

Attitudes, Perceptions and Knowledge of the local people regarding crocodile and their conservation in Charotar region, Gujarat, India

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Abstract

Wetlands in Charotar region in Gujarat state harbour good population of mugger crocodiles (*Crocodylus palustris*) who share these wetlands for various ecosystem services (water, fish and space) with humans. Humans and mugger crocodiles have been steadily increasing over the past few years around these wetlands, which has resulted in different types of human-crocodile interactions in this region, varying from peaceful coexistence to conflict. Conserving muggers in these human dominated landscapes require a firm understanding of people's relationship with this species. This research paper examines the attitudes, knowledge and perception towards muggers in agricultural dominated landscapes of Charotar region. A total of 360 interviews, which included 136 females and 224 male respondents from 43 villages, were carried out through key informant interviews to collect the data. We analyzed and tested for differences among 4 variables: gender, age, education and occupation. We found an overall positive attitude toward the presence of muggers in the area. However, local residents indicated a low level of knowledge concerning muggers and their management. 44.75 % of the total respondent reported that the mugger population has increased over the last 10 years. 11.61% reported that the population has remained stable, whereas only 3.6 % of the respondent reported a decrease in mugger numbers over these years. Only 48.38% of the responded knew that muggers are protected species under the Indian Wildlife Protection Act (1972). Recommendations developed from this study included: increasing the awareness of muggers through targeted education, facilitating of stakeholder involvement and exploring different cost-effective conflict mitigation strategies.

Introduction

The Marsh Crocodile or Mugger (*Crocodylus palustris*) is one of the common, widely spread and most adaptable crocodylian species in India (Da Silva and Lenin 2010). Mugger is known to inhabit many of the large fresh water bodies in the Gujarat (Vijaykumar et al. 1999; Vyas 2010; Vyas 2013). In early seventies, mugger population in Gujarat was also reported to decline, along with the overall decline in Mugger populations in India (FAO 1974; Vyas 2013). But certain population survived in the state, which was reported as significant as compared to other parts of the country (Vyas 2013). Mugger population in the state is estimated around 1650 based on the last state wide survey in 1995-96 (Vijaykumar et al. 1997; Vyas 2010). Since then no state-wide survey was carried out, and so the present status of mugger in Gujarat remains obscure. Most of the mugger population and its habitat in Gujarat are considered secure and safe, with few exceptions like Vishwamitri and Narmada rivers where the human-crocodile conflicts have been reported to increase, a phenomenon that is possibly the result of human encroachment into mugger habitat (Vyas 2010). Some mugger population in the state is saturated and has dispersed; resulting in increased human-crocodile interactions, especially in and around Vadodara City (Vyas 2005; Vyas 2010; Vyas 2012; Vyas 2013).

Earlier studies (Vijaykumar et al. 1999) show few wetlands of Anand and Kheda districts to contain a small number of muggers. However recent surveys by Vyas (2013) and Upadhyay and Sahu (2013) have

revealed that significant mugger population exists in Anand and Kheda districts (together they are known as Charotar) of Gujarat state, who shares these wetlands for various ecosystem services (water, fish and space) with humans. This mugger population is one of oldest mugger populations in the state, which survived in the state, in the pre-independence and before the Indian Wildlife Preservation Act-1972 was declared (Vyas 2013). The muggers of Charotar region survive in the man-made communal water bodies within the rural agricultural dominated region, establishing an ideal example of man-animal co-existence (Vyas 2013; Upadhyay and Sahu 2013). However populations of both humans and mugger crocodiles have been steadily increasing over the past years around these wetlands, which have resulted in different types of human-crocodile interactions in this region, varying from peaceful coexistence to conflict. Only a few cases of mugger attack have been reported in last few years from the present study area, which however, based on available evidences, seems to be to results of misidentification and provocation by humans (Upadhyay and Sahu 2013). However, the potential for mugger–human conflicts are likely to escalate with increasing populations of both humans and muggers in this rural landscape.

Muggers in this landscape will need to coexist with humans. Managing and conserving muggers in these human dominated landscapes will require interdisciplinary approaches based on firm understanding of mugger ecology; human dimension; and the complex relationships among people, muggers, and their shared environment. Hence, study of public opinion and knowledge becomes an important element of mugger conservation. Attitudes of people towards the crocodile and their conservation status are poorly understood in India. Likewise no research on public attitudes towards muggers has been published yet from this region. Hence, the purpose of this study was to determine the attitudes, perception and knowledge regarding muggers in the agricultural dominated regions of Charotar region, Gujarat, India, and contribute to the conservation and management of the species.

Methods and Material

From August 2013 to March 2014, as part of a monitoring and conservation project on the mugger and during the surveys, we carried out the systematic interview-based survey of adult villagers (18 to 80-year-olds) and young children (11-17 year-old) to understand villagers' perceptions of, and attitudes towards, muggers and to evaluate the status of mugger. Our interviews of adults were always aimed at people who either lived in or frequently visited the wetlands in the study areas. A semi-structured survey instruction was prepared in the form of an interview-based questionnaire (Table 1). Respondents were asked questions relating to dependence on water body, knowledge regarding mugger, attitude and perception towards muggers and human-crocodile conflict. Interviews were informally carried out by 1-2 researchers. We interviewed 360 randomly selected adults (136 women and 224 men) belonging to different families from 43 villages (Fig.1). The area covered by these surveys falls within two districts of Gujarat State, (Anand and Kheda). Results were majorly expressed as a percentage of the responses or as number of respondents.

Study Area

The study was conducted in the Charotar Region of Gujarat (Fig. 1). Charotar consists of parts two districts namely Anand and Kheda. It is located (22°44'N, 72°21'E and 22°15'N, 73° 4'E) between the Sabarmati and Mahi rivers in central Gujarat, and is well known for its crops such as tobacco, pulses, rice and wheat (Mukherjee et al. 2000). Large areas in this region are irrigated by Mahi Irrigation Project (Vyas 2013), and therefore most of the water bodies are interlinked/ connected by an intensive irrigation canal network. In Gujarati, the word "Charutar" means a pot full of gold. This was supposedly coined because of the agricultural fertility of the area. Because of the unique mixture of landscape feature, this region also harbours one of the highest densities of sarus crane (*Grus antigone*) in the state (Mukherjee et al. 2002). Although Anand and Kheda district do not have significant forested areas, they have high density of trees in the state, and are considered green bowl of Gujarat (Singh 2013)

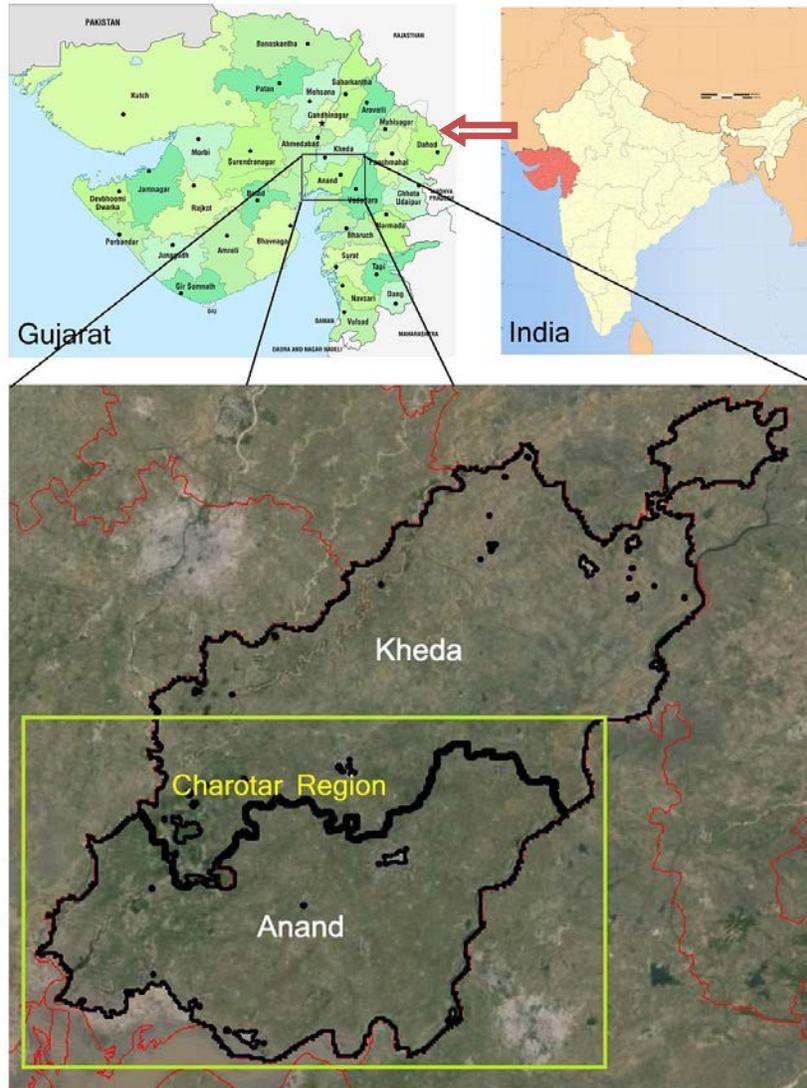


Fig.1: Map of the study area- Charotar region, Gujarat, India

Results

Information on respondents

A total of 360 interviews were conducted, which included 136 females and 224 male respondents from 43 villages in the study area, through key informant interviews to collect the data. The respondent belonged to different age groups and had different literacy levels. The research team surveyed 282 adults (above 18 years) and 25 young (up to 18 years) respondents. 12 respondents did not want to tell us of their age, and so, were excluded from the analysis relating to age. Majority (65.27%) of the respondent had either primary education (41.94%) or secondary education (23.33%), and only 12.5 % of the respondents were found illiterate. Twelve respondents also had university education. The responded belonged to varied class of occupation. As expected agriculture (35.56%) was the prominent way of livelihood in the study area, followed by labor work (13.61%). Only seven respondent (1.94%) practiced fishing. Majority of the respondent's family (62.78%) had been living for more than 20 year in this region. Whereas 27.50 % (n=99) of the respondent had moved to this region within last 20 year.

Dependence on the water bodies

All the mugger occupied wetlands were majorly used for activities like bathing, washing purpose and drinking. Only seven respondents answered that the wetlands are used for fishing too. However when we asked the question “do you go fishing”, more responded (23%) answered that they do occasional fishing. 71.66% of the interviewed people also reported that fishing in these wetlands is carried out by fishermen coming from outside the village. Majority of the wetlands are given on lease by the Panchayat (village authority) for fishing. Only 10 respondents said that the wetlands are also used for farming. The peak hours of water use by humans were between the 0500- 1000 hrs in the water bodies of the study area, which was followed by 1000- 1300 hrs. Livestock mostly used the wetlands in the morning up to 1000 hrs and in the evening around 1600 hrs. People also use some of this wetland to grow Indian water chestnut (*Trapa bispinosa*), and Lotus (*Nelumbo nucifera*).



Fig. 2: Women while washing the clothes, watch a croc go nearby at Deva village.



Fig. 3: Mugger basking in group at Deva Village.

Local people's knowledge regarding mugger

86.94% of the respondent had seen the mugger in the nearby wetlands. Only 22 respondents replied that they didn't see any mugger in the wild. Surprisingly, among the eight females, who replied no to "seeing a crocodile in the nearby area", two and one females belonged to Vaso and Heranj village respectively, which have significant mugger populations in the village ponds. 63.33% of the respondent said that the sole food of these muggers in this region is fish only. 16.11% (n=58) respondent also included other prey species such as birds, pigs, dogs and insects. Bird species reported included peafowl, ducks, crane and water hens. Only 8 respondents reported that muggers also prey on livestock in addition to fishes. Interestingly some of the respondent (n=25) also reported that the muggers in this region also eat cow dung, and the muggers are referred as "Chhaniya mugger" means Dung crocodiles. 44.75 % of the total respondent reported that the mugger population has increased over the last 10 years. 11.61% reported that the population has remained stable, whereas only 3.6 % of the respondent reported a decrease in mugger numbers over these years. 48.38 % of the responded knew that muggers are protected species under the Indian Wildlife Protection Act (1972). The awareness that the mugger is a protected species was more among the males than females. 54.91% males knew about the protected status of the species whereas only 30.16% of the females were aware of the same information. Information on nesting and breeding was also collected through interviews. The people's answers were in accordance with the data collected by our research team (see Table 1).

Attitude and perception regarding muggers

81 % (n=210) of the respondent said that they like mugger, of which 67.61 % were males and 32.39 % were females. Among those who said they didn't like mugger, majority were males (68.57%). Male respondents who liked mugger majorly belonged to 31-40 (23.94%) and 41-50 (26.06%) age groups. Similar trend was observed with females too. Unexpectedly, "beautiful animal" (41.87%) followed by "religious reasons" (33%) emerged as the major reason for liking the muggers. "Beautiful animal" (47.90%) was the major reason why most males liked the mugger, on the contrary females liked the species because of its religious sentiments (37.50). 6.90% said that they like the species because it is an endangered species and need protection. 13.30 % liked mugger because of their ecological importance in the ecosystem. 81.82% of the total respondents who replied to the question "Should these muggers be conserved?", agreed that the mugger should be conserved. Only 4.90% respondents replied that the muggers should not be conserved. Among the positive respondent 69.70% were males and 30.30% were females. Among those who were in favor of mugger conservation belonged to the younger 18-30 age group (30.81%), followed by 41-50 age group (23.74%). Mugger should be conserved was represented majorly among all the age groups and literacy level. Irrespective of age groups and literacy levels, majority of the respondent (67.52%) who wanted to conserve muggers replied that the muggers should be conserved where they are presently occurring. 15.81% also suggested that the mugger should be conserved in the protected areas and not there near the villages. To test the intensity of the positive attitudes of the people we asked the question " will you support mugger conservation, even if any of your family member is attacked?". And we received mixed results. 28.71% of the respondents still agreed to conserve the mugger, whereas 27.75% replied they will not conserve mugger, in case their family member is attacked. 37.32% of the respondent remained neutral to the query. Of the entire respondent, who didn't like mugger, 33.33% of the respondent attributed the reason to the scary look of the mugger, while 31.58% said that they don't like mugger because it is a threat to livestock. 24.56% of the respondent also said that since muggers are a threat to humans, they don't like them. Interestingly, scary appearance of mugger was the major reason (50%) why females don't like them, followed by threat to humans (27.78%). Contrary to women, threat to livestock emerged as the major reason male respondent do not like them

Human-Crocodile Conflict in Charotar

Although, at present, muggers in Charotar does not in itself appear to be a problem, but the wild populations are increasing in the region (Vyas 2013; Upadhyay and Sahu 2013) and although fewer, there are cases of mugger attacking human and their livestock. A total of ten cases of crocodile attacks were reported during the survey. Among this three crocodile attacks were reported on humans and six attacks on livestock (2 on goats, 4 on buffalos and 1 on dog). Among the three cases of attacks on humans only one was fatal. Details of two crocodile attacks on humans have been already provided by Upadhyay and Sahu (2013) and Vyas (2013). The third case of attack came in light during the interview survey, wherein a women in Deva while washing the clothes in the lake, was attacked and her hand was caught by the mugger. She received minor injuries as the mugger released her hand within seconds. Apart of aforementioned incidents, no other incidents of attacks were recorded in the study area. There could be few more instances of crocodile's attacks on animals (livestock/pets) in this region which remains unrecorded.

Discussion

Our samples were not equal, with male respondents almost double the number than females across age group, but our response rate was high across. Females in rural India do not interact much with males other than her family members. We tried to conduct more interviews from females, but they were reluctant to talk to us, even to our female team members. We also had less number of student respondents. So our results must be analyzed with caution because of potential biases. The overall conclusion from implementing sampling procedures is the importance of personal contact with authorities. In villages contacting the village head prior to contacting individual respondents were incredibly important and certainly an important reason behind the high response rates.

The respondents' views of muggers were surprisingly favorable in our study area, considering that muggers were feared for threatening human lives and livestock. This can have important implications for the conservation of muggers in this region, as these mugger populations are surviving outside the protected area and needs immediate conservation and management measure. Our study allows identification of certain target groups important for conservation and management of muggers. We found that the acceptability of mugger population in Charotar depended majorly on the literacy level and to certain extent age of respondents. We hypothesized that women would express more concerns about muggers than men would. In fact, overall men and women had similar concerns. We found some support for our hypothesis, however, in that more women than men were concerned about the danger posed by mugger to human life. By contrast, women and men showed almost equal tolerance toward mugger. Age differences were also limited and mostly concerned contrasts between those in the young and old age groups. We hypothesized that older people would express more concerns about mugger than younger people would. Consistent with this hypothesis, less tolerance of mugger was shown by older than by younger people. Younger people also consider mugger a "beautiful species" than older people did. By contrast, older people saw mugger as more of a danger to domestic animals and had more knowledge about mugger than younger people did. Older persons' concerns may have been leavened with more knowledge of the animals than younger people had. Although the main variable accounting for negative attitudes towards muggers was concern for safety, many other complex variables are also involved.

Certain key findings emerge from this study, these being relevant to both the social understanding of mugger perception, and knowledge of human-mugger relations in Charotar region. Age, education and gender were relevant to attitude and perception of mugger, but their influence varied according to the topic discussed. Our results indicated an education-biased attitude regarding the mugger. Mugger, although to lesser extent, were also seen negatively, based more on their intrusion into human spaces, livestock depredation and fear of attacks on humans than their natural behavior in "natural" areas. Despite

pronounced urbanization and reduction of habitats, muggers played an important role in people's consciousness. Despite some mugger attacks, tolerance for these animals persists, though more among the younger generation and literate than among older people and illiterate.

Mugger conservation in Charotar

Currently the Mugger populations in Charotar region seems to be doing fine, however certain threats have been identified during earlier surveys (Upadhyay and Sahu 2013; Vyas 2013). Muggers in Charotar live in very close proximity to the humans. This kind of close proximity to humans might result in conflict and can be particularly controversial when there is a question of human life or of the resources that have economic value such as livestock depredation, and the predators involved have a high conservation profile. With increasing mugger populations in the region, it is difficult to ascertain that they would not pose a problem to local people, who regularly share these wetlands with the muggers. Although religious beliefs might be one of the factors for the low level of conflict (Vyas 2003), but is clearly not the major one. Their existences have been positively accepted majorly because of the fact that there have been very few attacks in this region. In other words the acceptance of mugger by local people in this area depends on the degree of their contacts with muggers. So incident of few attacks could possibly lead to the rise in negative attitudes. Upadhyay and Sahu (2013) have reported one incident, wherein one girl was attacked and killed by a mugger in Traj Village in the study region. Agitated people demanded removal of muggers from that village and as a result 7-8 muggers were captured and removed somewhere else. As suggested (Upadhyay and Sahu 2013,) the occurred cases of mugger attacks on humans seem to be the result of mistaken identity and/or human negligence. The authors (Upadhyay and Sahu 2013) rightly pointed out that another reason for the minimal conflict in this region is that people do not offer anything to these muggers, due to which the muggers do not come out from their territories in to the human settlements. However during our surveys we found that in Deva village, which holds the one of the highest mugger numbers in Charotar (Upadhyay and Sahu 2013, Vyas 2013), animal skimmers of the village leave the dead animal near the lake for the muggers after skinning the dead livestock. Such behaviour could encourage muggers to lose the fear of humans and to come out from the water in search of easy food, leading to a close encounters with humans.

Moreover the media seems to play a major role in influencing the attitudes of the people. Most wetlands of Charotar are interconnected by canals, so during monsoon when the water rises in wetlands and the interconnecting canals this mugger's move from one village to another, sometimes reaching places where the people may not have seen any mugger. Such incidents are negatively highlighted by the media. We can't ignore the fact that, the people do fear of the crocodile attacks, and that such negative publicity may, while increasing the negative attitude, will hinder the conservation of muggers in Charotar and adjoining areas.

The other aspects of conservation and threats to mugger have been discussed by Vyas (2013) and Upadhyay and Sahu (2013) in detail. The local people are not majorly involved in fishing, and pose no threat to the muggers or to the wetlands. The real problem is the commercial fishing carried out in this wetlands. Most of the wetlands have been leased out by the village Panchayat (Village authority) to fishing contractors. During their fishing season they put large fishing nets in the wetlands, wherein sometime the muggers get caught in the fishing net. If not removed at the appropriate time, the animal might suffocate to death. Also these fishermen, who mostly come outside Gujarat, intentionally capture the mugger, tie them up and keep outside the water till they finish fishing, so as to protect their nets from breaking by muggers. Such fishing practice may injure the animal while capturing and keeping them tied up. It was during such fishing event at Traj village that a mugger was captured in nets, which was then tied up and kept at the bank. One of the kids playing nearby went to close to the animal and was attacked by the mugger (Upadhyay and Sahu 2013). The boy was rescued but was injured badly. Another threat which was identified is that the increased road network. One incidents of mugger death on road were

recorded during the survey. One crocodile (5.38 ft) was killed near Deva village while crossing the road. During monsoon, muggers in this region engage in local migration moving from one wetland to another. During such movements they have to sometime cross roads and railway tracks. It was during such movement that the animal was run over by some vehicle. Encroachment in to the mugger habitat was also found to be a serious threat to their survival. In April 2014, many mugger burrows were destroyed while reconstruction the side of the canal at Deva village, which harbours significant muggers populations in the area (Upadhyay and Sahu 2013; Vyas 2013).



Fig.3: A mugger run over and killed by a vehicle on road near Deva Village, Gujarat, India.



Fig.4: Injury marks on a cow's leg, caught by mugger at Traj Village, Gujarat

Recommendations

Although frequency of interactions between humans and mugger crocodiles have been increasing throughout Gujarat (Vyas 2010), public awareness of this ubiquitous species has generally been overshadowed by other species. Long term conservation of the muggers in this region will depend on the ability of wildlife professionals to develop effective education strategies and increase the awareness of locals to maintain and improve human attitudes toward these species. The effectiveness of education strategies will depend on the implementation of educational program strategies by multi-disciplinary groups. It is also crucial to develop strategies to reduce problems between muggers and human, otherwise increasing the attitude would be an almost impossible goal. A better appreciation by local people of the role of this prehistoric animal as “manager of the wetlands” should be emphasized in educational programs. Acceptance of predators not only depends on animal characteristics, but also on people’s demographic and personal variables, which implies that sociologists, educators, and other professional involved in rural development should be involved in conservation actions. A better overall protection to the wetlands and crocodiles, will assure a safer home for this species on a long-term basis. Regular, planned and systematic surveys of all wetlands and other potential habitats are necessary which will help in keeping a tract of the changes in mugger populations in Charotar region. There is also an urgent need for the Forest Department to establish a ground staff for protection, law enforcement and monitoring of the muggers in the region.

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Table 1: Information regarding fishing activities and mugger status at the wetlands surveyed. The numbers displayed in the table represents the number of respondents.

Sr. No	Village	Mugger Status	Do you go fishing?		Do people from outside village come for fishing?		Do muggers make den here?		Did you see the mugger eggs/hatchlings?	
			Yes	No	Yes	No	Yes	No	Yes	No
1.	Asmali	A		1		1				
2.	Balinta	A		2	1	1		1	1	
3.	Baroda	A		1		1		1		
4.	Bhaat-Talavdi	P					1		1	
5.	Bhadkat	P	1	1	2			1		2
6.	Bhaloda	P		1		1	1			1
7.	Buddhej	A		1		1				
8.	Changa	P	4	4	8			5	2	6
9.	Dabhau	P	7	6	11	2	10	2	4	8
10.	Dali	p		2	1	1	2			2
11.	Dethali	P		2	2		1	1		2
12.	Deva	P	13	26	44	1	46	1	36	12
13.	Devataj	P		1		1				
14.	Gada	A		1				1		
15.	Gangapur	P	1	2	3		2			
16.	Gorad	A	1	1	2			2		2
17.	Heranj	P	2	35	34	4	35	1	20	18
18.	Kasok	A	1	1						
19.	Kathoda	P	1	12	11	2	3	5	7	3
20.	Khandhali	P	5	12	15	2	11	3	8	8
21.	Kunjra	A		1		1				
22.	Laval	P	2	2	5		9		7	1
23.	Machhiel	P	3	18	20	2	21	2	8	14
24.	Magrol	P	3	1	4					
25.	Mahelaj	A		2				2		1
26.	Malataj	P	4	21	23	1	21	3	13	12
27.	Marala	P	5	5	5		2	2	2	6
28.	Moraj	A		1	1			1		
29.	Nagra	P	12	16	18	7	18	7	9	18
30.	Nandoli	P		2	1		1	1		2
31.	New Pallla	A		1		1				
32.	Palo	A		2	1	1		2		2
33.	Pariyej	A		1	1			1		1
34.	Rampur	A		1						
35.	Pij	P	1		1			1		1
36.	Shekhpur	A		1		1				
37.	Sojitra	P	2	7	9		3	6	2	4
38.	Traj	P	4	20	19	2	23	1	15	9
39.	Tranja	P	2	3	3		5	1	3	2
40.	Utai	P	2	1	3	1		3	3	
41.	Valli Kenaval	A	2					2		2
42.	Vaso	P	7	3	8	1	13		4	5
43.	Virol	P	1	1	2		1	1		1

A - Absent, P – Present

Table 2: Following questionnaire was used during the survey.

A. Basic information

- 1) Age and sex
 - 2) Education:
 - 3) Occupation:
 - 4) How long you have lived in this place?
- B. Dependence on water body**
- 5) How do you depend on the near water body? (Drinking, bathing & washing clothes, washing of household materials etc.)
 - 6) Time of utilization of water body by humans
 - 7) Time of utilization of water body by livestock
 - 8) Do you go fishing? (yes/no, if yes, specify mode of fishing)
 - 9) Do the people from outside village come for fishing? (if yes, specify the place & time of the year)
 - 10) Any other products that you collect from nearby water bodies?
- C. Local people's knowledge on mugger**
- 11) Have you seen crocodiles in the wild/near you? Yes/No, (if yes, where and how many?)
 - 12) How often do you see them?
 - 13) What do they eat?
 - 14) Do they nest here?
 - 15) Did you see the mugger eggs/hatchlings? Yes/No (If yes, how much and when?)
 - 16) Has number of crocodiles on nearby wetland/water body/property increased in the last 10 years?
 - 17) Do you know that crocodiles are protected? Yes/No
- D. Attitude and tolerance to Muggers**
- 18) Do you like Muggers? (Yes/ No)
 - 19) If yes, why do you like them? (If no, skip to question No. 24)
(a) Beautiful Animal (b) endangered species (c) maintains ecosystem (d) religious
 - 20) Do you like mugger near you? (Yes/No)
 - 21) Should these muggers be conserved? (Yes/No)
 - 22) Where these muggers should be conserved?
 - 23) Will you support mugger conservation even if a family member is attacked and injured?
(a) Agree (b) Neutral (c) Disagree
 - 24) Why don't you like muggers?
- E. Crocodile conflict**
- 25) Any incidence of crocodile attack on livestock/poultry/pets? (If yes, then when and where?) (If no, skip to question no.27)
 - 26) Do you guard your livestock near water bodies? Yes/No
 - 27) Any incidence of crocodile attack on humans? Yes/No (if yes provide details/If no, don't ask further question)
 - 28) Why do you think they attack?
 - 29) Have people ever tried to control/kill these problematic muggers? Y/N
 - 30) If Yes, then how?
 - 31) What steps the forest department takes to solve this problem?
 - 32) Are you satisfied with current problem-mugger management by forest department? (Yes/No)
 - 33) If no, what should be the problem mugger management strategy?