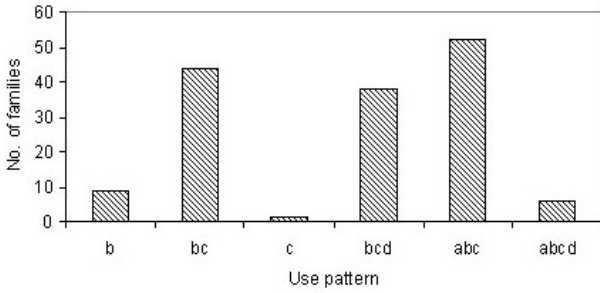


FIG. 3. Dependence of local people on Neyyar Reservoir: a, drinking water; b, bathing and washing clothes; c, washing of household materials; d, bathing of cattle.

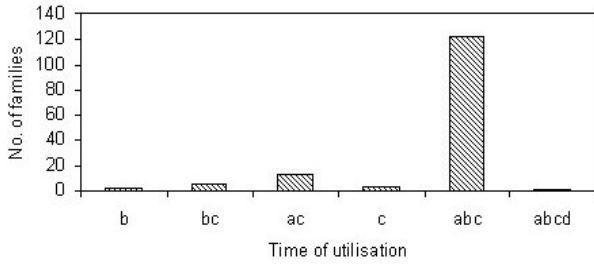


FIG. 4. Daily utilisation pattern of the Neyyar Reservoir: a, 0500 to 1000 hr; b, 1000 to 1300 hr; c, 1300 to 1600 hr; d, 1600 to 1830 hr.

8 to 60 years. According to local people, many attacks on livestock occurred after the release of the crocodiles into the reservoir, some of which were not reported to the officials. Many of the victims were alone when the attack happened. The chronology of attacks revealed that highest number of attacks occurred during the years 1995 to 2000.

Attacks on humans during the study. During the period of study, six crocodile attacks happened and two people died, whereas in the earlier incidents, no human casualties were reported (Table 3). The woman killed in the second attack and the man attacked in the fourth incident were following a regular pattern of activity, i.e. going for washing the clothes or bathing every day at a

particular time in same place. In the fifth attack, the man was unaware of the crocodiles in the reservoir and went to the reservoir alone in the morning; the body of the victim surfaced only on the next day. No specific time was observed in the pattern of attacks. The incidents of attacks were recorded from Kappukad to Kumbichal within a stretch of 26 km, but most people were injured near the dam site and Pantha within this stretch. In some cases, there is a relationship with the dumping of waste food in the lake. Following a regular pattern of activity might have helped the crocodiles to locate the humans for attack and wait for their arrival. All the attacks followed the known pattern of hunting behaviour reported in crocodiles (Daniel, 1983). As seen from the case studies, large crocodiles above 3 m length were involved in all the major and fatal attacks on humans.

Population pressure. A major factor contributing to the human-crocodile conflict is the proximity of human habitations to the reservoir. Local people were utilising the reservoir in a stretch of 26 km starting from Kappukad to Kumbichal (Fig. 3). Presence of people in the vicinity of the reservoir occurred between 0500 hr and 2300 hr. However, the majority of families (83%) were using the reservoir from 0500 hr to 1600 hr. During the study period, about 35 people were observed utilising a 3 km stretch of the reservoir in the morning (0600 hr to 0700 hr).

People utilise the reservoir for various daily needs, including washing, bathing, collecting water, washing cattle and retting of coconut leaves (Fig. 4). Apart from these, people cross the reservoir for collecting grass to be used as fodder and for gathering firewood. As many of the private holdings are surrounded by the waters of the reservoir, people cross the reservoir using traditional boats and two ferry services were operating across the reservoir. The number of households in the sampled areas is given in Table 4, which shows a high density of houses near the reservoir. Indeed, the main source of drinking water is the reservoir. The mean number of

TABLE 4. Number of households near the vicinity of Neyyar Reservoir.

Sl. No.	Locality stretch of 1 km	Distance from the Reservoir (m)				Total number of houses
		100	200	300	400	
1	Kappukad	0	0	6	6	12
2	Mlavatti	0	0	2	13	15
3	Neyyar Dam	109	12	7	2	130
4	Marakunnam	132	30	0	12	174
5	South Pantha	73	23	6	6	108
6	Mayam	77	20	12	30	139
7	Parathi	48	22	2	4	76
8	Kumbichal	70	45	40	14	169
9	Near Dam	35	40	52	72	199
10	Puravi Malai	24	2	8	23	57
Total		568	194	135	182	1079

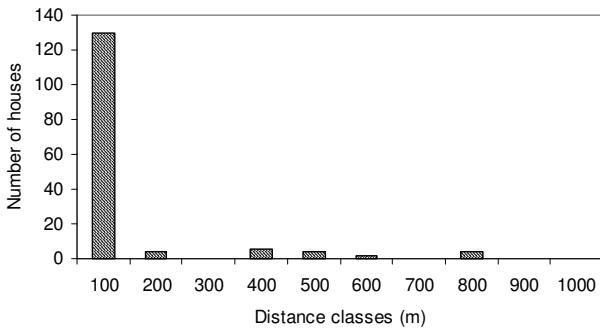


FIG. 5. Distance of houses from the Neyyar Reservoir.

houses in a one kilometre stretch was 108 and the maximum number of houses was seen near the dam site followed by Kumbichal, and Marakunnam. If we extrapolate this into 26 km of inhabited shoreline, 2808 houses are estimated to exist within 400 m of the reservoir.

Socio-economic status. The 150 families surveyed comprised 358 men and 334 women. Only 35 families were ready to move out in order to escape from the attacks of crocodiles. Most families were educated below high school level (453); others included members educated to high school level (160), higher secondary (57), and degree (23). Houses owned by low income families had reed roofs (30), while those of middle class families possessed asbestos roofing (53) and tiles (56). Other types of roof were only 12 in number. In terms of income, the families depended on daily wage labour for their livelihood (133), followed by farming (13). Of the surveyed houses, 130 were located within a 100 m of the reservoir (Fig. 5).

LOCAL ATTITUDES TOWARDS THE CONSERVATION OF CROCODILES

Sixty-one percent of the local people believed that the relocation of crocodiles from Neyyar Reservoir was the most suitable solution to the problem. Thirty-three families have no opinion and 17 families (11%) favoured killing the crocodiles. Nobody supported the idea of conserving the crocodiles in the Neyyar Reservoir in the present circumstances. Other methods, such as constructing fences were suggested by seven families; supplying drinking water through pipes was preferred by only one family, and relocation of families was suggested by one family. Sixty-one families (41%) depend on the reservoir, while 87 families depend on wells; two families depend on streams and one family on a pond. All the families raise livestock and 28 families have cattle, 38 have cats, 75 have dogs, 17 families have goats and 75 families have chickens.

DISCUSSION

The crocodiles were easily spotted when they basked on the banks of the reservoir and when they were swimming in the lake during the daytime. The best months for censusing the Mugger crocodile in Neyyar Reservoir are April and May, when the water level is the lowest and

banks are exposed to the maximum. By selecting these months, the basking crocodiles can be detected easily. In wild populations of crocodiles, natural mortality was very high and many juvenile crocodiles were entangled in the fishing nets and drowned in the reservoir. Additionally, local people destroyed crocodile eggs whenever they located them in the sanctuary. As a result, recruitment to the population of crocodiles is low or almost zero at Neyyar.

The density of herbivores was low in the Neyyar Wildlife Sanctuary, which could be attributed to a number of possible reasons. The history of the area shows that 111 ha of the sanctuary were planted with *Eucalyptus* hybrids in 1964 and 1965 (Vighnarajan, 1990). The planting operations and subsequent felling have reduced the density of herbivores and the remnants of the *Eucalyptus* plantations are seen in many places. Apart from this, the Kani tribals living in the sanctuary are hunter-gatherers and they hunt many small animals. In a previous study, this was confirmed from the adjacent Peppara Wildlife Sanctuary (Jayson, 1998). An adult wild crocodile with 3.5 m length, weighing 200 kg, may need 100 to 200 kg of food per year comprising all animals based on the assumption that the animal may consume 1-2% of body weight per week (Ross, 2000). From the analysis, it can be concluded that food in the form of fishes is sufficient, whereas food in the form of large mammals may be inadequate.

Possible reasons for attacks. One of the possible reasons for attack on people was territorial defence. From October to December, the males will be courting the females and intruders into the territory – including humans – are usually attacked. Again, in the months from February to May, the females will be laying eggs and defending nests, and attacks are more common. From June to September the females will be protecting the nestlings and chances of attacks are more by females during this time. Presence of livestock and other domestic animals on the banks may have attracted crocodiles to inhabited areas. In addition, the dumping of waste food materials on the banks of the reservoir provides an added attraction for the crocodiles. As the crocodiles grew, the number of attacks also increased, showing that the size of the crocodiles also contributed to the human-crocodile conflict.

The high human population density on the banks of the reservoir contributes to the human-crocodile conflict. It is not practical to relocate families from the banks as – with the exception of a few houses on the revenue land – all the owners had genuine land records. The analysis revealed that local populations heavily depended on the reservoir for their daily needs and most of the families depended on daily wage labour for their livelihoods. In the opinion of local people, removing the crocodiles from the reservoir by catching them or by killing them is the only way to solve the problem.

According to Richard Ferguson, Vice-chairman (Africa), IUCN Crocodile Specialist Group, the Zimbabwe programme with *C. niloticus* was the only major reintro-

duction programme carried out in Africa. It ran for five years between 1991 and 1995, but was assessed as largely unnecessary and could have been implemented more successfully on a smaller scale in better selected areas. In Africa also there have been a small number of incidents in which released animals have subsequently been shot for interfering with livestock and human use of the water bodies. The majority of the animals released in Zimbabwe during this programme will not yet have reached a size that is a real threat to humans.

CONCLUSIONS

Human attacks by crocodiles cannot be related to scarcity of food. Crocodiles of a sufficiently large size may attempt to prey on larger animals including humans in vulnerable locations independent of other food sources. Extremely well fed crocodiles with an abundance of natural prey might be less likely to prey on people, but this is uncertain. The relative size of prey, prey behaviour and particularly the apparent vulnerability of prey, hunger level, temperature, season, time of day and densities may be involved in a crocodile's 'decision' to carry out an attack. People, particularly those of smaller stature (women and children) at the water's edge or in the water, distracted by other activities (washing, fishing), following predictable daily patterns of movement and becoming complacent about crocodiles are likely to be attacked sooner or later.

The best solution is to change people's behaviour so that they are unlikely to encounter crocodiles in the crocodile's habitat. The provision of enclosures within which people can access the water's edge in safety to wash, collect water etc. is not feasible at Neyyar due to the long distance and varying water table and the steepness of banks. It is possible to manipulate the size distribution of the crocodiles by removing some of the larger and more dangerous individuals to other reservoirs in the State (Ross, 1998). Walsh & Whitehead (1993) also suggested capturing problematic crocodiles for relocation as a management strategy in Australia. Another strategy to manage the crocodile populations is to treat them as a sustainable resource (Brazaitis, 1983), which is not possible here unless the wildlife protection rules are changed. Due to social commitments, it is not practical to relocate people from the fringes of the Neyyar Reservoir to other areas. Except for a few recent settlements on the bank of the reservoir, the majority of the people have been living there from before the crocodiles were released into the reservoir. From our studies, it is clear that even if the local population is provided with drinking water they will continue to utilise the reservoir for bathing, fishing and washing of cattle. During summer, people from distant places also depend on the reservoir for drinking water and bathing.

As the local inhabitants dispose of waste food materials, including meat, into the reservoir, there is an added attraction for crocodiles to be near human habitations rather than the interior forests. As the herbivore population is low in density, crocodiles are always attracted

towards the populated areas from where easy prey like dogs, cows, goats, poultry and discarded waste food are easily available. This case study indicated the failure of the reintroduction programme of Mugger crocodile in the Neyyar Reservoir.

Based on this study, the following management strategies have been suggested to mitigate the problems connected with human-crocodile conflict in the Neyyar Wildlife Sanctuary. Assessment of the population of crocodiles in the reservoir is a prerequisite for any management decision. It is recommended to monitor the crocodile population in the Neyyar Reservoir to identify and selectively remove problem animals. Any crocodiles more than 3 m in length seen near the inhabited areas are potential attackers on humans. It is recommended to capture the crocodiles longer than 3 m from the Neyyar Reservoir and maintain them in captivity. Effective public awareness programmes with training, surveys, education and taking steps to reduce the chances of attacks should be initiated to save the crocodile population in the reservoir.

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