

Government of Bangladesh
Ministry of Environment and Forests
Dhaka, Bangladesh

Asian Development Bank
Global Environment Facility
Government of the Netherlands



**INTERNAL NOTES – IN NO.78
HUMAN-WILDLIFE INTERACTION STUDY**

Jagrata Juba Shangha (JJS)

August, 2003

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PROJECT FUNDING AGENCIES

- Asian Development Bank- Manila
- Asian Development Bank- Bangladesh Mission
- World Bank – Bangladesh Mission
- The Royal Netherlands Embassy

PROJECT AFFILIATED AGENCIES

- IUCN
- SWMC

STUDY REPORT ON
HUMAN-WILDLIFE INTERACTIONS IN RELATION TO THE
SUNDARBAN RESERVED FOREST OF BANGLADESH

Submitted To



Sundarban Biodiversity Conservation Project (SBCP)
Department of Forest
Ministry of Forest and Environment
People's Republic of Bangladesh

Submitted By



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ABBREVIATIONS USED

ACF	Assistant Conservator of Forests
FD	Forest Department
FGD	Focus Group Discussion
IWM	Institute of Water Modeling
JJS	Jagrata Juba Shangha
KU	Khulna University
NGO	Non Governmental Organisation
PCA	Principal Component Analysis
Ppt	Parts per thousand
RIMS	Research Information and Management Systems (Unit of the Forest Department)
SBCP	Sundarban Biodiversity Conservation Project
Tk	Taka

new abbreviations from hunting

HUMAN-WILDLIFE INTERACTIONS IN RELATION TO THE SUNDARBAN RESERVED FOREST OF BANGLADESH

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ACKNOWLEDGEMENTS

During this study we received much support and inspiration from a number of organizations and people. We highly appreciate the contribution of Robert van Zalinge, Associate Expert to the Sundarban Biodiversity Conservation Project (SBCP). Throughout the study design to report writing, every time, he reviewed and provided many valuable suggestions to the study team. He visited most of the study area with the study team, participated in many focus group discussions, community sessions, and individual interviews. He also provided time to time suggestions, reviewed the draft report and participated in the analysis of data.

We would also like to thank the following people for their contributions to this study:

Floris Deodatus, Hero Heering, Sailendra Saha, and Ruhul Amin from the SBCP for their comments and suggestions. Also special thanks to Shamsur Rahman for providing us with a report with statistics from the NGO household survey data. Gulnur Akturan from JJS and Jakir Hossain of Rajshahi University for proof reading the final document. Khasru Chowdhury from the Bengal Tours for sharing his experiences and ideas on the human-tiger conflict with us. Ali Reza Khan from Jahangir Nagar University for his discussions and sharing of findings. Osman Gani of the Bangladesh Forest Department for sharing his knowledge on tiger attacks with us. Many thanks to the people of IWM, especially Abdur Rahman Bhuiyan, Amirul Islam, and Fuad, for sharing their data on water salinity in the Sundarbans with us. Also thanks to the ACF's Fatimatuz Zohara and Faruk Ahmed, who accompanied the study team on field trips and offered their comments and suggestions. Last but not least, thanks go to the data collectors who were hired for this research study. Their hard efforts in the communities surrounding the Sundarbans determined the scope of the study.

There are NGOs, namely Sushilan, Sangkalpa, Nabolok, Prodipan, and Heed-Bangladesh whom we would like to thank for their help and advice during this research. We would like to thank all staff of JJS for their all out cooperation in carrying out this research.

We would like to express our thanks on behalf of the Study Team to the Asian Development Bank for their financial support and to all the team members and study participants who contributed their energy, enthusiasm, and insights to make this study a success.

PART 1: HUMAN-WILDLIFE CONFLICTS

1. INTRODUCTION

For many the name of the Sundarbans is synonymous with that of the Royal Bengal Tiger. The tiger is the main attraction for most tourists. Yet for the people living on the borders of the SRF as well as for those who enter the Sundarbans to support themselves and their families, the tiger can be a problem. When it enters areas of human habitation and kills livestock and people, fear can be replaced by resentment.

Wildlife conflicts are regarded as any confrontation between people and wildlife originating from the Sundarbans leading to human injury or fatality or the loss of crops and/or livestock. Wildlife conflicts in and around the Sundarbans are however, by far and large the result of tiger attacks. Tiger attacks on people could undermine the conservation efforts of the Forest Department and their relationship with local communities. This is especially true if the Forest Department is perceived as uncaring because of negligence in making attempts towards helping people when cases of human-tiger conflict occur in areas outside the Sundarbans.

Nearly all reports that exist on wildlife and tigers in the Sundarbans mention the large number of tiger attacks and discuss the possible root causes (e.g. Blower, 1985; Reza et. al., 2000; Tamang, 1993; Salter, 1984). Only a few studies however have attempted to study the conflict in some detail with the aim of producing factual information that could help for developing initiatives to lessen the number of attacks occurring each year (see: Gani 2002; Hendrichs, 1975; Reza et. al., 2003).

This study does not set out to prove or disprove theories on the causal factors for the large number of tiger attacks in the Sundarbans. Though the factors behind tiger attacks are analysed and discussed, the main aim of this study is to gain a better understanding on the impact of tiger attacks (or attacks by other wild animals) are having on those people affected and to come up with practical recommendations which if followed, could on the one hand lessen the loss of life, and on the other, lessen the negative impact of such attacks on the families of the victims.

2. OBJECTIVES

In order to achieve the main aim as described above, the study had the following objectives:

- 2.1. Assess the frequency of attacks on people by wildlife from the Sundarbans
- 2.2. Analyse the circumstances in which the attacks took place
- 2.3. Make recommendations that could lessen the vulnerability of people to attacks in future
- 2.4. Assess the economic impact of attacks on the victims and/or their families
- 2.5. Make recommendations on what could be done to help lessen this loss

3. METHODOLOGY

Essentially, the research into human-wildlife interaction in and around the Sundarbans entailed two separate topics, namely: conflicts between humans and wildlife, and the hunting of wild animals by human (see Part 2: Wildlife Hunting). Where there was opportunity to carry out activities on both topics together this was done. In fact combining the two was often very helpful as data collectors were able to subsequently touch on the more sensitive issue of hunting with many of the people they had previously been discussing the more approachable topic of tiger attacks with.

This chapter sets out, stepwise, in chronological order, the methodology used that is relevant to the study on human-wildlife conflicts.

Step 1: Collecting base information

Forest Department records on tiger attacks were obtained from the Divisional Forest Office, West Division. Newspaper clippings from the Coastal Development Project and the Umesh Chandra Public Library (Khulna) were examined for any articles on wildlife conflicts. Hospitals and local clinics were also consulted to obtain records of people attacked by wildlife.

Step 2: Identification of Research Officers

Four staff of JJS were identified as research officers to be responsible for supervising and monitoring data collection activities. Each research officer was assigned two districts within the Sundarbans Biodiversity Conservation Project's (SBCP) Impact Zone as the area for which they were responsible. These districts were Shatkhira, Khulna, Bagerhat, and Pirojpur / Borguna.

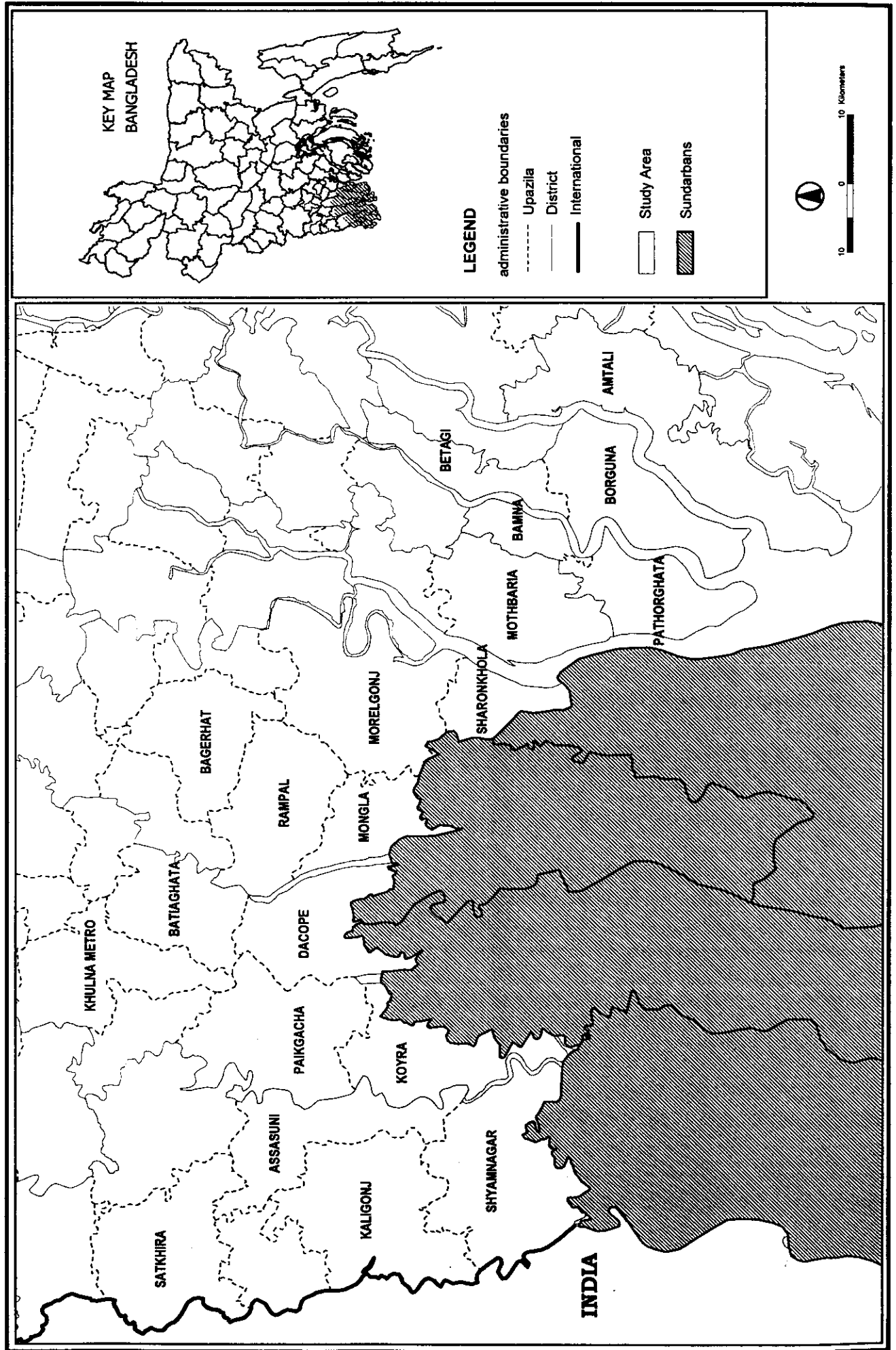
Step 3: Reconnaissance Survey and Identification of Data Collectors

A reconnaissance survey was carried out in order to assess the magnitude of attacks over the last five years. When the study team predicted the number of attacks over the last five years to be in the order of near about 300, it was decided to concentrate on the last three years, so that detailed interviews could be undertaken. During the reconnaissance survey suitable candidates (from the local area) for becoming a data collector were also identified. Each data collector was made responsible for two upazilas (sub districts). All data collectors chosen had completed their higher secondary school and had a good reputation for social networking skills in their locality. A total of 10 data collectors were recruited covering the upazilas: Shyamnagar, Assasuni, Kaliganj, Morrelganj, Sharankhola, Koyra, Paikgacha, Rampal, Mongla, Dacope, Batiagata, Mathbaria, Pathorghata, Borguna, Betagi and Bamna (*see figure 1*).

Step 4: Preparation of Questionnaires

Questionnaires were made for interviewing the witnesses of tiger attacks and the family members of the victims. The questionnaires were based on a checklist of questions provided by SBCP in the Terms of Reference (SBCP, 2002). Maps of the Sundarbans and relevant upazilas were also attached to the questionnaire for identification of attack and village locations by the respondent.

Figure 01: Study area for human-wildlife conflicts



Step 5: Training of Data Collectors

A training was held with the whole study team on the objectives, social webbing and interview techniques, and on use of the questionnaire for wildlife disturbances.

Step 6: Testing of Questionnaires

Questionnaires were tested before hand on a few of the cases that had already been identified in the reconnaissance survey to find out whether the questions were understandable and the design of the questionnaires was practical.

Step 7: Data Collection

Data collectors covered the upazilas they were responsible for, identifying and interviewing victims of wildlife disturbances and/or witnesses and family members thereof over a 20-30 day period. Besides the use of questionnaires, Focus Group Discussions (FGDs) and/or interviews were also held with forest department personnel, community people, witnesses of the attack, family members of the victims, and local NGOs.

Step 9: Monitoring of the Data Collection Process

10% of questionnaires were randomly selected for each data collector and verified by a repeat interview. The research officers and data collectors held these interviews together, often accompanied by the study coordinator and/or a member of SBCP.

Step 11: Data Analysis

Databases were prepared using SPSS (Statistical Package for Social Analysis) for easy analysis of findings from the survey questionnaires. Maps were made in ArcView GIS for analysis and presentation of spatial data. The PCA analysis in chapter 4.3.4. was done using MVSP, a multi-variate statistics programme. Data on the number of Sundarbans users per upazila and selected statistics were obtained from the NGO household survey conducted under the Sundarbans resource extractor communities for the SBCP in 2002. Monthly salinity distribution maps were obtained from the Institute of Water Modeling (Dhaka), which has been conducting research on water quality and hydrology in the Sundarbans from 2001-2002. These salinity maps were compared with tiger attack locations for the same period. Also, on the basis of these maps, months were classified into three groups: low salinity, intermediate and high salinity (see chapter 4.1). For most of the analysis, the data from the full three years of 1999-2001 were used. Only in cases where there was no reason to believe a seasonal effect would alter the outcome and lead to double counting, the three months of January, February and March of 2002 were added to strengthen the analysis.

4. TIGER ATTACKS IN THE SUNDARBANS

4.1. Trends

4.1.1. Yearly trends

Attacks on people by wildlife are largely caused by tigers. Of the 184 people that were attacked by animals in the Sundarbans, within the study period 181, or 98%, were attacked by tigers. By far the most attacks on people took place in the forest. The ratio of attacks in the forest to attacks in areas of human habitation was around **15:1**.

From 1999 to March 2002, 181 tiger attacks occurred, of which 71 attacks in 1999, 34 attacks in 2000, 46 attacks in 2001, and 29 attacks in 2002 upto March (one entry is missing from the total, as no year of attack was given). Using the three full years of 1999-2001 the average is around 50 people per year. However, 1999 was an exceptional year (see below). If one takes only the number of attacks in 2000 and 2001 as indicative of the normal tendency of attacks, the average is around 40 attacks per year.

Based on the Forest Department (FD) records on tiger attacks in the Sundarban from 1990 - 2000 the average number of attacks per year was 23 attacks per year. Indicating a discrepancy of 17-27 attacks per year. For the overlapping period between our study and the FD data the total difference was 60 attacks. The major difference was that they had only 12 cases reported in 1999. For 2000 the FD had 33 reported cases. This variation could be related to the proportion of victims of tiger attacks having been in the Sundarbans illegally as only the legal cases are reported to and by the Forest Department (see also chapter 4.5.2).

The number of tiger attacks in 1999 was a lot higher than in other years. In 1999 the price for shrimp fry raised dramatically as local shrimp farmers' demand for natural shrimp fry was unusually high. Many poor people in the Impact Zone, especially the people of Shyamnagar, were attracted to enter the forest for shrimp fry collection. The number of attacks, especially in the Shatkhira range (45 in 1999 versus 18 and 26 in subsequent years), seems to have risen as a result of the increase in shrimp fry collectors.

Hendrichs (1975) reported even greater fluctuations in the number of attacks per year. Between 1968/69 and 1970/71 the minimum was 7 attacks and the maximum 98. The data was collected from the range offices of the Forest Department. He however did not explain these differences.

4.1.2. Monthly trends

The monthly trend in tiger attacks shows that during the "wet" months attacks are lowest (see figure 2). The number of attacks shows a general tendency to steadily increase after the rains, peaking in "Jayistha" just before the rainy season begins. The dry period however also brings more people into the forest. In these months a variety of different products are harvested from the Sundarbans while in the wet months only fishermen (and some illegal extractors) enter the forest, and also in lower numbers.

Unfortunately no data has been collected on the numbers and distribution of people in the Sundarbans over time, so that no exact relation could be established.

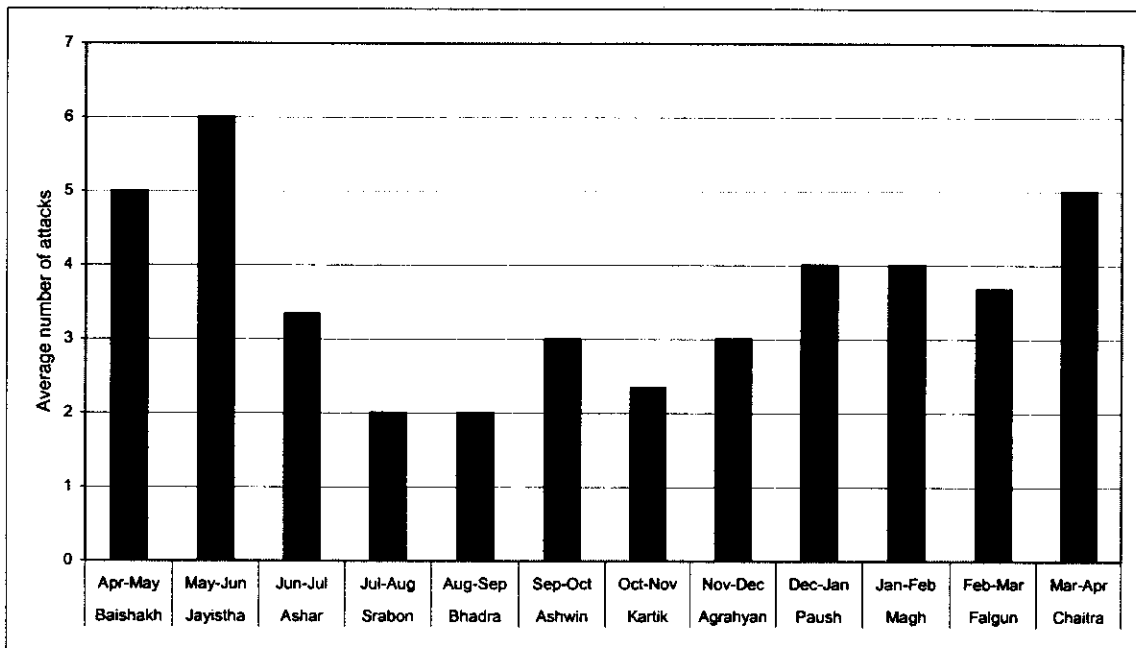


Figure 2. Average number of attacks per month for the years 1999-2001. The distribution of attacks is shown by the Bengali calendar as most people expressed it as such. The corresponding English months are shown, e.g. Baishakh is from mid-April to mid-May.

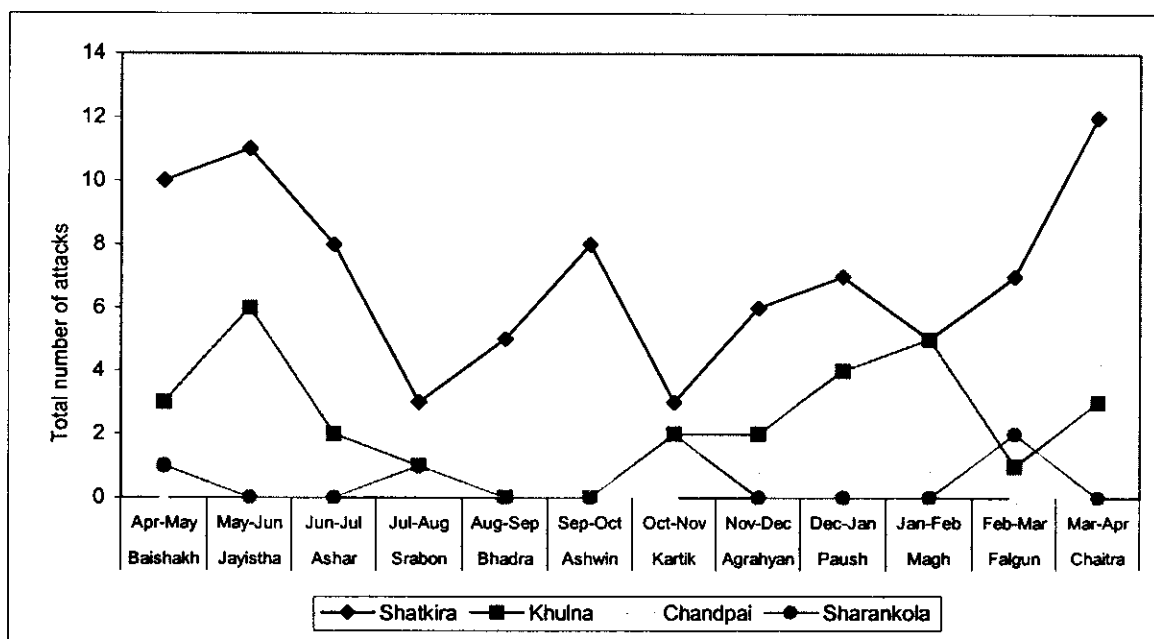


Figure 3. Monthly variation in total number of attacks, by range, for the years 1999-2001.

From figure 3, it can be seen that there are some differences in the monthly trend of attacks for the four ranges in the Sundarbans. Shatkhira has an increase in attacks in the month of September and part of October, which other ranges do not have. A large peak occurs in the period of March-May. In Khulna range peaks occur around May and again in December-January. The expected effect of the winter fisheries around Dubla in Sharankhola range can not be seen in the graph, however two incidents of tiger attacks near Dubla (compartment 8) were left out because the month in which the attack took place could not be verified. Chandpai range did not have any large peaks, though it can be observed that most attacks occurred from November-February.

Hendrichs, in his study on tigers back in 1975 found similar trends. In Shatkhira, peaks were observed in April, September and January-February. In both studies it was found that only Shatkhira range has an increase in the number of attacks around September. From figure 4 below it can be seen that in the month of "Bhadra" only fishermen were attacked (this group includes shrimp-fry collectors). Percentage-wise the number of attacks on people of different professions follows the seasonality of forest extraction in the Sundarbans. In the honey collecting season (April-May) an increasing percentage of mawalis are attacked, while the number of bawalis that are attacked starts to increase around Ashwin and continues to be high throughout the winter months. During the monsoon months little else is done in the Sundarbans besides fishing. It has yet to be established, if for some reason, more fishermen, shrimp-fry collectors or generally more people go to the Shatkhira range in September.

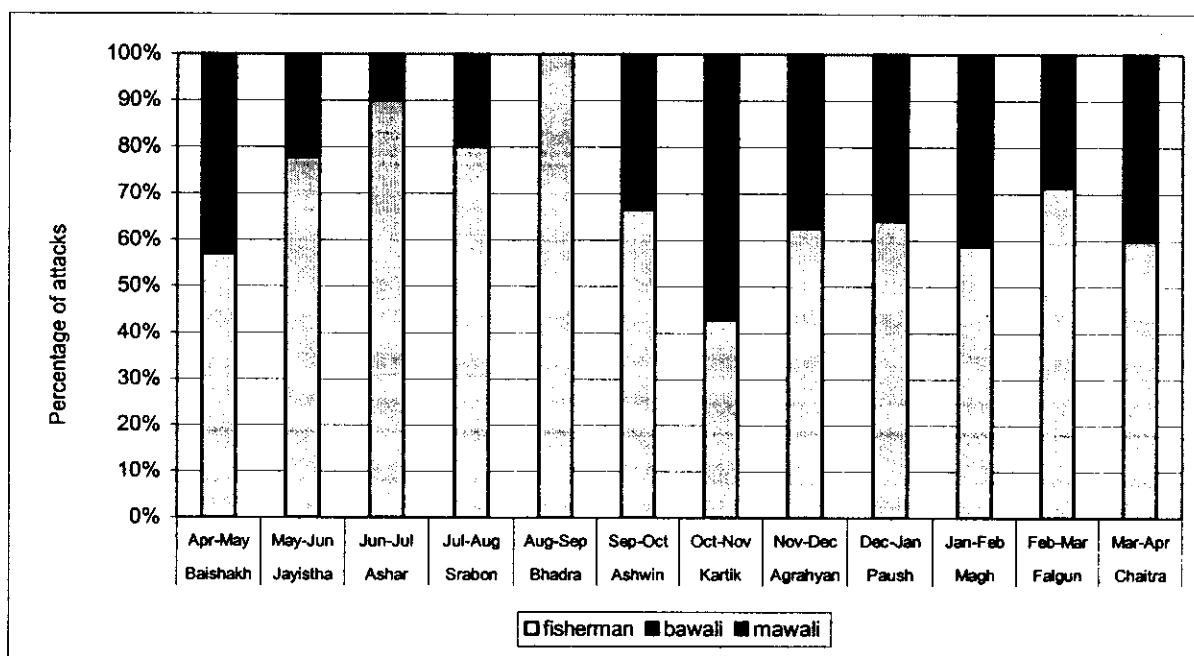


Figure 4. Percentage of attacks occurring on people of different occupation types per month

As Hendrichs had the same finding all the way back in 1975, it is likely that the isolation of attacks in September to the Shatkhira range is a yearly occurring trend. The monthly variation in water salinity in the Sundarbans is such a long-established trend. Generally, the months of August, September, October and November show the lowest salinity levels. In November the salinity level starts to increase rapidly

as fresh water flow from the water catchment areas is reduced. From December-February as well as later in July when the monsoon has just begun, the salinity levels can be said to be at intermediate levels. Between March and June water salinity throughout the Sundarbans has increased substantially from the levels observed in August-October. For example, salinity levels near Mongla port increase from below 1 ppt in August to over 15 ppt in May.

However, no clear trend was observed in the number of tiger attacks becoming more widespread as the salinity throughout the Sundarbans increased and vice versa. Table 1 shows the percentage of attacks occurring in each range by month. From this table it can be seen that in the Shatkhira range the highest percentage of total attacks occur in September, which is a low salinity month, followed by February, of intermediate salinity, and then by April and June, both of which are high salinity months. No correlation was found between the percentage of attacks and the general pattern of salinity changes per month, for any range.

Table 1. Percentage wise distribution of attacks by range per month.

Month	Salinity	Range			
		Shatkhira	Khulna	Chandpai	Sharankola
January	Intermediate	67%	21%	13%	0%
February	Intermediate	85%	8%	0%	8%
March	High	78%	13%	0%	9%
April	High	80%	13%	0%	7%
May	High	63%	37%	0%	0%
June	High	80%	13%	7%	0%
July	Intermediate	25%	25%	25%	25%
August	Low	75%	25%	0%	0%
September	Low	100%	0%	0%	0%
October	Low	50%	17%	0%	33%
November	Low	75%	25%	0%	0%
December	Intermediate	36%	55%	9%	0%
Average		71%	20%	4%	5%

4.2. Location of attacks

4.2.1. Attacks at compartmental level

Table 2. The ten compartments with the highest concentration of attacks (1999–2001).

Compartment	Range	Number of Attacks	Attacks per sq. km.
48	Shatkhira	18	0.22
47	Shatkhira	19	0.18
35	Khulna	11	0.17
49	Shatkhira	17	0.15
40	Khulna	5	0.12
53	Shatkhira	10	0.12

Compartment	Range	Number of Attacks	Attacks per sq. km.
55	Shatkhira	17	0.11
51B	Shatkhira	6	0.10
36	Khulna	6	0.08
46	Shatkhira	8	0.07

Figure 5, below, shows the location of attacks in the Sundarbans as well as the compartment in which they took place, while table 2, above, shows a selection of compartments that have the highest concentration of tiger attacks (for a full listing see the relevant table in the annex). From the map it can be seen that the compartments along the northern and western boundaries of the Bangladesh Sundarbans have the highest number of tiger attacks. Also in compartment 8 opposite of many fishing camps on Dubla Char, there are a relatively high number of attacks for that area. Especially the frequency of attacks in compartments along the northern boundary and near Dubla Char seems to suggest that there is a direct relation between the number of attacks and the number of people accessing these areas. The relation between attacks and number of people enter in Sundarbans is further explored in the next chapter.

4.2.2. Attacks by range and home district of the victim

Table 3. Concentration of attacks per range (and for the whole of the Sundarbans) for 1999-2001

Range	Land area in sq. km.	Number of attacks	Attacks per sq. km.	(Attacks per sq. km.) * 100
Shatkhira	1214.66	89	0.073	7.3
Khulna	1144.5	38	0.033	3.3
Sharankhola	923.23	10	0.011	1.1
Chandpai	829.95	8	0.01	1.0
Total Sundarban ¹	4112.34	152	0.037	3.7

From the above table it is clear that Shatkhira range has by far the highest concentration of attacks. Between 1999-2001, Shatkhira range accounted for 53-63% of all attacks each year. One explanation for this could be that it is because of the relative number of people accessing this range. After the moratorium on timber extraction Shatkhira has, according to many Forest Department officials, become the most popular range for resource extraction. The best quality honey can be found in Shatkhira range as well as most of the goran stock (KU & JJS, 2003). Collection of oysters is a special activity for this range and relatively many shrimp fry collectors are found here. Also, other fishing activities are practiced extensively, and there a number of people who harvest golpata from this range even though the quality of the golpata is less here than in the other ranges (KU & JJS, 2003).

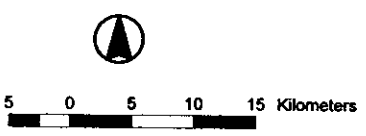
¹ The total for the whole Sundarbans is not the sum of the range values in this table. For a small portion of attacks the location could not be determined and so these were left out of all spatial analysis.

Figure 05. Location of tiger attacks (1999-2001) by compartment.



Legend

- Tiger attack points
- Compartment boundary
- Major water bodies



5 0 5 10 15 Kilometers

No data has so far been collected on the distribution of people in the Sundarbans. Though the numbers of resource extractors in different areas of the forest is not known, data does exist on the number of resource extractors living around the Sundarbans from the SBCP NGO household survey carried out in 2002. This data was used to indirectly analyse whether one range has a higher propensity for tiger attacks than another due to factors other than the number of people using that particular range.

Figure 6 shows the relation between the location of the attack and the victim's home district. It can be observed that there is a strong relation between the place of attack and a person's home district, which also indicates where people from particular districts go to extract resources. Thus it can be said that people from Shatkhira district predominantly go to the Shatkhira range to extract resources from the Sundarbans, people from Bagerhat go to Chandpai, Sharankhola, and also Khulna range, but hardly travel as far as Shatkhira. The people from Khulna district mostly seem to go to Khulna range but a large number of victims were also found in Shatkhira range (see also table 4).

The following table presents the data shown in figure 7 in tabular form.

Table 4. Cross-tabulation of the victim's home district and the range where the attack occurred (1999-March 2002).

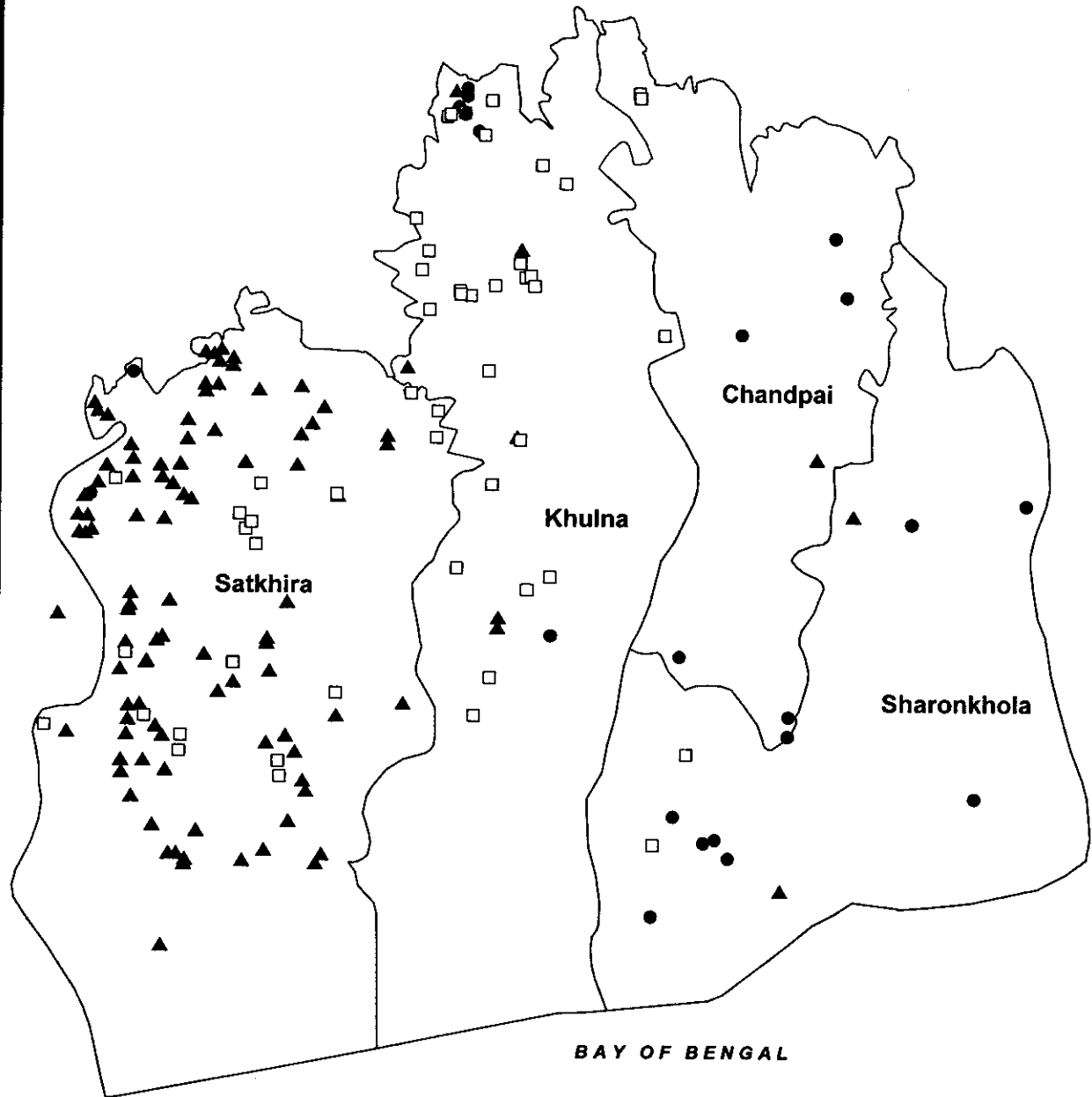
Home District	Range				Total
	Shatkhira	Khulna	Chandpai	Sharankhola	
Shatkhira	93	6	1	2	102
Khulna	18	29	2	2	51
Bagerhat	2	6	6	8	22
Total	113	41	9	12	175

A comparison was done to see how the likelihood of being attacked varied according to a person's home district. The percentage of male resource users found per district according to the SBCP NGO household survey (for the three districts: Shatkhira, Khulna and Bagerhat) and the percentage of victim's from these districts were calculated. The expected values (percentage of resource extractors) were then subtracted from the observed values (percentage of tiger attack victims) for each district. This gave a relative indication of the propensity for being attacked according to someone's home district (see table 5 below).

Table 5. Calculation of the relative chance of attack according to a person's home district

District	Number of male resource users	Fraction of total users (E)	Fraction of total attacks (O)	Observed (O) – Expected (E)
Shatkhira	20438	0.25	0.58	0.331
Khulna	23715	0.29	0.29	-0.001
Bagerhat	36926	0.46	0.13	-0.329

Figure 6. Relation between home district of victim and range where attack took place



Legend

— Range boundary

□ Major water bodies

Tiger attack points according to home district of victims

● Bagerhat

□ Khulna

▲ Satkhira



The following graph based on table 5 shows that people from Shatkhira district have a relatively higher chance of being attacked by a tiger in the Sundarbans. People from Khulna have a normal chance and people from Bagerhat have a much lower chance of being attacked. Resource extractors from Pirojpur and Borguna are even less likely to be attacked as no people from these districts were found to have been attacked by a tiger within the study period.

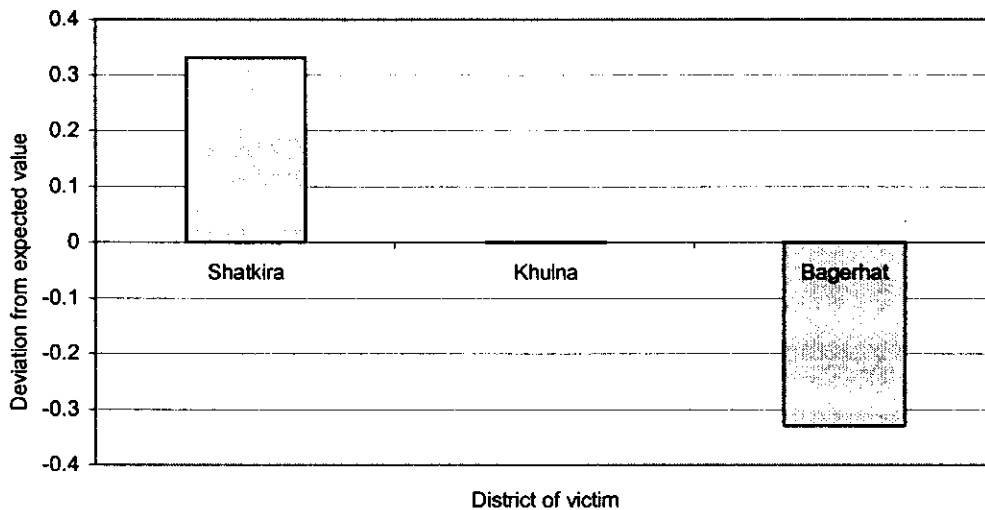


Figure 7. Vulnerability to attack related to home district. The vulnerability is based on the number of attacks that have occurred on people from the different districts between 1999-2001.

From table 4 it can be seen that around 90% of the people from Shatkhira were attacked in Shatkhira range. Combining this with the knowledge that more people from Shatkhira are being attacked than people from other districts, it can be concluded that Shatkhira range really is the most dangerous range in the Sundarbans for tiger attacks and that it is not purely related to the number of people extracting resources from this range.

Within the districts it can be seen that the number of victims by upazila varies a great deal. If one looks by upazila it can be seen that Shyamnagar has the largest number of tiger attack victims by far (53%), followed by Paikgacha (14%) and Koyra (13%). See the relevant table in the annex for a detailed table of attacks by upazila. The following chapter explores for factors that increase a person's vulnerability to tiger attacks.

4.3. Vulnerability to attacks

4.3.1. Time of attack

The figure below depicts the percentage of attacks that took place within each of the hourly ranges shown. From the figure, it can be seen that the number of attacks increased during the morning, peaking at midday, followed by a second peak in the late afternoon. The frequency of attacks over a day varied a great deal. The largest concentration of attacks occurred during daylight, as 94% of the attacks took place between 6 a.m. and 6 p.m. Only around 3% of attacks took place late at night between 9 p.m. and 3 a.m. The reason for this could be that resource extractors take great care to anchor their boats well away from the riverside at night.

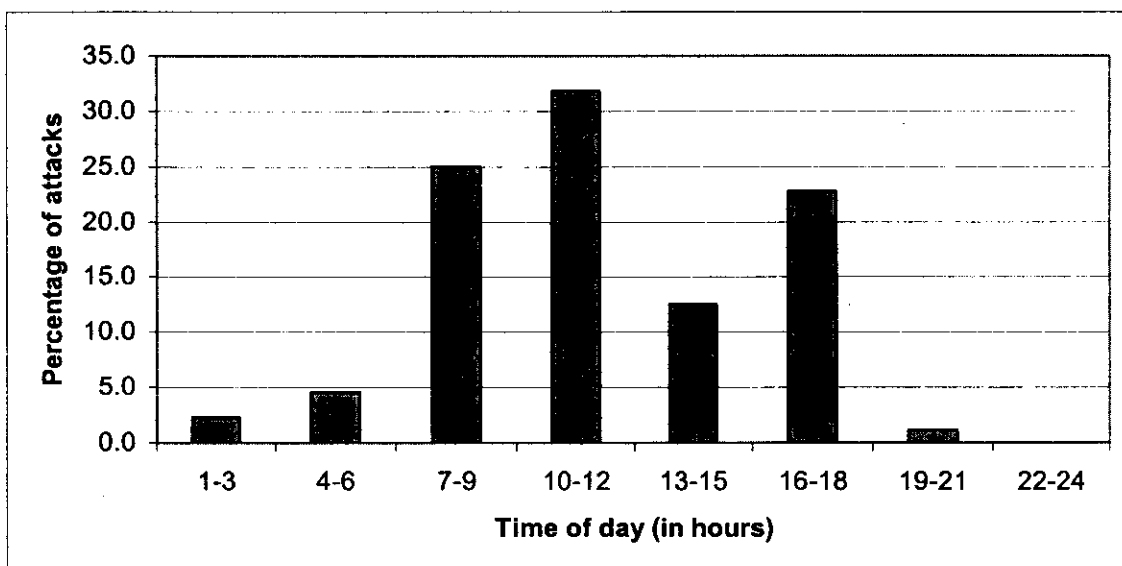


Figure 8. Trend in number of attacks by the time of day

The tendency for attacks to occur during the day has likely more to do with the activity pattern of the resource extractors than anything else. The maximum number of attacks taking place in the morning and late afternoon. Thus no particular vulnerability to tiger attacks can be determined for the time of day. Instead, generally it can be said that the more active the people are in the forest the more vulnerable they become to an attack by a tiger.

4.3.2. People around the victim

At the moment of attack, most of the victims were not alone. In only 6 cases (3.3%), there was no other person close enough to have noticed the attack. Resource extractors in the Sundarbans are aware of the dangers and usually tend to work in groups. Group sizes differ for different professions. Bawalis and mawalis go in groups of 5-9, and fishermen usually are found in groups of 2-3 people per boat. Yet they will often split in to smaller groups or even be alone for certain periods of time. It cannot be said that tigers are more inclined to attack single people or small groups isolated from the rest, without knowing the percentage of the total time people spend out of sight of other group members when they are in the

Sundarbans. However, it is clear from table 6 that the presence of others nearby does not always deter a tiger from attacking.

Table 6 shows the number of people that were in the direct vicinity of the victim at the time of attack. These people were not necessarily in direct observation of the victim, but near enough to notice when the attack occurred. It is assumed that the tiger would be aware of the presence of other people and that this may influence a decision to attack or not.

Table 6. Number of people in the direct vicinity at the time of tiger attack

Number of people	Frequency	Percent
0	6	3.3
1	34	18.8
2	64	35.4
3	39	21.5
4 or more	38	21.0

It seems that many tigers are confident enough of their strength and stealth to attack a person when others are nearby. The following observation from experienced resource collectors might be an accurate description of a tiger's method of attack.

In FGDs people univocally were of the opinion that the number of people in a group has less implication on the occurrence of an attack than the target itself. They said that when a tiger selects someone it will follow that person until finding a suitable opportunity to attack.

A suitable opportunity is likely to be at a moment when the intended victim is relatively secluded from the rest of the group. Yet the tiger takes big risks and often strikes even when others are close enough to interfere. Because of this, many tiger attacks often fail as the other group members drive the tiger off its kill. Unfortunately they are usually too late to save that person's life and due to the remoteness of the Sundarbans from any medical facility the mortality rate of tiger victims is high (see also chapter 4.4.1).

4.3.3. Age of the victims

Age is likely a variable that plays a role in the selection of individual people by tigers. Other important variables, which were not considered in our study, are the size of the victim (length, build) and the victim's general fitness, of which age is an indirect indicator.

In order to find out whether tigers are showing a preference for people of a certain age, we first constructed age groups of 14 years each, so as to get a continuous spread, but which also reflect different physical stages. We then calculated the fraction of people in each age group from the total number of people attacked. As a reference, we used the fraction of all Sundarban resource extractors belonging to each age group taken from the SBCP NGO household survey database. Subsequently we subtracted this reference fraction from the fraction of victims for each age category to get an indicator of

preference shown by the tiger for certain ages considering the availability of people of different age groups. The table below shows the sequence of calculation.

Table 7. Selection of victims by age

Age Range	No. of victims	Fraction observed (O)	No. of people	Fraction expected (E)	Vulnerability Index ((O - E)*100)
0-14	2	0.01	3664	0.03	-1.99
15-29	46	0.25	35707	0.30	-4.75
30-44	73	0.40	47993	0.41	-0.21
45-59	39	0.22	23285	0.20	1.88
60+	21	0.12	7739	0.07	5.07

We found a clear trend in the selection of victims by their age group. Figure 10 below shows the results graphically. From the graph it is clear that people in the age group 15-29 are the least vulnerable, while people that are 60 or over are much more vulnerable to tiger attacks.

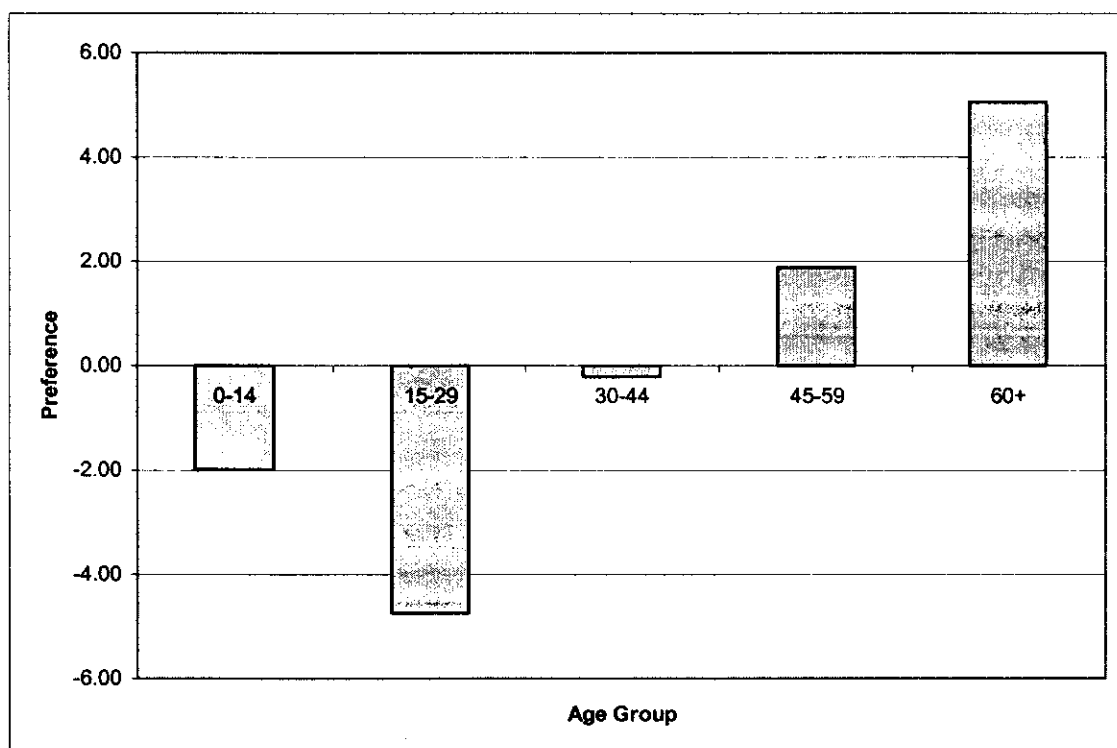


Figure 9. Relative selection of age groups by tigers (- is relative avoidance; 0 is no bias; + is increased selection)

4.3.4. Vegetation type

Vulnerability to tiger attacks is also likely to be influenced by the vegetation a person is in. Very dense vegetation increases the chance of disturbing a hiding tiger and is also likely to be a favoured ambush site for such a predator.

Unfortunately not enough data was collected through the questionnaires on the vegetation/habitat type in which the attack had occurred, as this question was largely misunderstood. Instead we tried an indirect analysis by relating the attack locations with the 1995 RIMS vegetation map provided by the Forest Department. Considering that the location points may not represent the precise location of the attack, the number of attacks were aggregated and compared with the percentage of vegetation types as used by RIMS at a compartmental level (see also chapter 4.2.1.). The analysis was done only for compartments where at least one attack had occurred.

For the analysis we used a PCA (principal component analysis). PCA is a commonly used explorative tool for indicating association between variables. It forms a number of principal components, lines of best fit as it were, which explain most of the variance observed in the dataset. Each component is completely uncorrelated and thus can explain different relationships. Most of the variation is explained by the first and second components (the x and y axis in figure 11), after which the strength reduces considerably. The first component explained around 31% of the total variation, while the second 21%. In the biplot in figure 11, vectors are drawn indicating the direction of increase of that variable in relation to the principal components. The more the variables tend to increase in the same direction, the stronger the correlation. Also the length of a vector along an axis indicates the strength of the correlation between that variable and the axis. The compartments (which are the samples) have also been plotted to show how they correlate to the variables. For more explanation on PCA and other related techniques see publications on the analysis of ecological data using multi-variate techniques, such as Kent & Coker, 1994 or the manuals of statistical software packages such as SPSS, S-Plus, and MVSP.

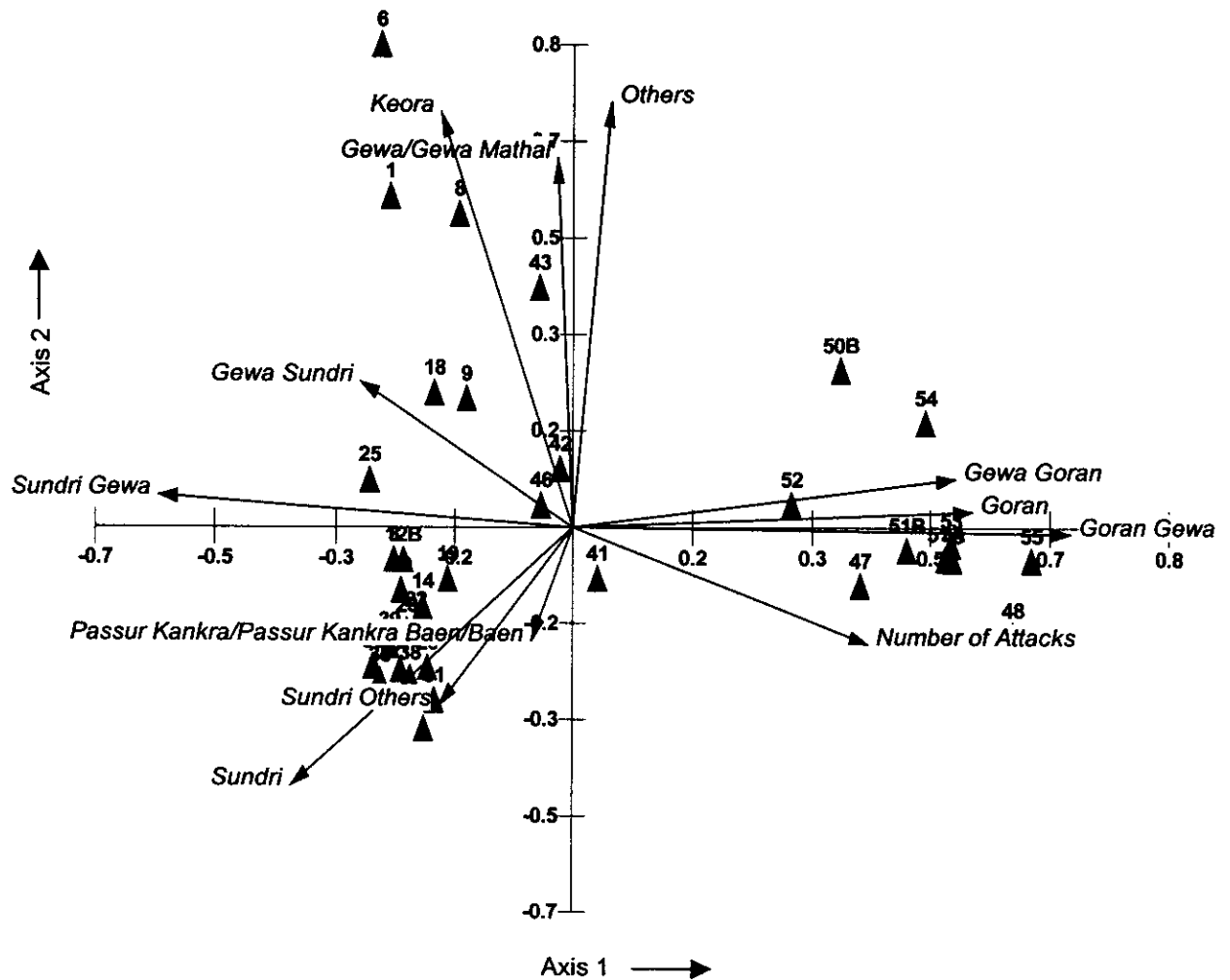


Figure 10. Biplot of PCA results. Variables are shown as vectors, samples (compartments) as points.

We can see from figure 11 that the number of attacks increases together with an increasing percentage of goran type vegetations. The number of attacks is negatively correlated with gewa sundri and sundri gewa vegetation types (the arrows point in opposite directions), in other words a decrease in the number of attacks is observed in compartments that have a higher percentage of these vegetation types. Thus the results from this analysis seem to indicate an increase in the number of attacks in compartments that contain a higher percentage of goran type associations and a decrease in those compartments where a mix of sundri and gewa prevails.

However, this does not mean that the number of goran trees explains the number of attacks. There could be other underlying factors to which both goran associated vegetation types and number of attacks are correlated. Possible factors could be an increase of the density of vegetation which increases with goran type vegetations and where more attacks are likely to occur, or it could be that the densities of natural prey such as deer and wild boar is the underlying factor, if higher densities can be found in sundri gewa mixed forests and less in goran type associations.

Due to a lack of accurate data this relation could not be analysed. The findings in the second part of this study, on hunting, show however that the eastern parts of the Sundarbans where sundri is more prominent are also the preferred hunting locations of deer hunters. Hunters commented that more deer could be found in these parts, but the distribution of deer according to vegetation types still has to be properly assessed.

4.3.5. Occupation of the victim / Reason for going to the forest

It was explored whether the profession of the victim at the time of entering the forest, i.e. their main activity, had a relation to their vulnerability in the forest. The following table shows a breakdown of attacks for the different general professional groups of the victims. It was independently verified that many 'fishermen' were in fact shrimp fry collectors. There is also a mixed group of people who described their occupation as businessman, mechanic, boat driver, etc. These people were excluded from the analysis. The frequencies were referenced to the overall distribution of these professions under Sundarbans resource extractors, for those upazilas that had tiger attack victims, as found in the SBCP NGO household survey database.

Table 8. Percentage of total population attacked per occupation type

Occupation	Fisherman	Bawal (woodcutter)	Mawal (honey collector)
Total as under HH survey	81128	16188	1556
Number of victims	98	33	8
Percentage of total	0.12%	0.20%	0.51%

From the analysis it appears that mawalis are the most vulnerable to tiger attacks. This can be expected because, they have to cover large distances in the forest to find the honey they are looking for. In their rush to get to the honey little precaution is shown and they spread out over a large area only staying in contact with each other through vocalizations. Bawalis were the second most vulnerable to attack which may also be expected. Still, 98 fishermen were attacked, which is surprising as fishermen are supposed to be associated with water, where they are safe from tiger attacks. To understand why also fishermen are vulnerable, the activity of the victim at the time of attack needs to be examined.

4.3.6. Activity of the victim at the time of attack

Relatively detailed explanations were given to the question "What was the victim doing just before the attack took place". These descriptions were grouped into categories describing their activities in order to explore the linkage between activities in the forest and vulnerability to tiger attacks (see table below).

Table 9. Frequency of activities at time of attack

Activity	Frequency	%
Extracting timber / fuelwood / golpata / goran	93	52%
Fishing	43	24%
Stationary activity	18	10%
Extracting honey	13	7%
General movement through the forest	11	6%
Intervening in attack	1	1%

Table 9 illustrates that around half the victims, irrespective of the purpose they went into the Sundarbans for, were attacked when collecting fuelwood, timber or other raw materials. Near to a quarter of the people were attacked while fishing. Of the total number of people fishing, 17 were explicitly described as having been 'pulling the net' along the banks of rivers, indicating they were on land and not fishing from the boat at the time of attack. This is believed to be the same with all other fishing cases. A popular fishing technique is to set the net in a very small khal that runs dead. These khals only fill up at high tide and are completely dry at low tide. The fishermen then span his net across the water at the peak of the high tide so that he effectively catches all the fish that have swum up such a "one-way street". These khals are found in the deep forest and the fishermen spend a great deal of their time on land. No cases were established during later reviews of the findings whereby a fisherman was fishing from his boat when attacked by a tiger.

There were quite a few attacks at a time when the victim was described as being stationary. The term 'stationary' was used here to describe such activities as resting, thatching the boat, washing, tying the boat, etc. For a complete description of activities see the relevant table in the annex. The term 'general movement through the forest' is used to indicate movement unrelated or unspecified as belonging to any of the other work activities.

People belonging to various professions (as described in chapter 4.3.5.) will extract many other resource types while in the forest. Each and every group needs to collect fuel wood for cooking as none of them bring their own from outside as fuel wood collected from the Sundarbans is essentially free and there is plenty of it. Also resources such as golpata are collected for construction or reparation of covering roofs for the boats, while gewa wood is collected as anchor posts for mooring the boats. Thus all resource users spend a significant amount of time on land searching for and collecting various types of resources.

This indicates that the activity of the person at the time of attack, is more helpful to understand the vulnerability of people in the forest, rather than their profession. Cross-tabulation of activity with profession revealed that 48 fishermen or 45% were actually extracting wood at the time of attack. This, together with the methods fishermen employ of fishing along the banks, or in deep forest, helps to explain why so many fishermen were found to have been attacked.

4.4. Man-eating behaviour

4.4.1. Results of attack

Table 10, below, shows that the majority of victims (78%) died during the attack or succumbed to their injuries afterwards. Still, 22% of victims managed to survive the attack. This was often found to have been due to the efforts of the rest of the group to rescue the victim from the tiger. The incidents of a group coming to the rescue of an individual especially occurred when there were other family members in the group. Family members were said to be a lot bolder in confronting the tiger and coming to the immediate rescue of a victim, while non-kin would usually first try to scare the tiger away by shouting and throwing objects from a safe distance, which could make the difference between life and death for the victim.

Table 10. Result of the tiger attack upon victim

Result of the tiger attack	Frequency	Percent
Fully consumed	13	7.2
Partially consumed	58	32.0
Killed but not consumed	70	38.7
Injured	40	22.1

Of the 196 tiger victims, 39% were fully or partially consumed. These cases are evidence of man-eating by tigers in the Sundarban. Usually the tiger does not have a great deal of time with the body as other members of the group chase the tiger away and take the victim with them. The potential number of man-eating incidents could therefore be much higher.

Though it was not included in the questionnaires, it was revealed by the data collectors, based on interviews with the witnesses that most of the victims were attacked from behind. This suggests that most attacks occurred as a result of the tiger stalking the victim, as in cases of a surprise confrontation between a person and a tiger, the attack will come from the front, unless the victim happens to be running away from the tiger which could trigger it's instinct to attack.

4.4.2. People's perception on man-eating behaviour of Sundarbans tigers

In the questionnaires, questions were put to the respondents if they believed all tigers were man-eaters and what their reasons for this were. A number of FGDs were also held in which this subject was discussed. This section puts forth the conception resource collectors have of tigers in the Sundarbans and their tendency to attack people.

Table 11. Response to the question: "Are all tiger's man-eaters?"

Response	Frequency	Percent
Yes	128	71.1
No	52	28.9

Among the 52 people who responded that not all tigers show man-eating behaviour 20% said that they have experienced that a tiger passed by them or other people without attacking. 50% of them said that usually a tiger is not a man-eater until for some reason it has tasted human flesh. 15% of them said that very young tigers are not man-eaters, but eventually become so as they get older. 8% of the respondents felt that tigers are not strictly man-eaters, but if they get a good opportunity, then like with other animals, they will go for the kill. However, it is not the case that all tigers hunt people.

On the other hand most (71%) of the respondents believe that all tigers are man-eaters. Of this group, 90% said that they think that all tigers are man-eaters, because they do not know of anyone who has experienced the situation where a tiger did not kill when it had the opportunity to do so. 10% of the respondents said that tigers are man-eater because it is easier to hunt man than it is other animals. In FGDs people were also of the opinion that all tigers are man-eaters because man is a potential food source. The people generally describe that in the sense of tiger behavior, if people are edible to a tiger, then obviously they will try to kill and eat people. Of these people, another 90% agreed that tigers are man-eater because human flesh is very sweet in taste and that tigers like it very much. "If a tiger but once eats human flesh, it will always try to kill again", they announced.

Thus there was a division of opinions, different people gave different answers to the questions and described different degrees of man-eating behaviour, yet it seems that even the people who said that not all tigers are man-eaters, believed that a tiger could quite easily change from becoming a tiger avoiding human confrontation to the type of tiger which considers people as part of its prey base and will attack if presented the opportunity (see also Hendrichs, 1975 for his theory on the change in a tiger's propensity to attack humans according to environmental parameters).

4.5. Measures taken before and after the attack

4.5.1. Safety measures

Resource extractors generally do not have any protection against tiger attacks when they enter the forest, except for their knives (machetes). 16% of victims had however also taken either spiritual or superstitious measures to ward off tigers. Most of them took a holy bond from the *Noapara* pir, a locally renowned pious man's shrine or from certain religious figures in their locality. Several victims also had offered worship to Bonbibi, goddess of the Sundarbans, before going to the forest.

When a tiger has attacked someone in a certain location a red piece of cloth is hung at the river's edge to warn others not to enter the forest there and to be extra careful in that area.

4.5.2. Reporting the case to the Forest Department

Table 12. Reporting the attack to the nearest forest office

Category of Response	Frequency	Percent
Yes	177	97.7
No	3	1.66

177 respondents out of the total population of 181 answered that the case was informed to the forest department (Table 12). This extremely high rate of report does not match with the records of the FD (see chapter 4.1.). The reason for under reporting is not fully understood. In discussions about this with FD staff and resource extractors it seems to be the case that if the FD considers someone illegal he will not be reported because he should have not been there. For example, it happens sometimes that a person has a pass for fishing, but is killed or injured by the tiger inside the forest, away from the river, and then the case is not reported as it is thought of as illegal. The people themselves do not feel that they are illegal because they have a pass, even though they might have been extracting other resources besides those they have been permitted for. The people who did not report the case to the FD knew full well that they were conducting illegal activities in the forest and were afraid of retribution if they reported the case.

4.6. Other wildlife attacks

During the study period only two crocodile attacks were found to have taken place. One occurred in January 2000 at Poddokhali, compartment 35, Khulna range, while the other in September 2001 at Malancha, compartment 54, Shatkhira range. Both attacks took place in the morning while fishing along the riverside. One man survived the attack. He described the attack as having occurred while he was in shallow water. The crocodile grabbed him by his thigh. Together with his friend they managed to beat the crocodile sufficiently for it to let go.

Only one shark attack was reported. The attack happened to a fisherman in March 2001 in the Shaka River bordering the Sundarban, compartment 37, Khulna range. The victim did not survive the attack. No other wildlife attacks on people were reported, neither were there any reports of deer damaging the crops on fields nearby the Sundarbans. Snakes can be found all over rural Bangladesh and so it is likely that any deaths by snake bite are not seen as anything related to the Sundarbans and are therefore likely to be under reported. The total absence of any findings however seem to indicate that the frequency of snakebites occurring in the Sundarbans is very low.

A comparison, made during group discussions with resource extractors, on tiger attacks with regard to other accidents revealed that people feel dacoits are more of a disturbance to them than the tiger. Tiger attacks in the three years 1999-2001 came to 152, where as the number of people that were killed by

dacoits is only around 15 (reported by people in FGDs), but people said that the kidnapping rate was much higher than the number of tiger attacks, though they could not say how many kidnappings occurred in this time period. 2 cases of drowning were identified as having occurred in the Sundarbans.

5. TIGER ATTACKS IN VILLAGE AREAS

5.1. Trend in attacks

Between 1999 and 2001 there were a total of 10 tiger attacks on people in villages bordering the Sundarbans. In 1999 there were 4 attacks, 3 of which took place in Mongla upazila and one in Morrelganj. In the year 2000 there were also 4 attacks inside villages yet none took place in Mongla, occurring instead in Dacop upazila (3) and Shyamnagar (1). In 2001 there were 2 attacks of which one occurred in Shyamnagar, the other in Mongla.

Most attacks seemed to occur in the months of July (2) and August (4). Together accounting for around 66% of all incidents. However, no attacks were observed in these months in 2001. All the attacks for July and August, within the study period, occurred in villages bordering the Sundarbans on the northeastern side (Dacop, Mongla and Morrelganj).

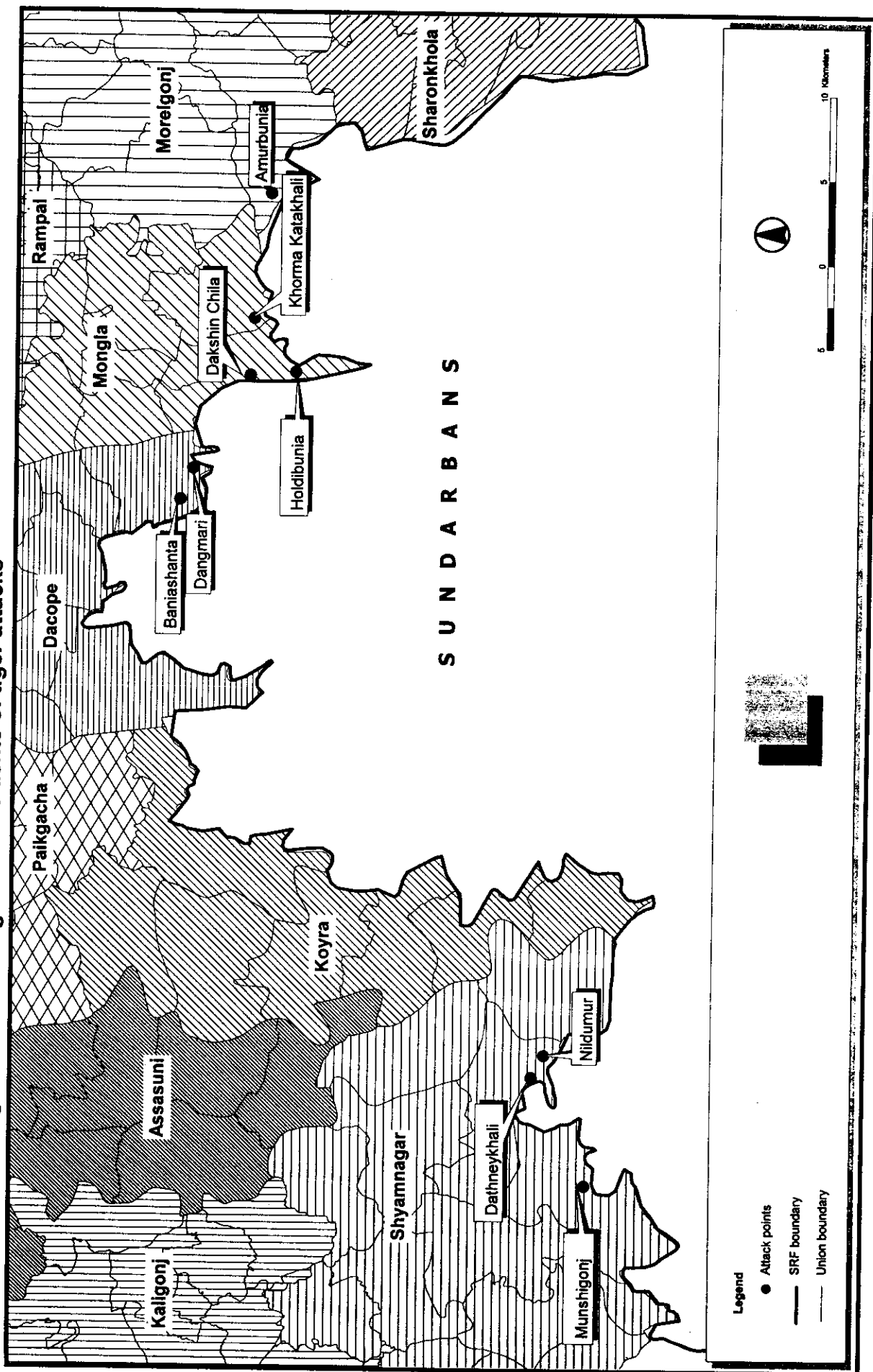
5.2. Location of attacks

40% of attacks occurred in the sub-district (upazila) of Mongla. The other attacks occurred in Dacop (30%), Shyamnagar (20%) and Morrelganj (10%). Of the villages where tiger attacks occurred, only the villages of Korma Katakhalī in Mongla and Dangmari in Dacop had two attacks on people within the study period. Both of these attacks took place in 1999. See *Figure 11* for the locations of all villages where attacks on people took place.

Evidently there are certain areas that are more sensitive to tiger incursions than others. In contrast to the situation within the Sundarbans, in villages, more attacks seem to occur in the areas bordering the northeastern part of the Sundarban. In these areas some of the rivers that used to separate the Sundarban from the villages have run dry. Thus there is no longer a natural barrier to be overcome. This makes it a lot more likely that an animal such as the tiger will be drawn in to the village looking for food.

On the other hand there are villages that are prone to tiger attacks even with the presence of rivers separating these villages from the Sundarbans. Usually these villages are located in a piece of land that is sticking out into the forest with forested land on both sides. These villages become more vulnerable to tiger incursions because of their location.

Figure 11. Map showing location of villages with incidents of tiger attacks



The number of villages bordering the Sundarbans where conflicts with tigers occur is much larger than represented by those where attacks on people have taken place. In many cases tigers entered villages, sometimes repeatedly to prey on domestic livestock without getting caught and without causing any human fatality. The human-tiger conflict in its wider sense took place, during the study period, in the following villages: Baniasanta and Dangmari in Dacop upazila; Baidhamari, Baritala, Dhakin Chila, Digraj, Holdibunia, Joymoni, and Korma Katakhalia in Mongla; Amor Bunia and Jeudhara in Morrelganj; Bogi and Tafalbaria in Sharankhola; and Dathneykhali, Hurinath, Munshiganj and Nildumur in Shyamnagar.

5.3. Consequences of attacks

In contrast to attacks that took place in the forest only 3 attacks in villages (30%) resulted in a human fatality. In another study it was reported that 2 people were killed and 12 were injured in between 1996-2001 (Gani, 2002). The casualty rate for tigers on the other hand is higher. Within the study period, 7 tigers that entered villages were reported to have been killed. Gani (2002) reported that 13 tigers were killed after entering villages between 1996 and 2000. This comes to an average of around 2-3 tigers a year.

When a tiger is found in a village the word spreads quickly and many people come to where the tiger is hiding. The tiger's escape routes are purposefully blocked. Often the tiger is kept cornered somewhere for a long time while people from the village and places nearby come to see the spectacle. Eventually the people try to kill it by stabbing it with spears, knives, axes and/or by throwing rocks. Cornered and injured the tiger will lash out at someone before it is killed. The Forest Department has so far been powerless to stop people from killing tigers under such circumstances and have in some cases been attacked themselves when trying to intervene.

5.4. Circumstances of attacks

It is not surprising therefore that the majority (75%) of attacks are a consequence of the confrontational circumstances that occur as described above. In these cases the tiger is provoked into attacking someone.

These tigers are usually found in the morning after having crept in to the village at night, probably in order to catch some of the village livestock that they may have heard or smelt from across the river in the Sundarbans. Gani (2002) reported that tigers killed 4 cows, 6 pigs, 16 goats, 3 dogs and 2 ducks from 1996-2000. He mentions therefore that most tigers entering villages can be termed as "cattle-lifters" rather than "man-eaters".

However, 25% of attacks seemed to be unprovoked. These cases originate from villages where there is no natural barrier between their village and the Sundarban. The victims were in the direct vicinity of the forest when a tiger attacked them.

6. IMPACT OF TIGER ATTACKS ON FAMILY HOUSEHOLDS

6.1. Income of the Victim

The victims were mostly from a low-income range. Most of the victims (62 %) income was between 1000-2000 taka per month. The average income was around 1900 taka per month.

Table 13. Income pattern of victims

Income range	Frequency	Percentage
Under 1000	6	3.2
1000-2000	116	62.4
2000-3000	34	18.3
3000-4000	17	9.1
4000-5000	9	4.8
Over 5000	4	2.2

6.2. Impact on family members

Table 14. Impact on the family of the victims

Type of impact on the family of victims	Frequency	Percentage
Decrease income & expenditure	126	68.1
Income source has stopped	52	28.1
Financial loss because of treatment	4	2.2
Had to sell everything	2	1.1
Victim's mother became mentally ill	1	0.5

The tiger attacks in the study area have had strong socio-economic and psychological impacts on the family of the victims. Most of the families of the tiger attack victims had to lose their main or one of the main income earners of the family. This led to income collapse in the family, and accordingly they had to decrease their expenditures. In FGDs it was established that this often came together with family members increasing their workload. Even with the increased workload of the other family members most families could not meet their previous expenditure pattern.

The respondents indicated that often they had to cut expenditures on some basic needs such as food, clothing and education. About 28% of the respondents reported that their income sources were totally lost, and could not cope to the changed situation. A number of respondents informed that they had to beg after the loss of their family members. One respondent was forced to sell all of his possessions for survival. During field visits it was observed that some of the children looked very under-nourished and weak, especially for those cases in which a single mother was left to raise a number of young children.

One case was found where the victim's mothers had developed mental trauma in the aftermath of the death of her two sons in the same incident.

From FGDs it was found that help often came from the community, who gave the family of the victim some assistance through donations and by sharing food. In one case it was also told that a local member of parliament had given money to the victim's family. Some people reportedly had received some money from the Forest Department, though this is from individuals as there is no official policy to give compensation to the families of tiger attack victims.

6.3. Compensation discourse

There has been some mentioning within the FD of the need for giving compensation to affected households after a tiger has come out of the Sundarban, entering a village, and has caused harm by injuring or killing either people or livestock (see: Dey, 2000; Gani, 2002).

A one time downpayment as compensation will go only a little way to actually aiding the household to deal with the victim's death in the long run, but may go a long way to improving relations between the affected community, the FD, and the tigers whom the FD represent in such a case. The level of compensation should be sufficient as an appeasing gift, yet can practically only be so large as the FD has limited funds available and what the people really need is long-term solutions.

Though the government should set the level of compensation, this study has done an assessment of the monetary loss to give an indication of what should be considered. In order to assess the compensation level required an analysis was done of the monetary value to the household that was lost as a consequence of the attack. There are three main categories and seven sub categories to be considered for different compensation levels. For each of these categories it was worked out what the monetary impact is for the household. The results are shown in table 15. Because the priority for receiving compensation is with people who have suffered from tigers (and other wildlife) that have entered village areas, the calculation shown in table 15 is based on data collected from the families of victims inside the villages.

There is a large role for NGOs in relieving the impact of tiger attacks on the families of all victims, inside the forest and out. If a dedicated NGO could focus on improving the lives of those families affected by the loss of their main or sole income earner in especially Shyamnagar upazila that would be a great step forward from a humanitarian's as well as a conservationist's viewpoint.

Table 15. Average monetary impact on households for the different categories of attack

Main group	Sub group	Indicator of compensation required	Recommended compensation
Human fatality or injury so that the affected person is unable to work (male/female/child)	Fatality	6 months average monthly income	About Tk. 13,000.00
	Permanently incapable of work	3 months average monthly income + average cost of treatment for serious injury	About Tk. 11,500.00
	Temporarily incapable of work	Average cost of treatment for moderate injury	About Tk. 4,000.00
Injured, but still capable of work	Non affected injury	Average cost of treatment for minor injury	About Tk. 2,500.00
Loss of Livestock	Cow	Half of average selling price	About Tk. 1,500.00
	Goat	Half of average selling price	About Tk. 500.00
	Pig	Half of average selling price	About Tk. 2,500.00

The level of compensation recommended in table 15 does not reflect the actual financial impact on the family of the victim. It is impossible for the FD to compensate the family for this. Thus the reason for giving compensation is mainly psychological. However the immediate financial needs of the family should be reflected also. Therefore we have used the above calculations to distinguish compensation levels required for different cases.

In the case of fatality of the victim the family will face serious economic loss and psychological trauma. Therefore this compensation level should be the highest. We have fixed the compensation at the same level for male, female and child because we feel that their real value is the same. If a married male has died we feel that the compensation should be given directly to the widow and not to any other family members. In other cases, e.g. unmarried men, women and children compensation can go to the family in general.

In the case whereby the victim survives, but is permanently incapable of work the psychological impact is much less. Therefore we have initially lowered the compensation indicator. However the cost of treatment will be high and this should be reflected in the compensation. If a person is temporarily incapable of work only the average cost of treatment is considered to set the compensation level. This cost is lower than for serious injuries, but higher than for minor injuries (injured, but capable of work).

7. LIMITATIONS

There were a number of restrictions to this study. Firstly it was a baseline study, which was necessarily constrained by time and money. Therefore a rapid assessment was done through the use of questionnaires and plotting of attack locations on a map. It was found that it would have aided the analysis of vulnerability if questions on size, health and fitness of victims had been included. Some questions such as the one on vegetation type were misinterpreted and thus this had to be analyzed indirectly. Exact and straightforward phrasing of the question is essential to make sure the question is communicated properly in such surveys.

The number of attacks that took place in the Sundarbans is probably higher than reported in this study. All interviews were held with people living within the districts of Shatkhira, Khulna, Bagerhat, Pirojpur and Borguna. Any victims coming from places outside the study area were not included. The largest potential discrepancy would be for the winter fishermen of Chittagong who come in the hundreds to Dubla each year. The number of attacks on this occupational group is therefore still unknown.

The exact reason for going to the Sundarbans could not be easily retrieved from the questionnaire; therefore their occupation in the forest (e.g. fisherman, mawali) had to be determined from their profession(s) and their activity at the time of attack. Unfortunately no distinction was made between fishermen and shrimp-fry collectors. The vulnerability of shrimp-fry collectors (which is expected to be higher than that of ordinary fishermen) could therefore not be ascertained.

As we are relying on people's memories there is potential for error, though it is also likely that with significant events such as a tiger attack the event is remembered well. However, for all variables there were gaps here and there when someone had forgotten and couldn't tell the interviewers what they wanted to know, for example, at what time the attack took place.

There is a lot more scope for further analysis. It is the hope that in a few years time another survey like this will be carried out; covering the time elapsed between this survey and the next. By this time the SBCP and Forest Department should have more data on the distribution of tigers and on its main prey species such as deer and wild boar. The spatial distribution of people in the Sundarbans is another key aspect for which as yet no data has been compiled. Vegetation maps need to be more diverse, including golpata stands and grasslands. When this information is combined and analyzed together a greater understanding of the determining factors for tiger attacks can result.

8. DISCUSSION

8.1. Tiger Attacks in the Sundarbans

Most habitats in the world that support large populations of tigers have now been declared protected as national parks in which human activities are kept at low levels and no resource extraction is permitted. The Sundarbans on the other hand has a high rate of utilization by people who come to extract a wide variety of resources. With also a sizeable population of tigers sharing the same space, it is not surprising that a large number of attacks take place each year.

However, analysis of tiger attacks within the Sundarbans showed that the frequency of attacks is not only related to the number of resource extractors but also to location. Shatkhira range (53-63% of attacks per year) had far more attacks than expected based on the analysis of home-district of the victim and location of attack (chapter 4.2.2.). Khulna range also had a large number of attacks (23-32% per year) while Chandpai (4-9%) and Sharankhola (6-9%) always had considerably fewer attacks each year.

The ten compartments with the highest number of attacks per square kilometer were, starting with the highest: 48, 47, 35, 49, 40, 53, 55, 51B, 36, and 46. These compartments are all located inside the Sundarbans West Division. Roughly it can be said that there is a strip about two compartments deep, starting from the river Sibsha, going west along the boundary of the Bangladesh Sundarbans down to the Bay of Bengal, where most attacks occur (see chapter 4.2.1, figure 12).

Why certain areas of the Sundarbans are more dangerous than others still has to be properly studied. Hendrichs (1975) found positive correlations between the number of attacks and water salinity as well as maximum water levels and hypothesized that tiger attacks were related to the availability of fresh drinking water. Our rough analysis however shows no relation between the variation in attacks and that of water salinity by month, with more attacks occurring in the same area in relatively higher as well as relatively lower salinity months.

The number of attacks was correlated to certain vegetation types. Goran type vegetations, to which the number of attacks was positively correlated, also occur in areas that have higher water salinity throughout the year. Therefore, is the (permanent) unavailability of fresh drinking water an important causal factor for the higher number of attacks observed in the Shatkhira and Khulna ranges? Only such experiments as making sure that there is enough fresh water available, through construction of fresh water ponds in one of the compartments with the highest number of attacks, and then seeing if the numbers go down over time could answer this question.

It could also be that the vegetation itself is contributing to the number of attacks, as the vegetation in the Sundarbans gets a lot denser from east to west. Dense vegetation could make the number of attacks higher because of a number of reasons: it could make the chance of coming too close to a tiger a lot higher; the tiger itself is able to hide better, making it bolder in its attempts to hunt people; also,

the dense vegetation could be an obstruction to its ability to hunt other prey and thus the tigers found in these areas could have become more opportunistic. Vegetation type could also indirectly influence the number of attacks by the occurrence of variations in prey densities in the different vegetation types. If natural prey densities are lower in goran type forests perhaps this influences tigers to hunt people to supplement their food requirements. The possible explanations are many, and most likely a combination of factors are at play, but in this study we have come no further in ascertaining the root causes for the relatively high numbers of attacks found in the Shatkhira and Khuina ranges.

Without an adequate understanding of the complete picture of what influences tigers to increase their attacks on people in certain areas, preventive measures become more important. The results of this study did strengthen the hypothesis that there is a relation between tiger attacks and the intensity of human disturbance. However solutions along the line of decreasing confrontations between people and tigers either means reducing tiger populations or banning people from these areas. Shooting tigers is not advisable as the tiger is a threatened species and Bangladesh has drawn up laws that are committed to the protection and preservation of such an endangered species. While on the other hand banning people from the Shatkhira range is not an ideal solution either and carries many pitfalls with it, such as increased levels of extraction in other areas, increased budget for enforcement activities with decreasing revenue earnings, and increased poverty in already very poor areas.

This study found indications that certain people are more vulnerable than others. It was found that mawalis (honey collectors) are the most vulnerable group. The age groups of 45-59 and especially those over 60 were more vulnerable as well. It was also found that a lot of fishermen were putting themselves at risk by collecting resources other than fish from the forest. From these results a number of recommendations have been made for the Forest Department and other agencies committed to the conservation of the Sundarbans to contemplate (see chapter 9). Other wildlife attacks are very scarce and therefore all recommendations focus on reducing the risk of tiger attacks.

8.2. Tiger attacks in village areas

Between 1999 and 2001 three people were killed, seven were injured and seven tigers were killed after they had entered villages. It was also reported that tigers had killed 4 cows, 6 pigs, 16 goats, 3 dogs and 2 ducks, between 1996 and 2000 (Gani, 2002). Thus, on average about 1 person and 2-3 tigers are killed each year. No evidence was seen of an increasing trend in the number of incidents in village areas.

Most attacks occurred in the months of July and August. These attacks came from villages located from Dacope upazila eastwards indicating a reverse situation of that happening in the Sundarbans itself. However, tigers entering villages seem to be more likely to be looking for food in the form of livestock rather than attacking people. Only one case occurred in which a tiger broke into a home and attacked someone while he was sleeping. This case happened in Hurin Nagar a few months after the data

collection was completed. Within the study period three attacks occurred which seemed unprovoked, but there were no incidents in which the tiger had eaten the victim.

Why there were more attacks in July and August and why there were more attacks in villages around the northeastern portion of the Sundarbans could not be ascertained. July and August are the months in which the rains are at their heaviest. This could have an effect on the hunting conditions in a muddy forest such as the Sundarbans whereby tigers living near border areas are tempted to try their luck with the easier prey found in villages. Some of the rivers on the northeastern side between the Sundarbans and localities have silted up, providing easy access. However not all villages, even on the northeastern side, were located along such rivers.

It is difficult to stop tigers from entering villages without taking such extreme measures as fencing the boundary between village and forest (along the village side of the river) or by constructing steep embankments that could prevent tigers from climbing over them. Dredging of silted up rivers may be an option if funding can be found, as this not only could lessen tiger incursions in these areas, but would also protect the Sundarbans from encroachment by people.

According to Gani (2002) "Tiger Conservation Committees" have been created in communities suffering from frequent tiger incursions. These committees are supposed to conduct night patrols together with forest guards (from the forest department). If a tiger is seen they will try to chase it back to the forest by using firecrackers and drums. These committees are still active in Dangmari and Korma Kotakhali (Gani, pers. com.). Renewed attention towards the creation of such committees in other areas, whereby community members and forest department staff jointly patrol villages to ward off tigers could be very beneficial to reducing the conflict between tigers and people (see chapter 9 for more recommendations on reducing the number of tiger incursions into villages).

The loss of a major income earner can result in economic disaster for the family of a victim. Nearly 30% of families had lost their only supply of income together with their father/husband in the attack. Especially in younger families where a wife with young children is left behind the impact is devastating. The government cannot afford a policy of giving compensation to the families of all tiger victims. Most people who extract resources from the forest understand that they are entering the tiger's home and do not demand compensation. Yet their loss is great and it is recommended that the government set up a relief fund for the families of tiger victims together with NGOs. Through the NGOs family members could receive food and care while undergoing skills training that could help them generate income.

When the tiger enters the homes of people however, as in the cases of incidents outside the Sundarbans, compensation should be given. Giving compensation will not solve their problems in the long run, but is a "gift of appeasement". If the villagers are not compensated for their loss they will not cooperate with any FD efforts and the killing of tigers will continue (see chapter 6.3 for the recommended compensation depending on the type of incident).

9. RECOMMENDATION

- ξ An awareness campaign is needed, in areas containing resource extractors, and especially in Shyamnagar upazila, on the dangers of tiger attacks in the Sundarbans and in which at least the following findings of the study are communicated to the people:
- Compartments 48, 47, 35, 49, 40, 53, 55, 51B, 36, and 46 are the most dangerous compartments
 - Mawalis are most at risk, followed by bawalis and then fishermen (within this group it is assumed that shrimp-fry collectors are more vulnerable than fishermen)
 - Fishermen increase their risk by collecting other resources from the forest. They should think about taking everything they need with them into the forest and taking nothing but fish out of the forest in order to minimize their time on land.
 - People should stay close together when walking through the forest, in groups of four or more when possible
 - They must take care of the older and weaker members of the group and always keep them well in the protection of the group, the strongest and fittest members being on the outside (back and front when traveling in a line)
 - People over the age of 45 are especially vulnerable and should consider going to safer areas of the forest
 - They need to be extra vigilant in dense forest types, particularly those with a high percentage of goran, as many attacks occur there
 - It is advisable not to run when suddenly faced with a tiger. Instead hold your ground, clapping or holding your hands above your head (this makes a person look bigger) and show your strength by shouting loudly at it. Never approach the tiger.
 - Always carry a thick-wooded stick in the forest, which can be wielded as a club (this should be permitted by the Forest Department)
- ξ No tourists should be allowed to go to compartments 48, 47, 35, 49, 40, 53, 55, 51B, 36, 46, 37, 51A, 19, 8, 50B, and 41 for jungle walks or other activities which require them to go on foot through these areas.
- ξ Experiments can be tried with measures such as those that have been used in the Indian Sundarbans which have had some degree of success at reducing tiger attacks, especially the use of facial masks worn on the back of the head. As it was reported that most people are attacked from behind there is a chance that if the resource extractors can be convinced to wear them at all times when on land this measure could reduce the number of attacks. Communication should be established between the Forest Department of Bangladesh and that of India to learn how they implemented such measures.
- ξ "Tiger Conservation Committees" based on volunteers who patrol at night together with the Forest Department, as proposed by Gani (2002), could also be established in other village areas, besides Dangmari and Kotakhali, where the human-tiger conflict is particularly high, such as around Buri

Goalini and Munshiganj in Shyamnagar. These "committees" should be especially active in the rainy season when more tigers seem to be inclined to enter villages.

- ξ The Forest Department needs a number of specialized "tiger units" consisting of forest personnel trained in using dart guns, immobilization of tigers and related veterinary skills. These "tiger units" should be stationed at key areas such as Buri Goalini and Chandpai range offices where they can quickly react to cases when a tiger has been reported in a village, before people take matters in their own hands. These foresters will then be "on call" 24 hours, should a tiger be seen in any of the villages bordering the Sundarbans. After a successful capture of a tiger it should then be tagged and brought back to the forest opposite the village. The committees and forest department should then intensify their patrols over the next few weeks. If the tiger is again found in a village it should be tagged for a second time and relocated far away from the village boundary. At the same time a policy needs to be developed on what to do with problem tigers that keep re-entering villages (more than twice). Should they be relocated further away from village areas or put in zoos, in order to decrease the number of such incidents?
- ξ Compensation should be given to the people that have been affected by tigers entering villages as in such cases the tiger has entered their home instead of the other way around which can cause a great deal of resentment against not only the tiger, but also the Forest Department (see chapter 6.3 for the recommended compensation levels).
- ξ For resource extractors going into the forest the Forest Department can consider setting up a voluntary insurance policy. Each time a resource extractor goes into the forest he could decide if he wants to buy the insurance. If he buys the insurance and is attacked on that trip he or his family would receive compensation from the Forest Department (at levels equivalent to those given to villagers, see chapter 6.3). If he does not buy the insurance no compensation will be given.
- ξ The government can set up a trust fund to which also international governments and organizations can donate money. National and international NGO's should then be called upon to provide assistance to the families of tiger victims through this trust fund. Most of these families have lost their main income earner as a consequence of the attack, many having become women headed households that suddenly find themselves belonging to the poorest of the poor.
- ξ As a high dependency of a large population on forest resources is a leading factor determining the scale of the conflict between people and tigers a number of long-term strategies should be eventually developed to prevent further escalation of the number of people entering the Sundarbans. The Forest Department should take a more conservationist approach and set limits to the total number of resource users allowed access to the Sundarbans and effectively enforce these restrictions. Such measures will not only benefit the tiger but the whole Sundarbans ecosystem in general.

ξ Further data is needed on the distribution of people in the Sundarbans over time as well as the distribution of tigers and prey species such as spotted deer and wild boar. If this data is collected in the near future it can be analysed in comparison with the findings from this study in order to determine the causal factors behind the spatial variation in the number of tiger attacks in the Sundarbans.

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ANNEXURE

Summary Tables

Table 1. Residence of tiger attack victim

Bagerhat: 22 victims

Upazila	Union	Village	Total
Morrelganj (13)	Baraikhali (1)	East baraikhali	1
	Dhibagnyanhati (2)	Gabgasia	2
	Khuolia (2)	Khuolia Babuana	1
		Purba Khuolia	1
	Nishanbaria (7)	Gulisakhali	5
		Rurba Amurbunia	2
Putikhali (1)	Sonakhali	1	
Sharankhola (8)	Dhansagar (1)	Rajapur	1
	Khontakata (2)	Madha Khontakata	1
		Purba Khontaka	1
	Raenda (1)	North Tafalbari	1
	Dakshinkhali (4)	Middle sonatala	1
		Dakshinkhali	2
Bogi		1	
Mongla (1)	Mongla (1)	Madrassa Road	1

Khulna: 53 victims

Upazila	Union	Village	Total
Paikgacha (25)	Chandkhali (15)	Dhamrail	7
		Fatepur	2
		Dhemsakhali	1
		Chak Kaoali	1
		Kaoali	2
		Kekaouali	2
	Godaipur (1)	Boalia	1
	Goroikhali (2)	Fakirabad	1
		Goroikhali	1
	Lata (3)	Komlapur	2
		Gadardanga	1
	Deluti (4)	Madhukhali	4
	Koyra (23)	Dakshin Bedkati (1)	Jorshig
Koyra (17)		2 Koyra	2
		4 Koyra	7
		5 Koyra	2
		6 Koyra	2
		Fultala	1
		Madinar Abad	1
		Muslim Para	1
		Uttar Madinar Abad	1
		Maharajpur (3)	Maharajpur
Uttar Bedkati (2)		Pathorghata	1
		Uttar Betkashi	1
Dacop (5)		Baniashanta (2)	Dangmari
	Uttar Baniashanta		1
	Sutarkhali (3)	Nalian	2
		Kalabogi Sutarkhali	1

Shatkhira: 106 victims

Upazila	Union	Village	Total
Assasuni (10)	Anulia (1)	Maniour	1
	Khajra (2)	Khaira	1
		Rautara	1
	Pratapnagar (7)	Sriour	3
		Chackla Telikhali	2
		Kurikahania	2
		Noabeki	2
Syhamnagar (96)	Atlia	Soto Kulot	2
		Soto Kupat	1
		Dathnevkhal	3
	Buri Goalini	Pankhali	1
		Pankhlichandiour	1
		Chakoara	3
	Gabura (24)	Horis Khali	1
		Parsemari	1
		Paishabari	1
		Shora	6
		Chakraba	2
		Chandimukhi	4
		Dumuria	2
		Gabura	1
		Khalishabunia	3
		Soto Gabura	1
		Dumghat	1
	Ishwaripur (2)	Kovratoli	1
		Kashimari	1
	Kashimari (4)	Bashimari	2
		Gangmati	1
		Jovakhali	7
	Koikhali (24)	Kathamari	1
		Koikhali	6
		Parchim Koikhali	1
		Poranpur	2
		Rurba Koikhali	4
		Shahebkhal	2
		Boiskhal	1
		Atirupar	1
	Munshiganj (19)	Dhakhinkodomtala	1
		Harinagar	4
		Jotindro Nagar	3
		Moikhali	1
		Munshiganj	7
		Atirupar	1
		Shinchartali	1
		Padmapukur	4
	Padmapukur (5)	Pakhimara	1
		Kalinchi	1
	Ramzannagar (7)	Mora	1
		Ramzannagar	2
		Shora	1
		Kalike	1
		Tangrakhali	1

Table 2. Villages where tiger attacks occurred during the study period

Zilla	Upazila	Union	Village	Total
Satkhira (3)	Shyamnagar (3)	Buri Goalini (2)	Nildumur	1
			Dathneykhali	1
		Munshiganj (1)	Monshiganj	1
Khulna (3)	Dacop (3)	Baniasanta (3)	Baniasanta	1
			Dangmari	2
Bagerhat (5)	Mongla (4)	Chila (2)	Dhakhin chila	1
			Holdibunia	1
		Sunderban (2)	Korma katakhali	2
	Morrelganj (1)	Nishanbaria (1)	Amur Bunia	1

Table 3. List of activities of victim at the time of attack as reported by witnesses

Activity of the victim at the time of attack	Frequency	Activity of the victim at the time of attack	Frequency
Brushing his teeth	1	Making a karu for honey hunting	3
Carrying honey	1	Pulling net	17
Carrying wood	1	Pushing the boat	1
Carrying fire wood	1	Rescuing another tiger victim	1
Catching fish	24	Searching for his cow	2
Chopping fire wood	3	Setting the net	1
Cleaning the net	1	Sitting on boat	2
Cutting wood	39	Sorting shrimp fry	1
Cutting fire wood	16	Standing in the forest	2
Cutting garan	24	Standing by the side of the river	1
Cutting golpata	6	Standing next to boat	2
Cutting hetal	2	Taking honey	8
Eating	1	Taking rest after cutting wood	1
Finding his friend	1	Thatching the boat	1
Going to forest	1	Tying the boat	1
Going to boat	2	Untying net	1
Going home	1	Walking through forest	1
Going to a field	1	Walking through forest for taking honey	1
Going to toilet	3	Washing hands and legs	1
Guarding the wood	1	Washing leg after work on boat	1

Table 4. Attacks by range and compartment

Range	Compartment	Land Area (km ²)	No. of attacks	Attacks / km ²
Sharankhola	8	138 069	8	0.058
	12B	36 202	1	0.028
	3	57 814	1	0.017
	6	79 398	1	0.013
	1	107 883	1	0.009
	5	51 618	0	0
	24	53 324	0	0
	2	55 589	0	0
	11	56 611	0	0
	4	65 229	0	0
Chandpai	45	106 466	0	0
	7	115 027	0	0
	31	64 429	2	0.031
	23	38 221	1	0.026
	14	43 061	1	0.023
	9	132 297	3	0.023
	25	45 84	1	0.022
	22	48 327	1	0.021
	12A	21 425	0	0
	26	38 265	0	0
	27	40 775	0	0
	28	42 405	0	0
	29	44 269	0	0
	21	46 472	0	0
Khulna	30	52 322	0	0
	13	55 594	0	0
	15	55 753	0	0
	10	60 496	0	0
	35	65 795	11	0.167
	40	40 839	5	0.122
	36	72 247	6	0.083
	37	58 056	4	0.069
	19	79 357	5	0.063
	20	79 063	3	0.038
	33	53 344	2	0.037
	39	61 516	1	0.016
	18	126 773	2	0.016
	38	63 504	1	0.016
	Satkhira	43	111 482	1
34		47 851	0	0
32		55 459	0	0
16		62 818	0	0
17		76 933	0	0
44		89 461	0	0
48		80 62	18	0.223
47		104 026	19	0.183
49		115 483	17	0.147
53		82 579	10	0.121
55		160 385	17	0.106
51B		60 748	6	0.099
46		111 31	8	0.072
51A		60 4	4	0.066
50B	34 6	2	0.058	
41	71 374	4	0.056	
42	71 679	2	0.028	
52	117 728	2	0.017	
54	124 712	2	0.016	
50A	19 012	0	0	

PART 2: WILDLIFE HUNTING

1. INTRODUCTION

The Sundarbans of Bangladesh, comprising the reserved forest and wildlife sanctuaries, covers an area of 6017 km², out of which approximately two-thirds is land and the rest is water. Tidal forces push the large volumes of water being brought down the delta by rivers, such as the Raimangal, Shibsha, Passur and Baleswar, back, spreading it across the land, and dividing the land of the Sundarbans into a formation of tiny islands, separated from each other by creeks and rivers. These conditions create a rare ecosystem in which even the terrestrial fauna and flora has adapted to a semi-aquatic and saline environment. Though the variety of terrestrial animals that can be found in the Sundarbans at present is low compared to other tropical forests, the mix of land and water together still supports a rich biodiversity. Due to alluvial depositions and its major importance as a spawning ground for fish, the Sundarbans also has a very high productivity.

In the past there was a far greater variety of wildlife than there is today. Both Indian and Javan Rhinos could be found in and around the Sundarbans, as well as Leopard, Wild Buffalo, Hog Deer, Swamp Deer, Gharial, and the Fresh-water Crocodile. Hunting in the pre-independence days was largely condoned. The high levels of hunting practiced in those days were not sustainable however and it is believed that over-hunting was the main cause for the extinction of these species from the Sundarbans (Kran, 2003).

The largest species of mammals that have survived up till now and can still be found in the Sundarbans are the Bengal Tiger (*Panthera tigris*), Spotted Deer (*Axis axis*), Barking Deer (*Muntiacus muntjac*), Wild Boar (*Sus scrofa*), Rhesus Macaque (*Macaca mulatta*), Smooth-coated Otter (*Lutra perspicillata*), and Oriental Small-clawed Otter (*Aonyx cinerea*) (Gurung and Singh, 1996). Several species of dolphins are also found in the larger rivers and the Bay of Bengal, such as the Ganges River Dolphin (*Platanista gangetica*), Irrawaddy Dolphin (*Orcaella brevirostris*) and Indo-Pacific Humpback Dolphin (*Scusa chinensis*) (Deodatus, 2003). Furthermore the Estuarine Crocodile (*Crocodylus porosus*) still occurs, yet at population levels far below the potential (Deodatus, 2003). Three species of monitor lizard: the Bengal- (*Varanus bengalensis*), the Yellow- (*Varanus flavescens*), and the Ring Monitor Lizard (*Varanus salvator*) and a variety of other species of reptiles and amphibians exist in the Sundarbans.

Of the species named above, only two are not threatened, three are vulnerable, five are endangered, and the Irrawaddy Dolphin, Bengal Tiger, and Estuarine Crocodile are critically endangered in Bangladesh (IUCN, 2002). The Yellow Monitor Lizard is in fact the second most endangered species of monitor lizard in the world, after the Komodo Dragon (Bennett, 2003). Though the Bangladesh Wildlife Act of 1974 has made hunting of the before mentioned species illegal, hunting at present is still a major threat to wildlife populations in the Sundarbans. By examining newspaper reports and talking to people knowledgeable about the Sundarbans it can be easily understood that hunting practices are still being carried out at a large scale. However, no study has as yet attempted to quantify hunting intensity in the Bangladesh Sundarbans, so that the scale of this threat to species populations is still unclear.

This study is a baseline study on hunting in the Sundarbans. It aims to provide an initial glimpse in to the underground world of hunting and wildlife trade for species originating from the Sundarbans. The study also attempts to quantify the number of professional hunters active in the Sundarbans and their offtake levels for the different species they hunt. Based on the results a number of practical recommendations are made, to the Forest Department in particular, yet appealing to all concerned.

The study goals are to:

- ξ Assess the number of people who have made the hunting of wildlife from the Sundarbans a profession
- ξ Give a general description of the hunters and their profession
- ξ Provide information on hunting effort and catch rates for the different species which, when combined with population estimates can be used to recommend species-specific management strategies
- ξ Provide information on the status of the trade for all wildlife products from the Sundarbans

2. METHODOLOGY

Essentially research into human-wildlife interaction in and around the Sundarbans entails two very different topics, namely: attacks on humans by wild animals (see part 1 on wildlife conflicts), and the hunting of wildlife by humans. Where there was opportunity to carry out activities on both topics together this was done. In fact combining the two was often very helpful as data collectors were able to subsequently touch on the more sensitive issue of hunting with many of the people they had previously been discussing the more approachable topic of tiger attacks with. This chapter sets out the methodology used as relevant to the study on hunting in the Sundarbans.

2.1. Activities and approaches of the study

2.1.1. Contact with Forest Department and other sources - Review secondary data

The team first made contact with the forest department and people knowledgeable on hunting practices in the Sundarbans, and reviewed published data. The objective of this activity was to find the information and data that already exists on wildlife hunting and trade in relation to the SRF. Records on wildlife confiscations and the arrests of poachers were collected. Secondary sources of information for the study include newspaper clippings, forest department's records, SBCP NGO household surveys, Sushilan, Unnayan Prochesta, Shangkolpo, staff members from Jahangir Nagar University and from Bengal Tours.

2.1.2. Field reconnaissance

The field reconnaissance survey took place over a period of one and a half months while the study team went from village to village for the study on wildlife conflicts (see part 1 of the human-wildlife interaction study). The field reconnaissance was conducted for some important reasons. Since, the study problem is a new one, it was necessary to first visit the potential study areas and assess the situation before delineating the final study area and conducting fieldwork. The team identified the constraints and threats regarding interviewing the hunters and traders, and accordingly devised the best possible ways to approach the fieldwork. The SBCP Impact Zone was split into 10 sub-zones for conducting the reconnaissance work. Preliminary assessments of the (informal) markets for wildlife products were carried out. Through the reconnaissance survey, the study team identified hunters and key informants (traders, local leaders, different forest users). The team approached local people and used the Social Webbing Technique for an initial identification of the hunters (see Annex 2: "Data collection tools and their application", for an explanation about social webbing and other social survey techniques used in this study).

During the beginning of the reconnaissance survey suitable candidates for becoming a data collector were identified. Each data collector was then made responsible for two upazilas (sub districts). All data collectors chosen had completed their higher secondary school and had a good reputation for social networking skills in their locality. A total of 10 data collectors were recruited covering the upazilas: Shyamnagar, Assasuni, Kaliganj, Morrelganj, Sharankhola, Koyra, Paikgacha, Rampal, Mongla, Dacope, Batiagata, Matbaria, Pathorgata, Borguna Sadar, Betagi, and Bamna. After recruitment they immediately started assisting the study team by conducting interviews with victims of wildlife attacks and by intensively searching for hunters in the upazilas they were responsible for. Four permanent staff members of JJS were assigned the role of research officer (for each of the following districts: Shatkhira, Khulna, Bagerhat and Pirojpur/Borguna) whereby it was their responsibility to monitor the progress of the data collectors and to verify the accuracy of the data as well as assisting them in the identification of hunters.

2.1.3. Orientation and training of data collectors

Having recruited field crew for data collection, a two-day training on research questions and fieldwork techniques was organized for the team of 4 research officers and 8 data collectors. The Team Leader and Study Coordinator conducted the training to familiarize the field team with the methods and tools, including rapport building skills and analytical tools.

2.1.4. Contact with hunters

In the first two months, by using the social webbing technique, and by making personal contacts the study team established contact with the hunters.

2.1.5. Data collection on hunting and trade

In the last month research focused on holding questionnaire interviews with hunters, traders, and tanners, but data was also collected from community people as well as forest users, and forest department personnel. Prices of alternative animal protein sources, such as beef and mutton were collected from the same areas where hunters lived to compare with the price of deer meat. Shopkeepers and traders in the end markets of wildlife products have also been sources of primary information for the study. All professional and semi-professional hunters identified by the data collectors were approached for individual interviews. A sample of former and amateur hunters that had been identified during the reconnaissance survey were similarly interviewed. Topics for data collection on hunting and wildlife trade included (a) distribution of hunters for whom hunting is a major form of employment; (b) hunting offtake for wildlife; (c) seasonal trends in hunting; (d) main areas used for hunting per species; (e) various wildlife products obtained per species; (f) amount of wildlife product produced per animal; (g) market chain linkages; and (h) data on locations of local and regional (e.g. Dhaka) markets, including main buyers and bazaar areas.

2.1.6. Monitoring of the Data Collection Process

10% of questionnaires were randomly selected for each data collector and verified by a repeat interview with the respective hunters. These interviews were held by the research officers and the data collectors together often accompanied by the study coordinator and/or a member of SBCP.

2.2. Study population

The study population were primarily hunters, former hunters, forest users, forest department personnel, community people, traders (of animal and other protein sources), and local leaders. During the reconnaissance survey the study team identified 318 hunters. These hunters were classified into groups according to their present activity as a hunter. Hunters were classified as professional if hunting was their major source of income, semi-professional if it was their secondary or tertiary profession, amateur if they did not hunt for a living, and former if they had hunted in the past, but were not hunting anymore. All semi-professional (52) and professional (80) hunters within the list were selected as study population. In order to obtain further information 19 former hunters and 28 amateur hunters were also selected. A total of 179 hunters comprising of former, amateur, professional and semi-professional hunters were the study population.

In addition, 12 wildlife traders, 20 community people as well as forest users, 3 forest department personnel, and 6 traders of animal and protein sources were interviewed. Information was also collected from shopkeepers and traders at the end markets of wildlife products such as skins and horns.

2.3. Final study area

During the reconnaissance survey, hunters were found in Shyamnagar, and Assasuni Upazila of Shatkhira district; Koyra, Paikgacha, Dacope, and Batiagata, Upazila of Khulna district; Morrelganj, Sharankhola, Rampal, Mongla, of Bagerhat district; and Pathorgata in Borguna district (see Figure 1).

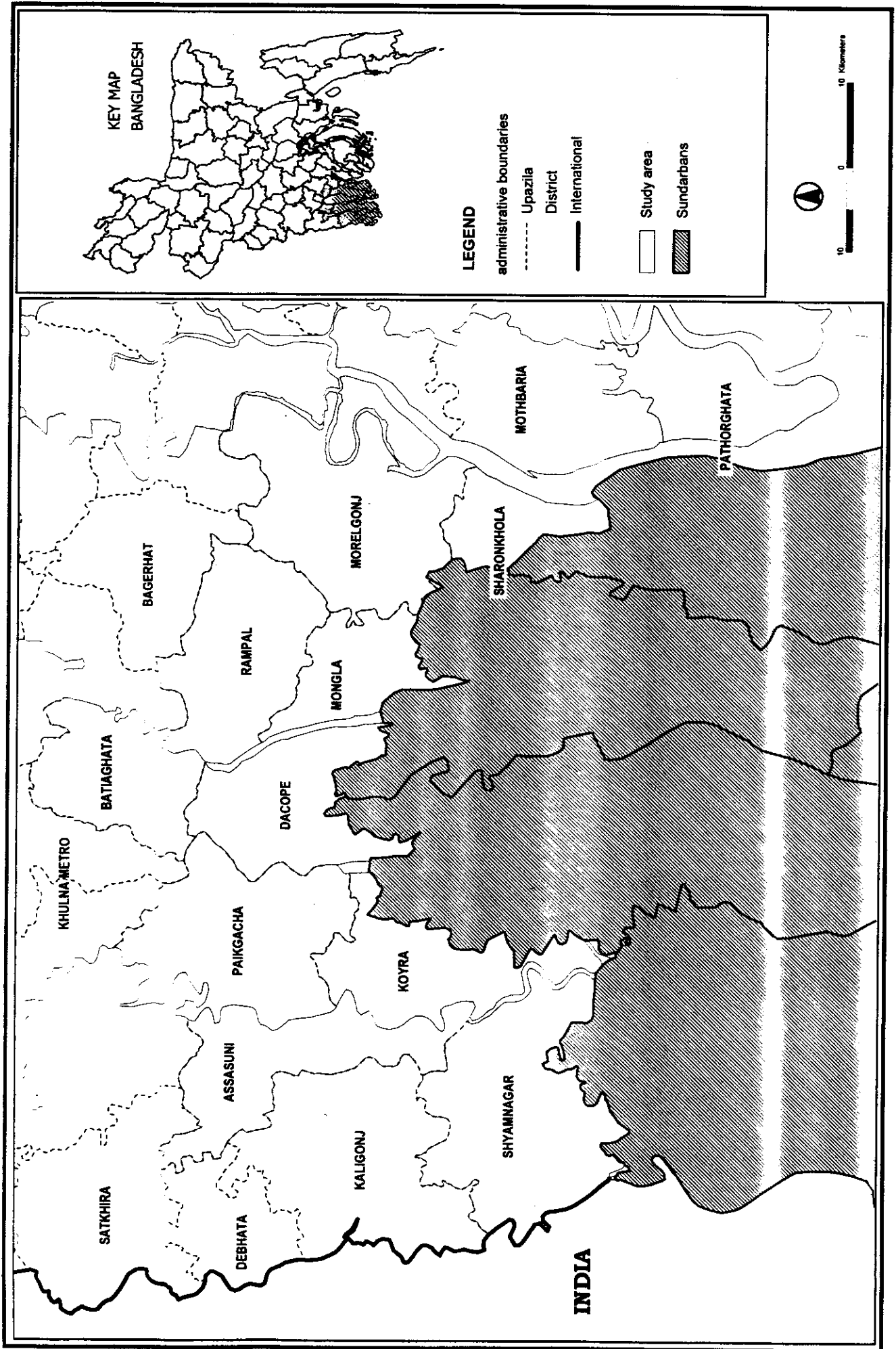
The final study area for conducting interviews was selected on the basis of the distribution of professional and semi-professional hunters. Amateur hunters do not have to come from areas near the Sundarbans and therefore this study does not attempt to identify all these hunters. Interviews were still conducted with samples of both former and amateur hunters in order to compare their methods with that of professional and semi-professionals.

In view of the above-mentioned criteria, the upazilas: Shyamnagar of Shatkhira district; Koyra, Paikgacha, Dacope of Khulna district; Sharankhola, Rampal, and Mongla, of Bagerhat district; and Pathorgata in Borguna district, became the study area for identifying those hunters for whom this practice currently is a form of employment (see Figure 1. Map of study area for wildlife hunting)

Although a number of hunters were found in Amtali, Assasuni, Batiagata, Bamna, Borguna Sadar, Debhata, Khulna City, Matbaria, Rayenda, and Shatkhira Sadar these upazilas were not considered as the final study area for holding interviews as no professional or semi-professional hunters were found in these areas.

Although initially the study concentrated on the areas close to the Sundarbans, where hunters were found, the study later followed the market chain of wildlife product to other places. Accordingly, the study area also covered Uttara, Gulshan, Sonargon and Sheraton Hotel areas, Hazaribag, Dhanmandi, New market, Elephant Road of Dhaka city, Shatkhira Sadar, Bagerhat Sadar, and Khulna city.

Figure 01: Study area for wildlife hunting



3. SPECIES HUNTED IN THE SUNDARBANS

179 out of the total 181 hunters interviewed targeted spotted deer. 2 hunters were interviewed that target crocodiles and they both belonged to the same and only existing group of crocodile hunters (see chapter 4).

The crocodile hunters did not hunt anything other than crocodiles. Most of the hunters of Spotted deer do not hunt any other species either, but in the study it was found that about 51 hunters or about 30% would also hunt non-target species if the opportunity arises (see table 1 below).

Table 1. Hunting of non-target species by deer hunters

Type of hunter	Hunt non-target species?	
	Yes	No
Amateur	12	16
Professional	21	61
Semi-professional	14	38
Former	4	10
<i>Total</i>	<i>51</i>	<i>125</i>

[Note: There are five "no" response entries]

Of the different groups, amateurs were relatively more inclined to hunt other species than Spotted deer on their hunting forays. For the professional groups and even former hunters the ratios are quite similar, with most hunters only targeting the spotted deer.

The most popular non-target species was jungle fowl (table 2). However, other birds, tiger, wild boar, turtles, and monkey were also non-target species. In the end markets large quantities of snake and lizard skin products were found. Through deer hunters it was found that other groups hunt monitor lizards in the Sundarbans (see table 3). There was no evidence however of any hunters targeting snakes from the Sundarbans for the wildlife trade.

Table 2. Number of hunters that say they will also hunt indicated species

Species	Type of hunter				Total
	Amateur	Professional	Semi-professional	Former	
Jungle Fowl	10	17	11	2	40
Birds	3	6	8	3	20
Tiger	1	3		1	5
Wild Boar	1		3	1	5
Monkey	1		3		4
Turtles		1	1		2

[Note: This is a multiple response analysis. 51 hunters out of 181 gave multiple responses on the non-target species they hunt and there was scope for mentioning the name of 3 species]

In a similar exercise hunters were asked if they knew of the different species hunted in the Sundarbans by other people (see table 3). Most hunters mentioned that tigers are hunted, but also otters and monitor lizards were mentioned. It is believed that all tigers are hunted by the deer hunters themselves, yet only 4 active hunters mentioned that the tiger is a non-target species (table 2). Some fishermen from Shyamnagar and Koyra capture otters from time to time in order to rear and train them for a special fishing technique, which is only practiced in the Sundarbans. This practice is condoned by the authorities, as it has a long tradition and by itself should not have a significant impact on otter populations in the Sundarbans. However, it was heard that there is also a trade in otter skins, but no hunters were found that admit to hunting otters. Deer hunters also mentioned that some groups of fishermen and crab-collectors, from Dangmari, Baniashanta, and Sutarkhali hunt monitor lizards. They then sell the skins at a very low price and use the meat of the lizards as bait. However, this study was unable to find people who acknowledged that they hunted any monitor lizards.

The deer hunters themselves also named other groups of people that are involved in hunting. Of these groups the only ones not covered in this study were dacoits (bandits), tribal people, and hunters that cross the border from India. The tribal people that live near the Sundarbans can be found in Shyamnagar and Koyra upazilas. They are people from the Munda tribe. The Mundas target wild boar, but also sometimes hunt other species such as Spotted deer. They are very few in number and only hunt for their own subsistence.

Table 3. Species hunted in the Sundarbans other than those the hunters target themselves (this table does not give any indication of hunting pressure)

Species hunted in the Sundarbans	Frequency of response
Tiger	89
Jungle Fowl	62
Wild Boar	56
Otter	40
Monkey	38
Monitor Lizards	37
Birds	35
Crocodile	25
Turtles	23
Deer (mentioned by crocodile hunters)	2

[Note: This is a multiple response analysis. 78 hunters gave multiple responses and there was scope for mentioning the names of 5 other species.]

4. CROCODILE HUNTERS AND THEIR HUNTING METHODS

In the study, the team actually interviewed two crocodile hunters, both of them hunt in the same group together. In fact there seems to be only one group of crocodile hunters. They are professional hunters from Sharonkhola upazila in Bagerhat district. Sometimes, fishermen catch juvenile crocodiles in the fishing net, which they then proceed to sell, but they do not actually target these crocodiles. The two hunters that were found in Sharonkhola are from two families that hunt the crocodile together. There are eight hunters in the two families. They have a long tradition in crocodile hunting whereby the skills are transferred from generation to generation. The sons are taught the ways to hunt crocodile from the age of fourteen. This is the main income of these families. One family has lost its most skilled and elderly hunter and no good suitable male members are available to continue the profession. Even though their son is still only eleven years old he now has to take over the job that was his fathers.

The hunters usually hunt throughout the year but in their opinion, winter is the best time for hunting crocodiles. The hunters usually hunt at night, roaming the khals with their torchlights. When they spot a crocodile 3 or 4 hunters with very sharp pointed spears will attack the crocodile simultaneously. The first point they go for is just beneath the base of the head. They catch the juvenile crocodiles by using strong nylon fishing nets. Sometimes they will also use a gun for hunting crocodiles, targetting the head and chest. This happens during the daytime yet is not commonly done.

The usual places where they hunt crocodile are the Shapla, Shiala, Dora, and Bhadra rivers, Also Andarmanik, Harbaria and its closest rivers and cannels are used. They will stay in the forest for around nine days. In their last three trips they caught an average of 2.7 crocodiles, varying between 1-4 crocodiles per trip.

5. DEER HUNTERS

Nearly all hunters that were found and interviewed fell in to this category (99%). Of these hunters 80 were classified as professional (hunting as major profession) and 52 as semi-professional (hunting as secondary or tertiary profession). In addition 28 amateur and 19 former hunters were interviewed. This section concentrates on the professional and semi-professional groups as being the most important to provide information on, yet draws comparisons with amateur and former hunters where relevant.

5.1. Spatial distribution of hunters

In terms of geographical location of professional and semi-professional hunters, of the 132, 50 reside in Khulna district, 32 in Bagerhat, 28 in Shatkira, and 25 live in Borguna district. Within the 50 hunters who reside in Khulna district, 19 hunters live in Paikgacha, 17 in Koyra and 14 in Dacope. Among the 32 hunters from Bagerhat, 17 are from Sharonkhola, 8 from Mongla and 7 are from Rampal. In Borguna district all hunters are concentrated in Pathorghata (22). Such concentrations of hunters were also found in Shatkira where all 28 hunters are from Shyamnagar upazila (see figure 2 and figure 3).

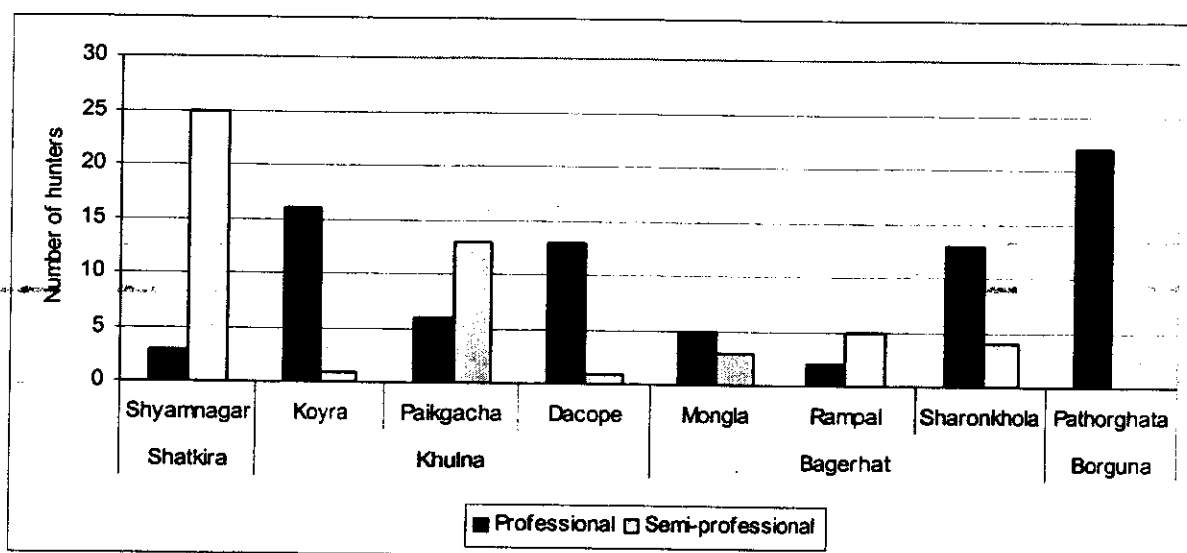


Figure 2. Distribution of professional and semi-professional hunters by their resident upazila (top) and district (bottom).

From figure 2 it can be seen that in Shyamnagar a high number of semi-professionals were found, while Pathorghata has no semi-professionals, but many professional hunters. It therefore seems that in some places there is a tendency for hunters to be either mostly professional or semi-professional. The hunters are also very localized, with certain areas containing many hunters and others with none (see figure 3). This is probably due to the influence of family, friends and neighbours (see also table 4). People are influenced by others, and it is likely that, as hunting has been practiced for a very long time in the Sundarbans, hunting has become a localized profession due to knowledge transfer and the

bonds between people in these areas. It is likely that the choice in making hunting a main occupation or not also has to do with other factors such as alternative economic opportunities.

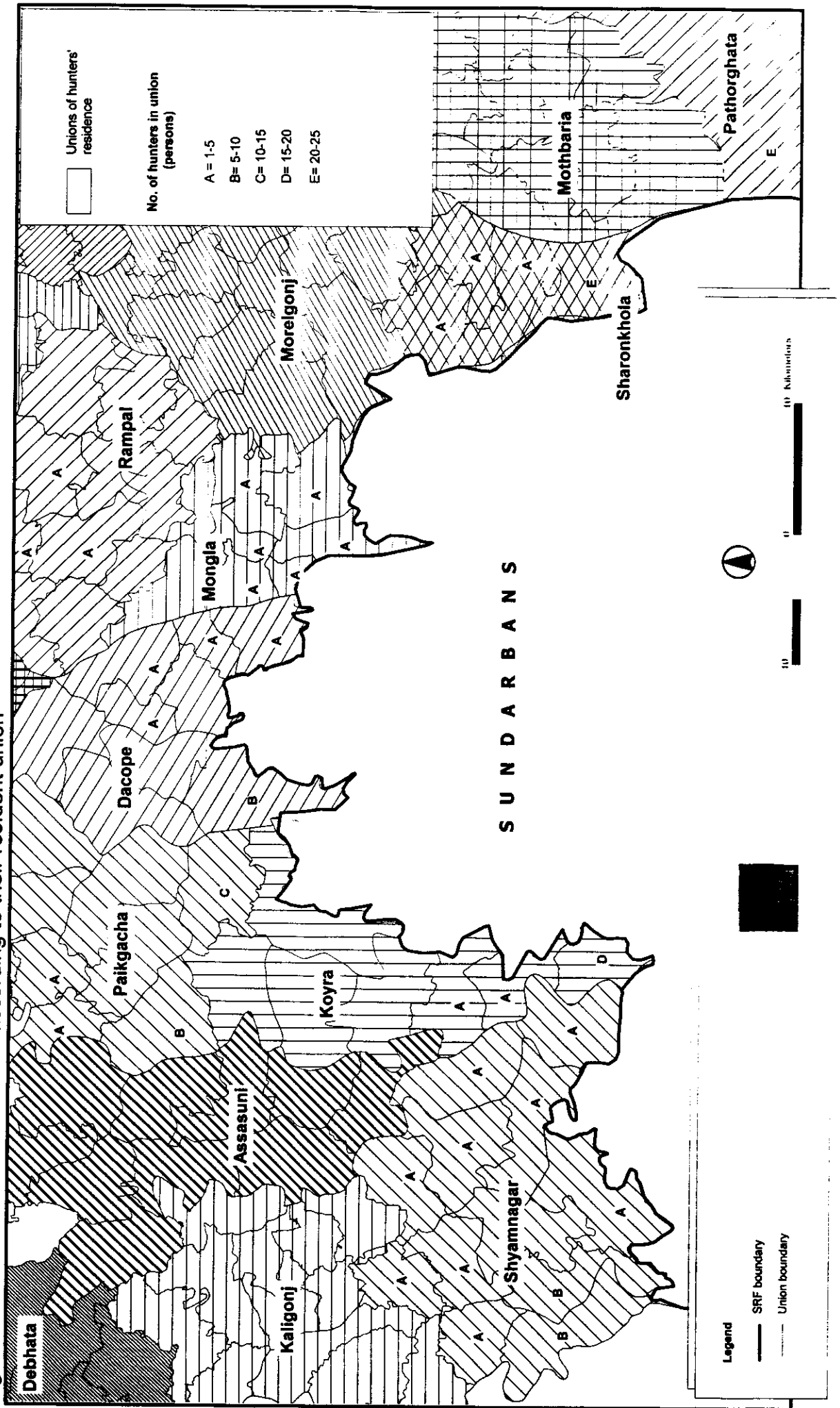
Major concentrations of hunters are found in Pathorgata, Paikgacha, Koyra, Dacope, Shyamnagar, Sharankhola, Mongla upazila in the Impact Zone. Within the upazilas most hunters come from: Garaikhali, Kumkhali, Shanta, and Chandkhali in Paikgacha; Dakin Bedkashi, Uttar Bedkashi, and Maharajpur in Koyra; Ganpara, Charduan in Pathorgata; Tafalbaria, Rajapur in Sharankhola; Chila, Sundarban, in Mongla; Baniakhali, Nalian, and Sutarkhali in Dacope; Koikhali, Atlia, Padmapukur, and Burigoalini in Shyamnagar (see *Figure 3. Distribution of deer hunters according to their resident union*).

The largest part of amateur hunting is done in the time of the "rash mela", a festival of Hindu origin that has become rooted in the culture of all Bengalis. During this time large numbers of tourists visit the Sundarbans and for some it is a tradition to eat deer meat. For this they usually contact a professional hunter to supply them the meat or to accompany them on a hunting trip. The other group of amateurs that can be distinguished are more intensive hunters that will go to the Sundarbans throughout the year. These hunters are likely to be concentrated in areas in close proximity to the Sundarbans as the habit to go hunting is based on an increased opportunity to do so. From interviews with a sample of this group it was found that these amateurs target deer, yet as table 1 shows, 75% of them were also inclined to hunt non-target species on their hunting forays.

5.2. Socio-economic background of hunters

Deer hunters come from diversified socio-economic backgrounds. First, in terms of age distribution, it is found that the age range starts from 22 till above the age of 75. Looking at the ages of professionals and semi-professionals a concentration of hunters is visible within the age range of 40 to 49 (see figure 4). There are also more hunters with ages over 50 than there are hunters under 40. Thus it can be said that professional hunting is done relatively more by people from the older age groups. There were no amateur hunters below the age of thirty. Again most amateurs belonged to the age group of 40-49, yet unlike for the professionals the number of hunters over 50 and the number of hunters under 40 are nearly the same.

Figure 3. Distribution of deer hunters according to their resident union



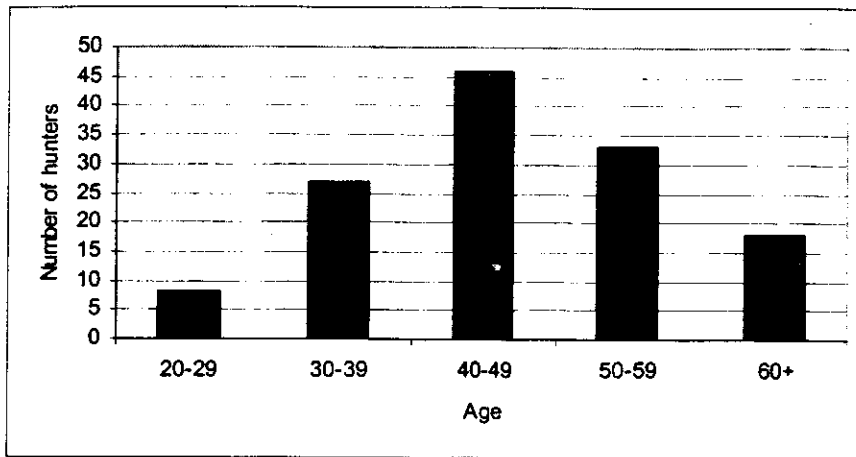


Figure 4. Number of hunters according to age group (professional and semi-professionals only)

In terms of family size, professional and semi-professional hunters had an average family size of around 6, while amateurs around 5. The ratio of working to non-working members was fairly similar for all groups, being about 1:2.5. Education wise professional hunters were the worst off as 21% had received no education, a further 49% had only primary education and just another 21% had gone to secondary school. In the semi-professional group 15% had no education, 33% primary, yet 48% had gone to SSC. All amateur hunters had received some form of education with 21% up to primary school, 54% class 6 to SSC, and 18% had even gone on to HSC level.

When it was asked why they started hunting, 33% of professional hunters said they became hunters due to poverty, while only 6% of semi-professionals gave this as reason (see table 4 below). Other common reasons for becoming a hunter were given as "family tradition", which 32% of professionals and 23% of semi-professionals gave, and "hunting with friends", which 24% of professionals, 45% semi-professionals, and also 80% of amateurs gave. Also it was separately mentioned that it is very easy to take up hunting if you are poor, as it requires very little financial investments.

Table 4. Primary reason for becoming a hunter according to those interviewed

Reason for becoming a hunter	Type of hunter			
	Amateur	Professional	Semi-professional	Former
False case		5	1	
Family tradition	3	23	11	11
First as hobby		1	8	1
Hunting with friends/neighbours	12	17	21	5
Poverty		24	3	
SRF is near the village		1		
Used to hunt while fishing		1	3	
<i>Total</i>	15	72	47	17

With a "false case" as mentioned in table 4, it is meant that the hunter had stopped hunting previously but subsequently he was constantly being harassed by law enforcers threatening to put him in jail and demanding money. They gave a false case and claimed that he has hunted deer recently. Because of

this harassment the former hunter started hunting again as when he hunts he spends a great deal of his time in the forest away from the authorities that seek to harass him and put him in jail (this description is a direct reflection of the statements of the hunters only, but has been identically replicated by a number of different hunters).

The most popular secondary professions of professional hunters were: farming (39%), trading (26%) and fishing (13%). For semi-professionals the most popular major professions were: trading (64%), farming (21%) and fishing (9%). All semi-professionals that had fishing as their major occupation came from Rampal upazila. Especially in Shyamnagar it was found that the semi-professionals were traders by main occupation.

For professionals hunting represents on average about 60% of their total income, while for semi-professionals this is only around 25%. All in all the general situation seems to be that a large part of, but definitely not all, professional hunters have turned to hunting as a means to make a living in otherwise very poor socio-economic conditions. However, another part of the professional group and a large section of the semi-professionals have turned to hunting not because they need to but because it is something they enjoy doing or have been taught to enjoy by family and friends.

An analysis was done on the dynamics of deer hunting as a profession for different upazilas. From table 5 it can be seen that hunting is relatively dynamic in Koyra, Shyamnagar, Sharonkhola and Pathorgata, where a large spread is found in the number of years people have been hunting and the average number of years is quite low. The lowest average was actually found in Rampal where the maximum number of years anyone has been hunting is 15 years, indicating that Rampal is a relatively new area for people to take up hunting. As the minimum number of years as a hunter was 5, it is not clear if the trend is continuing today. Paikgacha, Mongla and Dacope had the highest average number of years that people have been hunting in this area. Here it was noticeable that these upazilas had far more experienced hunters than new recruits, indicating that the deer hunters from these areas mainly started hunting around the time this was still condoned, but that relatively few people are attracted to become hunters at present.

Table 5. Number of years as a hunter (by upazila)

Upazila	Paikgacha	Koyra	Dacope	Shyamnagar	Sharankhola	Rampal	Pathorgata	Mongla
Average	24	19	22	13	10	9	14	26
Min	6	2	12	3	3	5	3	10
Max	40	50	30	50	30	15	50	40

5.3. Perception of hunters on their profession

Hunters have their own perceptions about the existing risks related to their profession. Overall, the biggest threat to hunters is the tiger, followed by the Forest Department and dacoits. Least feared were, the police, snakes, and the coast guard, as hunters are less at risk of running into them (see table below).

Table 6. Risk assessment by type of hunter

Threat	Type of hunter			Total
	Amateur	Professional	Semi-professional	
Tigers	8	52	31	91
Forest dept.	5	23	33	61
Dacoits	11	28	17	56
Police	-	5	6	11
Snakes	3	4	3	10
Coast guard	1	7	1	9

[Note: this table is based on a multiple response question]

The various types of hunters assessed their risks differently. For professionals the forest department did not pose as much a risk as tigers and dacoits. However semi-professionals were of the general opinion that the forest department and tigers were a lot bigger threat to them than dacoits. Amateurs on the other hand fear dacoits the most when they are in the forest, followed by the prospect of an accidental encounter with a tiger.

When asked if they were satisfied with their job 76% of professional hunters and 63% of semi-professionals answered "no". As reason, 88% of professionals and 70% of semi-professionals said they were not happy, because it is a "dishonest job". Another 20% of semi-professionals said that they felt hunting did not provide them enough income. For both groups around 93% wanted to work as a trader (not specifically in the wildlife trade) instead of as a hunter.

Around 90% of hunters expressed a willingness to cooperate with the Forest Department. The hunters mentioned the reciprocal relationships that could be established between them and the Forest Department (table 7). The most popular suggestion was for the FD to employ local people within their ranks. The hunters complain that the FD is not "people-friendly" enough and has no understanding of the needs of local people. Thus they feel that if local people are recruited, the FD will be more cooperative to them. Other respondents said they would stop hunting if the FD asked them to. Around 15% wanted the Forest Department to give permits for hunting. Considering the large number of hunters who had previously expressed their dissatisfaction with hunting only a surprisingly small number of hunters mention that providing alternative jobs could be a way in which the FD and the hunters could help each other. Certain hunters were prepared to provide the FD with information on illegal activities in the Sundarbans.

Table 7. Ways in which the FD and the hunters can cooperate (as expressed by the hunters themselves)

How can you help each other?	Type of hunter		Total
	Professional	Semi-professional	
By employing local people in FD	26	6	32
Stop hunting	7	4	11
Give permission for deer hunting	7	3	10
Alternative job	7		7
Give information of hunting/smuggling	3	1	4
Awareness building	1		1
Stop wood cutting	1		1

6. DEER HUNTING

6.1. Seasons for deer hunting

It can be seen from figure 5 that deer hunting is mostly carried out in the winter months. Figure 5 shows the results of an exercise in which each month was assigned a score, indicating preference for hunting, with a maximum of 12 points and a minimum of 0 points. Different months could carry the same score. From all the hunters the average score given was then calculated for each month. Generally there is a cycle of hunting activity going from the peak in January down to the lowest levels in May-September after which hunting activities increase again. All hunters were combined for this analysis after it was predetermined that there were no large differences in monthly hunting activities for the various hunting groups.

Even amateurs showed the same monthly preferences as the professional groups. Hunters stated that throughout the year wildlife is hunted, but during the winter season, the "Rash Mela" attracts many people to the Sundarbans. The professional groups of hunters and even some of the amateurs are hired by tourists during this period. Deer is the target species, but it has been said that also a lot of jungle fowl is hunted as non-target species.

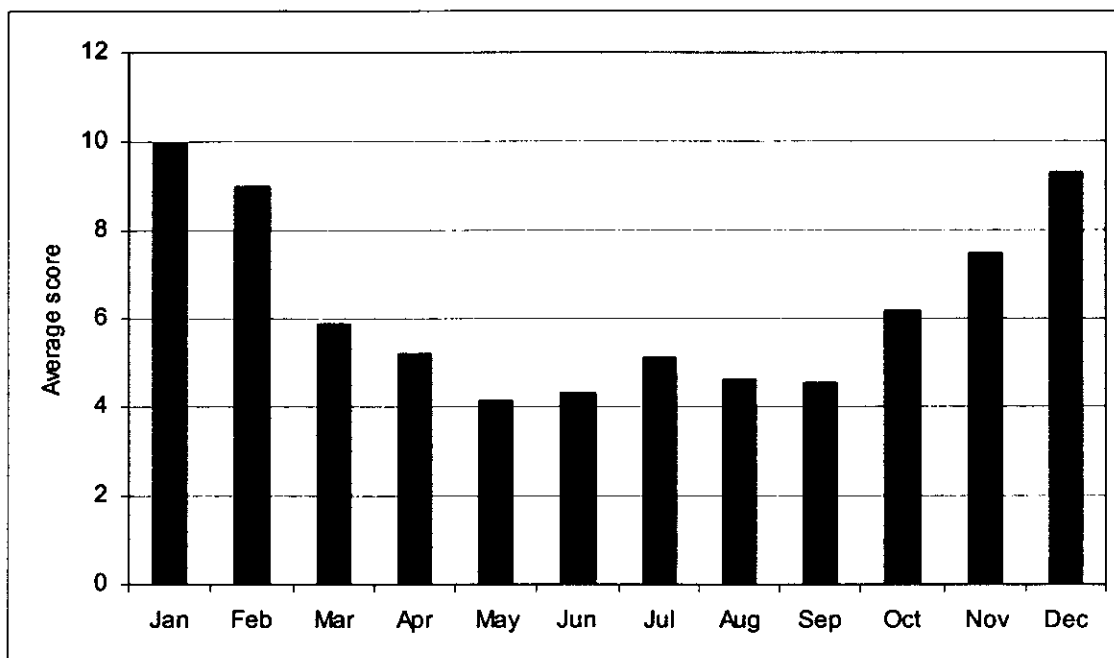


Figure 5. Monthly preferences shown by deer hunters for conducting hunting activities in the Sundarbans

6.2. Position of the Sun and Moon

Hunters hunt both in day- and nighttimes. Their choice seems to depend mostly on the visibility of the moon. Hunting at night with a new moon seemed to be preferred the most. However, if there is no new moon they prefer hunting in the daytime (see table 8).

Table 8. Cross-tabulation of preference for hunting according to the cycles of the moon and the sun

	Full moon	New moon	Both	Total
Day	42	10	1	53
Night	8	68	1	77
Both	4	2	14	20
Total	54	80	16	150

If the level of the river, i.e. high and low tide, is taken into consideration, it is evident that a larger number of hunters prefer to hunt during the high tide. This is likely to be because deer are necessarily congregated in relatively smaller areas as the water intrudes on the land. However, there still are a number of hunters who said they preferred to hunt during low tide or did not have any preference. Proportionately these hunters were mostly semi-professionals.

Table 9. Preference for deer hunting according to tide levels

Tide level	Type of hunter			
	Amateur	Professional	Semi-professional	
High	13	54	20	87
Low	5	17	17	39
Both	2	8	3	13
Total	20	79	40	139

6.3. Hunting techniques

Hunting techniques are changing over time. It was reported that while in the not too distant past only the gun was used, yet now the hunters use a variety of techniques. Roughly there is a relation between the wealth of the hunter and the technique he uses. The poorest hunters prefer to use nylon rope or poison to catch the deer. However, the use of rifles or shotguns was still found to be the most popular method. Hunting with nylon nets and snares has several advantages over hunting with a gun. It is much more silent, whereby the authorities can be avoided better. A second advantage is that more deer can be hunted at a time. It is also the cheapest type of hunting equipment available to a hunter. The last advantage is that it is possible to keep the deer alive. It is popular among hunters, especially from Sharankhola and Pathorghata upazilas, to keep the deer alive as long as possible in a pit near their house, until they have found people interested in purchasing deer meat. To do this they can only hunt with traps and snares. Nowadays, hunters are also putting sleeping pills into bananas (usually for deer), or poison into meat for tigers.

In Shyamnagar the highest number of hunters were found that use a gun for hunting, yet at the same time the highest variety of techniques ranging from gun to nylon nets to poison was found used by hunters from this area. In Pathorghata, Sharonkhola and Rampal, nylon nets and snares are very popular. In Pathorghata hunters nearly exclusively use nylon nets and snares. This is largely due to that hunting in Pathorghata started among poor people who did not have access to guns and the tradition to hunt with nylon nets and snares still remains. It was also observed that in the areas where nylon nets and snares are widely used this is mostly by relatively young hunters, the older people still preferring to use the rifle. Below some of the techniques used by hunters are described.

- ξ One popular technique of hunting with a rifle/shotgun is locally known as "khaluni". The hunter uses a small creek at night during low tide to move through the forest without being readily observed by the deer. A companion shines a very strong torchlight around looking for the deer. Once spotted the torchlight is directed straight at the eyes of the deer, which transfixes them, so that they remain motionless. Hunters claim that they are able to even shoot more than one deer at a time as the deer remain captured in the spotlight and do not flee after the rifle is fired.

- ξ Another common technique is "batal". This is done at high tide. The hunter climbs into a tall Keora tree on the dry land with the purpose of shooting the deer from his elevated position. The Keora tree is chosen, as the deer like to feed on its leaves. The hunters break off some branches and imitate the sound of the monkey to attract the deer.
- ξ The last and simplest method with guns is to just walk through the forest in search of deer. Usually a few hunters do this together.
- ξ Another method of hunting is with nylon nets. The hunters drape a large net over the forest floor in a relatively open area. The hunters then herd the deer towards the net. When the deer walk over the net their hooves get tangled until they are stuck. The hunters can then easily capture them alive. This is an especially common technique with hunters from Pathorghata.
- ξ Also popular is to span a row of snares in between some trees. The hunters then drive the deer towards the snares. The snares are suspended at a height so that the deer, when moving through the trees, will get their heads stuck in the snare, which tightens so that the deer cannot escape.
- ξ Less popular but also sometimes used is a method by which a row of snares is placed on the ground. Each loop is tied loosely together with some hental leaves. For every two loops there is a hunter who will pull the loop tight if a deer walks in to the trap. Unlike the other methods here the hunter sits and waits for the deer to come by.
- ξ Also, sometimes the loops will not be tied together with hunters controlling them, but instead the snare is tied to a flexible but strong young sapling, which is bent and functions like a spring. Under the snare there is a little hole covered with some leaves and with a stick functioning as the trigger mechanism. If the stick is dislodged the snare will spring shut.
- ξ Deer are hunted now a day with some very tricky methods. Some sleeping pills are inserted into a banana and kept in a place where the deer can easily find the banana. After taking the banana, the deer is drugged and the hiding hunter appears to kill it. This technique is especially common under the hunters of Paikgacha, Koyra and Dacope.
- ξ Hunters also will hang a banana along a line that is connected to a hook hidden inside the banana. When a deer comes and eats the banana, it is hooked and as it tries to jerk away the hook is only embedded further into the deer's mouth. Sometimes, poisons are also used together with bananas. If the deer eats the banana it will die.

The methods of tiger hunting were also described by some deer hunters. A description is given below.

- ξ If hunting with a gun, the hunter will try to set up a ambush location along the fresh tracks of a tiger. The hunter climbs into a tree which has a vantage point over the tracks and in the direction he expects the tiger to return.
- ξ Another increasingly popular method is to leave the dead body of an animal, usually a dog, but also cow or goat, in the forest. The body is covered with poison to kill the tiger. This method has the advantage that the skin of the tiger is left fully intact and thus the hunter is able to sell it for a higher price.

6.4. Group Size, Hunting Interval and Trip Duration

Table 10. Average statistics by type of hunter

Type of hunter	Hunting interval for the hunter (in days)	Hunting interval for the hunting groups (in days)	Trip duration (in days)	Group size
Professional	25	22	3	10
Semi-professional	78	55	3	6
Amateur	141	62	2	5

It is found that professional hunters take short intervals of around 25 days between two separate trips. Their groups however go every 22 days on average. The discrepancy between the hunter's interval and that of the group is because hunters do not always join the group that they usually go with into the forest. A group is formed by a number of different hunters who know each other well, and often, but not always accompany each other to the forest. Semi-professional hunters take comparatively longer intervals (around 78 days and 55 for the group), while amateur hunters take the longest interval (141 days for the hunter and 62 for the groups they go with). The duration spent in the forest is fairly similar between the different types of hunters. Professional and semi-professional hunters staying on average 3 days, which is one day longer than amateur hunters.

Amateurs go with their friends or professional hunters. Professional hunters go with their fixed hunting groups, semi-professional hunters go with their professional fellows (usually semi-professional hunters are those who go to the Sundarbans for other reasons, like fishing, wood cutting, etc). The groups of semi-professionals are not as fixed as those of professional hunters as their main occupations get priority. Thus the composition of a group and its size varies a lot depending on the number of hunters willing to join a hunting trip.

The average number of people in a hunting group ranges from 2-50. However, it should be noted here that higher numbers of people involved in a group is particularly relevant to the period of Rash Mela, when large groups go hunting together. In normal hunting activities, groups are usually limited to less than 20 people.

6.5. Estimation of number of deer hunters

The study found 80 professional and 52 semi-professional deer hunters. However, questions were asked to the hunters about the number of deer hunters they estimated to be active in their upazila. Their estimates are usually a lot higher than the number of active professionals and semi-professionals found in the study. The discrepancy is believed to be largely due to the number of amateur hunters and also the inclusion of former hunters into their estimate. In the peoples eyes such people always remain a hunter. It is unfortunate that the study did not have enough time and scope to conduct a more intensive search for all the deer hunters (including amateurs) that are active in the Sundarbans. The estimation of the number of professional and semi-professional hunters should therefore be considered as a minimum estimate until more research is carried out in this regard.

Table 11. Difference between the number of professional and semi-professional deer hunters found and the total number of deer hunters estimated, by upazila

Statistic	Upazila of the hunter									Total
	Paikgacha	Koyra	Dacope	Shyamnagar	Sharankhola	Rampal	Mothbaria	Pathorghata	Mongla	
Average estimate	15	25	16	34	28	80	14	315	99	625
Number pro & s-pro	19	17	14	28	17	7	0	22	8	132
Amateurs covered	0	3	0	12	9	3	1	0	0	28
Difference	-4	5	2	-6	2	70	13	293	91	465

It can be seen that in many cases the study is very close to the estimated number of deer hunters. Of course, it must also be said that one must not assume that the estimation is a correct representation of the actual number. Therefore it seems that Paikgacha, Koyra, Dacope, Shyamnagar, Sharankhola and perhaps even Mothbaria are likely to be accurately covered. The difference between the two estimates being either due to the inaccuracy of the estimate or due to the total number of amateur hunters in that upazila. The differences observed in Pathorghata, Mongla and Rampal are however so large as to raise questions about the comprehensiveness of the study in these areas. More research is needed focusing especially on these three upazilas to solve this issue.

7. OFFTAKE LEVELS

Offtake levels were calculated for the different species both deer and crocodile hunters caught over the last three trips that they had made. The final estimation of offtake for each species is based on the average number of species caught by each type of hunter (amateur, professional and semi-professional), the average number of hunters operating in the Sundarbans, the average number of trips per year, and the median group size. The median group size was used instead of the average because of the effect of the rash mela in which a number of hunters found in our study go hunting together with a large number of amateurs from outside the study area. This was found to have a strong influence on the average group sizes. The calculation procedure is shown below. The figures below are shown rounded off to whole numbers while the calculations were actually made more accurately.

Table 12. Calculation of the number of deer hunters active at group level

Type of Hunter	Number of Hunters Found	Interval between trips for a Hunter (days)	Interval between trips for a Group (days)	Fraction of Hunters Active at Group Level	Number of Active Hunters at Group Level
Amateur	28	141	62	0.44	12
Professional	80	25	22	0.85	68
Semi-Professional	52	78	55	0.70	37

As hunters do not always join the groups on each trip the number of hunters active at the group level had to be calculated. Dividing the hunting interval for groups by the interval of the hunter represents the fraction of hunters active. This fraction was then multiplied by the number of hunters found, in order to get the number of hunters active at group level. The number of amateurs is not realistic, but it is included here to show the offtake level estimated for the sample of 28 amateur hunters. The number of professional and semi-professional deer hunters should be close to the real figure.

Table 13. Calculation of the number of trips per year

Type of Hunter	Interval between trips for a Group (days)	Trip Duration (days)	Number of Trips per Group per Year
Amateur	62	2	6
Professional	22	3	15
Semi-Professional	55	3	6

Here the interval between trips and trip duration for a group were added together to get the total time spent in between two hunting forays. The total number of days in a year was then divided by the total time spent in between two trips to get the number of trips made per year.

Table 14. Calculation of effort

Type of Hunter	Number of Active Hunters at Group Level	Group Size	Number of Groups Found	Number of Trips per Group per Year	Total Effort (no. of trips per year)
Amateur	12	4	3	6	17
Professional	68	6	11	15	167
Semi-Professional	37	6	6	6	38

To calculate the total effort in a year the number of active hunters at group level was divided by the group size to get the total number of groups represented in this study. The total yearly effort is then the number of trips made per group per year multiplied by the number of groups.

Table 15. Calculation of offtake levels for deer hunters

Type of Hunter	Total Effort	Spotted Deer		Jungle Fowl		Other Birds		Wild Boar		Rhesus Macaque		Tiger	
		OT	OY	OT	OY	OT	OY	OT	OY	OT	OY	OT	OY
Amateur	17	3	54	0.07	1.24	0.14	2.48	0	0	0	0	0	0
Professional	167	5	775	0.005	0.82	0	0	0	0	0	0	0	0
Semi-Professional	38	4	148	0.10	3.87	4.66	179.09	0.01	0.52	0.01	0.52	0.01	0.26
Total Offtake / Year			976		6		182		0.5		0.5		0.3

[Note: Offtake levels are averages based on the last three trips. This produces relatively accurate figures for the target species (spotted deer). It may however give an inaccurate representation of offtake levels for non-target species, as there is more variation per trip. Sensitive cases such as the tiger are likely to be underestimated.]

The yearly offtake (OY) is based on the total effort, or number of trips per year, and the offtake per trip (OT). The total estimated annual offtake for professional and semi-professional deer hunters is 923 deer per year. Amateur deer hunters have not been fully included and there is also the existence of other groups such as dacoits and Indian hunters, as well as other specialized groups targeting tiger, otter and monitor lizard. Therefore the estimates shown here can be considered to be the minimum annual offtake by deer hunters.

Table 16. Calculation of crocodile offtake

Type of Hunter	Interval between trips for the Group (days)	Trip Duration (days)	Number of Trips per Year	Offtake per Trip (no. of individuals)	Total Offtake per Year
Crocodile Hunter	30	9	9.37	2.67	25

Only one group of crocodile hunters was identified. This group made around 9 trips per year. The average number of crocodiles (juvenile and mature) that they managed to hunt per trip is near to 3 individuals, thus the total yearly offtake comes to an estimated 25 crocodiles.

The minimum offtake levels found do not seem to be particularly threatening to the overall population of spotted deer if one assumes that there are around 50,000 deer in the Sundarbans (Khan, 1986, cited in Hussain & Acharya, 1994). However, when asked about trends in spotted deer populations nearly 90% of the hunters said that populations in the Sundarbans are declining.

Osman Gani in his study on the loss of Bengal tigers found that 23 tigers died in between 1996-2000. He reported that 9 tigers were killed by poachers, which comes to an average of 1.8 tigers per year. However this data came from the incidents in which the poachers were caught or disturbed whereby the skins were recovered. Even combining our estimate with his figure to get an average of around 2.1 tigers a year is likely to be too low.

8. WILDLIFE PRODUCTS AND TRADE

8.1. Local trade in deer meat

When a deer is killed the processing is usually done within the Sundarbans. Within the group of 146 respondents, 45% said that they always do the processing, i.e. skinning, butchering, within the Sundarbans. Around 14% of the hunters said that it depends on the circumstances and they will process the carcass either in the Sundarbans or after returning to their village. However, there were differences between the types of hunters. Nearly all amateurs would do the processing inside the forest, while only 43% of professional and semi-professional hunters always completed the processing in the Sundarbans before going home. If they brought the deer back to the village, around 80% of the professional hunters would process the deer themselves, while 57% of the semi-professionals did it themselves, the rest giving the carcass to tanners and butchers for processing.

The average quantity of meat that hunters got from one deer was 55 kg. Amateurs seemed to only hunt relatively large deer, as their average was 80 kg. Professionals had an average of 45 kg, and semi-professionals an average of 40 kg per deer. It was found that professional hunters would sell around 91% of their deer meat and consume the rest. For semi-professionals this came to 81% and amateurs sold only around 42% of the meat. The annual average offtake in terms of quantities of deer meat per hunter were found to be: 647 kg for a professional hunter, and 135 kg for a semi-professional. Only one amateur reported his annual offtake of deer meat at 150 kg.

From this data new estimates of annual offtake can be produced based on the average quantity of deer meat obtained per hunter, the average meat obtained per deer, and the total number of hunters. These estimations come at: 1150 for professional hunters, 177 for semi-professionals, and 53 deer per year for amateurs. This estimation procedure is believed to be more inaccurate than the one given in the chapter on offtake levels, as it completely relies on the hunter giving an accurate figure on the total amount of deer meat he was able to obtain in a whole year.

Due to the difficulties in keeping meat fresh, deer meat has only a regional demand and is consumed most often in the localities directly surrounding the Sundarbans. The hunters themselves therefore play a large role in the local trade in deer meat.

Around 90% of professional and semi-professional hunters said that they did not supply enough deer meat to satisfy the demand. Hunters therefore have a strong influence over deer meat prices and the price will depend on how successful the hunters have been on a hunting trip. If they have not been that successful they will raise the price and vice versa, the price is at its lowest if they have caught a lot of deer. The average price of deer meat is 120 taka per kg, though this fluctuated between 70 and 200 taka per kg. This is lower than the price of mutton (average price Tk. 130 per kg), yet higher than that of beef (average price Tk. 80 per kg).

Table 17. List of Primary Market Villages of Deer Meat

Batiaghata	Paikgacha	Koyra	Dacope	Shyamnagar	Morelgonj	Sharonkhola	Rampal	Pathorghata	Mongla
Gangarampur	Chandkhali	Uttar Bedkashi	Baniashanta	Ramjannagar	Nishanbaria	Southkhali	Rampal	Charduani	Chila
	Garaikhali	Dakshin Bedkashi	Bajua	Allia		Khontakata	Ujolkur		Sundarban
		Koyra	Chutarkhali	Kaikhali			Baintala		Shonaitala
			Chaina	Munshiganj			Banshtoli		Mithakhali
				Padmapukur					
				Burigoalini					
				Gabura					

There are two trends, either the hunters themselves sell the meat, or hunters sell the whole deer to a middleman or broker. Most of the deer meat directly changed hands between the hunter and the customers. This is also why deer hunters are so well known in the localities. 37% of their deer meat is sold to traders or middlemen that bring the deer meat to other villages and towns in the region. Only a few secondary markets are found where there are some meat businessmen (kashai) who also sell deer meat. These markets are: Rayenda in Sharonkhola, Pathorghata Bazar, Pourashava and Chila Bazar in Mongla, Shamnagar Bazar, Bhetkhali and Koikhali in Shamnagar, Garaikhali in Paikgacha. The average price of deer meat in these markets is Tk. 160 per kg.

No tertiary markets are observed in marketing deer meat. In some cases the hunter will get an order for deer meat from someone who is willing to pay a higher price. Then the hunter will try to supply this person with the required quantity of deer meat. This usually is the case if a well-off person is organising

a celebration party and wants to make certain he can entertain his guests with some deer meat, which is considered as a special treat. These people usually come from cities such as Khulna or even Dhaka.

8.2. Regional sale of wildlife products

For the study on wildlife trade some information was obtained from hunters, traders, and shopkeepers in the end-markets for wildlife products. Places that were visited for collecting information on trade, besides the study area for hunters, are, Khulna, Shatkhira and Dhaka cities. The research in Dhaka concentrated on the already known areas of wildlife trade including, Hazaribag tannery site, Elephant Road, Gulshan 2, the Sonargon Hotel, and the souvenir shops opposite the Sheraton Hotel.

The trade in deerskin is not very high. A visit to the Hazaribag tannery area in Dhaka revealed that the tanners do not feel it is very profitable anymore to process and trade in deerskins, as the demand is low. Therefore it is not surprising that most hunters said that they leave the deerskins behind and only take the meat if they do the processing in the forest. The hunters actually sell most of the skins to local households (69%). Another 30% of the skins are sold to traders. The average price of deerskin varies by the size of deer and the condition of the skin. If the skin has a bullet hole or is otherwise damaged, its price is reduced, and is then not higher than that of cow- and goatskin. The price fluctuates by quality from 150 to 1000 taka. The average price is 400 taka.

The market for deerskin is mostly local and fully domestic. Locally deerskin is used as a curiosity item and functions as a rug or tapestry. Secondary markets are very few in number. The skins mostly go via Swarupkathi, Barishal, Mongla, Pathorghata Sadar, Assasuni, Shyamnagar, Shatkhira, Bagerhat, Khulna, Rayenda, and Chalna Bazar on their way to Dhaka. In the secondary markets its price is 500 to 2000 taka. Here it is important to mention that 2000 taka is for a very big and non-damaged skin with head and horn. There is no real market outlet for the deerskin in the secondary market. The middlemen found in the secondary markets keep contact between the end-market, which is mostly Dhaka, and the hunters. In the Dhaka end-market, especially that of Gulshan 2, the skins of spotted deer were mostly seen fashioned into ladies shoulder bags or purses. The Forest Department has also auctioned both confiscated deer meat and skins to interested buyers in the past.

There is also some demand for deer horn. Hunters sell around 56% to local people interested in owning a deer horn as a curiosity, and 33% is sold to traders. The average price hunters get for a complete set of deer horns is 310 taka with a minimum of 100 and a maximum of 700 taka. Secondary markets are usually found in the upazila capital cities, where it is sold secretly from some grocery shops. Deer horn is also processed into high quality walking canes. The whole horn can be used to make several canes. Markets for this item are in antique shops or the bigger departmental and grocery stores in Khulna and Dhaka. Mounted horns were seen in the souvenir shops of Gulshan 2 and opposite the Sheraton hotel yet it was claimed that these were antiques stemming from times in which the hunting of deer was legal.

The price for a complete set of head and horns is double that of only the horns and is in reasonably high demand.

During the informal discussions held with tanners at Hazaribag in Dhaka, the tanners said they were not interested in the trade in deerskins anymore. The deerskins they had were very old and they did not seem to be taking any new supply. They were mostly interested in the skins of snakes, lizards, otters and tigers. They said that this is because of the export market. Tiger skins had a high demand nowadays in places like Hong Kong, Taiwan, China, and Thailand. They also mentioned places such as Burma, Singapore, Saudi Arabia, Dubai, Kuwait, Qatar, U.A.E., Oman, Hungary and Poland as international links in the trade in tiger skin. Snake, lizard and otter skins could be eventually made in to bags, ladies purses, wallets, ornamental objects and such.

It was found however, that there is also a sizeable domestic market in leather and skins made from various wild animals. It was difficult to get information on the origin of wildlife products sold at "souvenir" and leather shops around Dhaka. As no hunters even new of any hunting of snakes going on in the Sundarbans, it is assumed at this point that the wide range of snake skins come from elsewhere. Snakeskins were sold at nearly all leather shops in Gulshan 2, Elephant Road, and inside the Sonargon Hotel. The skins identified were from python, cobra and water snakes.

Crocodile skins were in high demand for the making of various leather items, such as bags, purses and belts. When asked about the origin of his crocodile skins one shopkeeper mentioned Khulna. Crocodile skins originate from Sharankhola. From there the route is through Khulna and Mongla on the way to Dhaka. Other markets are in Barishal and Chandpur (secondary markets) though it has been confirmed that these skins also are sold on to Dhaka.

The hunters initially sell their crocodile skins at prices of Tk. 100 to Tk. 200 per square inch. There is a grade system for crocodile skin. The low grade is thin skin, which is sold at a price of Tk. 100 per square inch, and the high grade is for thick crocodile skin at Tk 200 per square inch. The high grade is therefore for older crocodiles, while the low grade is for mostly the juveniles. These days leather made from juvenile crocodiles has a higher demand in the end markets, yet this is not reflected in the price that the hunters get. Secondary market prices range between 150 and 300 taka per square inch. Manufactured products from crocodile leather were especially available at Gulshan 2, while dried and rubbed skins of juvenile crocodiles were sold at the souvenir center opposite Sheraton Hotel.

Crocodile skin is reported to be relatively easy to traffic. The sizes requested from the hunters are easily portable and there are few law enforcers who even if they inspect the bags, will actually recognize that it is crocodile skin and know it is an illegal product.

There is also a very regional trade in live juvenile crocodiles. The live crocodiles are very costly and sold per inch. The price is around Tk. 1500 per inch. The transaction is done straight from the person who has caught the crocodile to the buyer. It is not only sold by the crocodile hunters but also by

fishermen, who get this accidentally in their nets. They then try to find the upper class people that would be interested in buying such a crocodile for their private collection in the larger towns and cities of the region. This sort of trading is sometimes done in Shyamnagar and Khulna.

Products made from both Ring- and Bengal monitor lizard skin were sold at Gulshan 2, while the shops opposite the Sheraton had skins of young Bengal monitor lizards. Deer hunters claimed monitor lizards are sold by crab-collectors from Dangmari, Baniashanta and Sutarkhali for a very low price to middlemen who mostly come from Khulna, Mongla and Rayenda, though also a few mentioned that some skins cross the border to India. There is no domestic demand for the meat of monitor lizards, but the same hunters use it as bait for catching crabs. The extent of a possible international trade in crocodile and monitor lizard skins could not be determined, though in the 1980's Japan was importing hundreds of thousands of skins from South Asia (Bennett, 2003). Populations of Water monitor (*V. salvator*), were decimated in Bangladesh at the end of the 1980's, while the Yellow monitor or Ring lizard (*V. flavescens*) was estimated to occur at densities of 7.5 individuals per square kilometer (Khan, 1988 as cited in Bennett, 2003). Monitor lizard skins are still highly prized in the world of leather manufacturing for their soft- and suppleness (Bennett, 2003).

Products made from otter skin were not available at end-markets in Dhaka and it is therefore believed that the skins are mostly exported out of the country. The statements of some of the deer hunters support this opinion. They mentioned that Indian traders buy the skins from middlemen found in Assasuni and Shatkhira Sadar, and then smuggle them over the border. The otter hunters themselves come from Shyamnagar and Koyra. However, in one of the shops opposite the Sheraton, otter skin could be made available on demand for around 6000 taka per piece.

Tiger skin was surprisingly easy to come by in the end markets in Dhaka, especially in the souvenir shops opposite the Sheraton Hotel. It was also possible to purchase a whole tiger skin from one souvenir shop and one leather shop in Gulshan 2, and a ladies shoulder bag made from tiger skin was being openly sold in a leather and gift shop in the Sonargon Hotel. The tiger skins were usually not directly available, but could be brought to the shop if requested. It could not be verified where the skins originated from however. The presence of leopard skins and one skin of a Sambar deer, which were said to have come from Burma and India, makes it possible that not all tiger skins come from the Sundarbans. It is however likely that most skins do come from the Sundarbans, as this is the most accessible market for merchants interested in the trade of tiger skins. Other tiger parts for sale in the shops around Gulshan 2 and opposite the Sheraton were its nails and teeth.

Deer hunters mentioned that the primary markets (or points of origin) for tiger skins are mostly places such as, Chila and Sundarban in Mongla, Koikhali and Padmapukur in Shyamnagar, Dakkhin- and Uttar Bedkahshi in Koyra, Suterkhali in Dacope, Protapnagar in Assasuni, Chandkhali and Garoikhali in Paikgacha, and Tafaalbaria in Sharankhola. Because of the risk involved there seem to be only a few secondary markets or middlemen. However from the limited data and information, the secondary markets where middlemen can be found, are in: Chila, Rampal, Sundarban, Khulna, Mongla,

Shamnagar, Assasuni and Rayenda. Mongla port is one of the channels for trafficking tiger skin. Therefore, a lot of tiger poachers are reported as originating from around there.

The price of tiger skin at the secondary level was reported to be around 30-50,000 taka. Usually the traders at the end-market have direct links with the hunters who supply them tiger skins. The Forest Department also was found to have officially sold a tiger skin to S.A.F. Industries in Jessore. The skin was of a tiger that had been killed by local people after it had entered their village on the 10th of January, 2002. Only a few deer hunters had heard of a market in tiger bone, so the trade of this seems very limited in Bangladesh.

Species such as wild boar, birds and jungle fowl are only hunted for consumption and either consumed by the hunters themselves or sold locally. The only reason for hunting monkeys would be to trade them as pets. However, there is no business centered on a pet trade in monkeys, and in the few cases whereby a monkey is caught the hunter will usually sell it locally to someone interested at a very low price, or give it to friends or relatives.

Table 18 shows the accessibility and price ranges for the various wildlife products found in shops in Dhaka. The accessibility index is a qualitative assessment based on the availability and the openness or ease in which to buy the product.

Table 18. Accessibility of various wildlife products in Dhaka

Wildlife Product	Price per Piece (in Taka)	Accessibility
<i>Gulshan 2</i>		
Cobra-skin bag	600 - 1,600	
Cobra skin	500	
Cobra-skin wallet	250	
Crocodile-skin bag	1,350 - 12,000	
Crocodile-skin belt	1,600 - 2,200	
Crocodile-skin wallet	1,500 - 3,500	
Ivory (crafted)	2,000 - 285,000	
Ivory (plain)	1,200 - 7,500	
Leopard-skin bag	4,500	
Leopard skin	18,000 - 39,900	
Ring Lizard-skin bag	750	
Ring Lizard-skin wallet	250	
Python-skin bag	1,000 - 1,600	
Python-skin belt	450	
Python skin	2,500 - 6,500	
Python-skin wallet	300	
Spotted Deer-skin bag	1,000 - 1,200	
Spotted Deer horn (mounted)	4,000 - 7,000	
Spotted Deer skin	1,500 - 3,500	
Tiger claw	500 - 750	
Tiger skin	102,500 - 115,000	
Tiger teeth (elephant bone)	100 - 150	
Tiger teeth (real)	1,000 - 2,000	
Watersnake-skin bag	600 - 650	
Watersnake-skin belt	350	
Watersnake-skin wallet	120 - 200	
<i>Inside Sonargon Hotel</i>		
Cobra skin	250	
Leopard-skin bag	5,500	
Python skin	6,500	
Tiger-skin bag	10,500	
Unidentified Cat-skin bag	3,500	
<i>Opposite Sheraton Hotel</i>		
Crocodile skin (juvenile)	8,000	
Leopard skin	28,500 - 45,600	
Bengal Monitor Lizard skin	250	
Spotted Deer skin	1,500	
Sambar Deer skin	10,000	
Tiger skin	91,200 - 114,000	
Unidentified Cat skin	4,000	

9. DISCUSSION

A study on illegal hunting practices faces the drawback that it has to rely on obtaining facts from a study population that is largely reluctant to reveal such information to a group of strangers. By hiring local people as data collectors this study overcame some of these barriers, but not all. However in the villages of Bangladesh it is hard to keep secrets and one can be reasonably confident that most professional and semi-professional deer hunters were identified in the study area. Deer hunting is not treated as sensitively in village areas as one might expect. Nearly everyone can name the deer hunters in their village once their confidence has been won. The deer hunters themselves were also in most cases quite open about their activities, though it is only natural to believe that it is possible that they may have felt it necessary to lower their estimates on offtake somewhat.

The real difficulty was getting information on the hunting of sensitive cases such as the tiger. Only one hunter admitted having hunted tiger in one of his last three trips and only 4 currently active hunters said they would hunt tiger if they got the opportunity. However, nearly all claimed that there were other hunters who do kill tigers. As example, one of the data collectors had an uncle who was a professional deer hunter. When interviewed this hunter candidly gave information on how many deer he had hunted, but when it came to tigers he only reluctantly admitted to having shot one tiger in his whole career. However, after the interview was finished the data collector mentioned that his uncle had killed at least 13 tigers in the past.

Due to the duration of the study (only three months of field work could be allocated) there was not sufficient scope to explore certain aspects further, such as the hunting of tigers, wild boar, otters and monitor lizards. The hunting levels of these species therefore remains largely unexplored. Also a complete census of all hunters (including amateurs) could not be carried out.

The hunting and trade of various species of wildlife and their products appears to be a lucrative business in which many people are presently involved. Hunting is also a popular recreational activity for some. It is estimated that there are at least 80 professional deer hunters, 52 semi-professional hunters and several hundreds of amateur hunters that reside in areas near to the Sundarbans. In addition to this during the rash mela period, people come from all over Bangladesh with the intention of enjoying a leisure trip through the Sundarbans and getting the opportunity to eat deer meat.

The winter period was considered the best time for hunting, not only by deer hunters, but also by crocodile hunters. Favourite times for hunting were at high tide, when deer are necessarily congregated in smaller areas, and at night, especially during the new moon.

The most popular hunting method is still by using guns. Hunters especially from Pathorghata, but also from Sharankhola, like to use nylon nets for hunting. Besides from being cheap this method also allows hunters to catch the deer alive. These hunters will then often keep the Spotted deer in pits nearby their house in order to keep the meat fresh. Snares are also used, again mostly by hunters from the

Pathorghata and Sharankhola area. A noticeable trend was that if these techniques were used in other areas, it was mostly by the younger hunters. This suggests that new generations of hunters are adopting these techniques. Other techniques which are increasing in popularity are the use of poison and sleeping pills. Poison is also used for catching tigers. The adoption of techniques such as nets, snares, drugs and poisons to catch wildlife is alarming. These methods are cheap and easy to use. There is therefore a propensity for hunting intensity to increase dramatically as these techniques become more and more popular.

It is estimated that at least 923 spotted deer are hunted each year by professional and semi-professional hunters alone. This is likely to include some of the deer that are hunted during the rash mela, as the "tourists" will usually hire some local hunters to do the hunting for them. If it is considered that there may be another 465 local amateur hunters (see chapter 6.5), then our estimate would be doubled to nearly 2000 spotted deer per year. This was however not verified in this study. The offtake levels for other species remain low, except for birds, for which an offtake of 182 per year was estimated. These are mostly water birds, but unfortunately no species-specific information was collected.

Only one group of crocodile hunters was found. The crocodile hunters usually hunt the adult crocodiles with spears, and sometimes with guns. Juvenile crocodiles are caught with sturdy nylon nets. The professional group was estimated to hunt around 25 crocodiles, of all ages, per year. No other professional groups were found, though fishermen will sometimes sell juvenile crocodiles caught in their nets. The level of this "by-catch" is unknown. This, like with deer, should therefore be considered as a minimum estimate until the by-catch of fishermen can be properly assessed.

The survey on trade in Dhaka revealed that leather of snakes and crocodile is in high demand for manufacturing in to all types of goods from mens' belts to ladies shoulder-bags. Monitor lizard, tiger and deer skins were also being used to make wallets and bags. Whole skins of tiger, deer, cobra, python and monitor lizard were also sold as souvenir items. Though it was astonishing to see such brisk trade being done in wildlife products, the trade in tiger and crocodile is especially disturbing, as these are critically endangered species. Surprisingly a lot of the trade is very open with wares made from protected species such as python, spotted deer, crocodile, and even tiger being stalled on shelves inside the shops. This indicates that very little is being done at present to combat the trade in illegal wildlife products. This is further evidenced by the sale of deer meat, deerskins and in one case even tiger skin by the Forest Department to interested buyers. These transactions were all observed to have been done officially.

The trade in deerskins and horn is small in comparison to the trade in deer meat. Deer meat is readily available in areas near to the Sundarbans, so much so that its price is even lower than that of mutton. Again, this indicates that the Wildlife Act of 1974, drawn up to offer legal protection to the natural heritage of Bangladesh, is not being effectively implemented and therefore also largely ignored by the people.

10. RECOMMENDATIONS

ξ Most recommendations given below are based on one of the most important aspects of wildlife conservation, which at present is not being carried out effectively enough, namely, law enforcement. Wildlife in the Sundarbans urgently need better protection. The open sale of wildlife products in various shops and even prestigious hotels in Dhaka, and the easy availability of deer meat in localities surrounding the Sundarbans, combined with the fact that some hunters keep the deer alive in pits near their house, shows how ineffective law enforcement is at present. Though the exact ways to combat poaching and trade are best designed by the law enforcers themselves, the following suggestions may prove useful in this regard:

- The rash mela is the most intensive hunting period in the year. If the government can sum up enough man power to patrol the Sundarbans during this period a large proportion of all hunting activities can be disrupted. Possible ways to sum up the man power is through joint efforts of the FD, Coast Guard and BDR.
- The winter season is the favourite time for hunting, due to the good weather conditions in the Sundarbans. Thus by patrolling more often in the winter season law enforcers can more effectively channel their resources.
- Night time is also preferred. Increasing the number of patrols at night would therefore be an effective way to combat poaching.
- Favourite hunting areas are delineated in Sundarbans based on the data collected from the field and presented in **annex 1**. By concentrating patrols in these areas, anti-poaching activities can become more effective.
- Most hunters live very close to the Sundarbans. The distribution of hunters has been given in this report. These areas should come under closer surveillance.
- Stronger action needs to be undertaken against the traders of wildlife products. Thus more raids need to be undertaken on the outlets of wildlife products in Dhaka, followed by arrests of the middlemen who have been supplying these shops, and down to the hunters who have been supplying the middlemen.

ξ New wildlife laws need to be drafted which detail the penalties that will be exacted for hunting all the different species that need protection. These laws should also encompass the trade in wildlife. The penalties for hunting and trading in nationally endangered species, such as the tiger and crocodile, should be particularly severe.

ξ Once the new laws have been drafted the government could consider passing a decree which absolves all hunters and traders of their past crimes. This combined with the imposition of the stricter and more severe new laws would make many hunters and traders reconsider continuing in that direction. This decree as well as the details of the new laws should be widely disseminated through all media for maximum effect.

- ξ The Forest Department should not have double standards. They cannot say they are committed to the conservation of wildlife on one hand and on the other be selling wildlife products on to the market. All confiscated wildlife products should be stockpiled and ceremoniously burnt once a year to show their commitment to wildlife conservation.

- ξ More research is needed on hunting practices in the Sundarbans. Especially areas such as Pathorghata, Rampal and Mongla need more coverage. Also a complete census of all hunters should be undertaken, including amateur hunters as well as those that come to the Sundarbans during the rash mela and participate in hunting activities or otherwise eat deer meat.

- ξ Surveys also need to be undertaken on population levels of the different species of wildlife that are hunted in the Sundarbans, in order to establish the current status and to be able to give an indication on how large an impact the hunting offtakes found in this study (especially for deer) have on the total population.

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ANNEXURE 1

NAME AND MAPS OF HUNTING AREAS IN THE SUNDARBANS

LIST OF AREAS IN SUNDARBANS GENERALLY USED BY THE HUNTERS FOR HUNTING

Agunjal	Dubla	Kaborkhali	Latabeti	Shakrabari
Alkirdip	Dudhmukhi	Kachikata	Laudob	Shapla
Alorkol	Dumchibaria	Kachikhali	Lebubunia	Shedlarchar
Ambaria	Dumuria	Kagaboga	Malancha	Shekerbari
Andarmanik	Ferengirchar	Kagarchar	Manikerchar	Shelarchar
Bachikhali	Golapdir ati	Kalabagi	Manikkhali	Shibsha
Badamtala	Habolvangi	Kalagachia	Maronchar	Shulorkhal
Barajala	Hajarirchar	Kalamia	Mathavanga	Shupoti
Baramayna	Harbaria	Kalikhali	Mithakhali	Sonakhali
Barobibikhali	Hariharpur	Kalirchar	Morgirchar	Talpatti
Betkhali	Harintana	Kashitana	Mrigomari	Tetulbere
Bokchara	harkhali	Katka	Muroli	Tiarchar
Boyarshingh	Hiron point	Katla	Naibunia	Tiger point
Burirchar	Hogoldora	Kayorabone	Nandabal	Triconisland
Chaltabunia	Holdibari	Keurabunia	Narkebaria	Tushkhali
Chandeshwar	Holdikhali	Khajurarchar	Nilbaria	Ulokhali
Charkhali	Hulo	Khajurbaria	Nildomon	Varkhali
Chatkatala	Itkhali	Khalshimari	Nilkomal	Vedakhali
Com. No. 7	Japhrarchar	Khalshirchar	Nobeki	Veri river
Com. No. 8	Jala	Khamurarchar	Pajrakuta	Vodra
Com. No. 9	Jauakhali	Khejurdana	Pashakhali	Vomrakhali
Dayergang	Jhalow	Kokilmoni	Patakata	
Dayingmari	Jhapa	Koromjal	Poshpakathi	
Dayurmadi	Jhetamukha	Kukumari	Rajakhali	
Dobeki	Jongra	Lataber	Saprakhali	

Figure A. Hunting zone of SRF used by the hunters from Dacope upazila

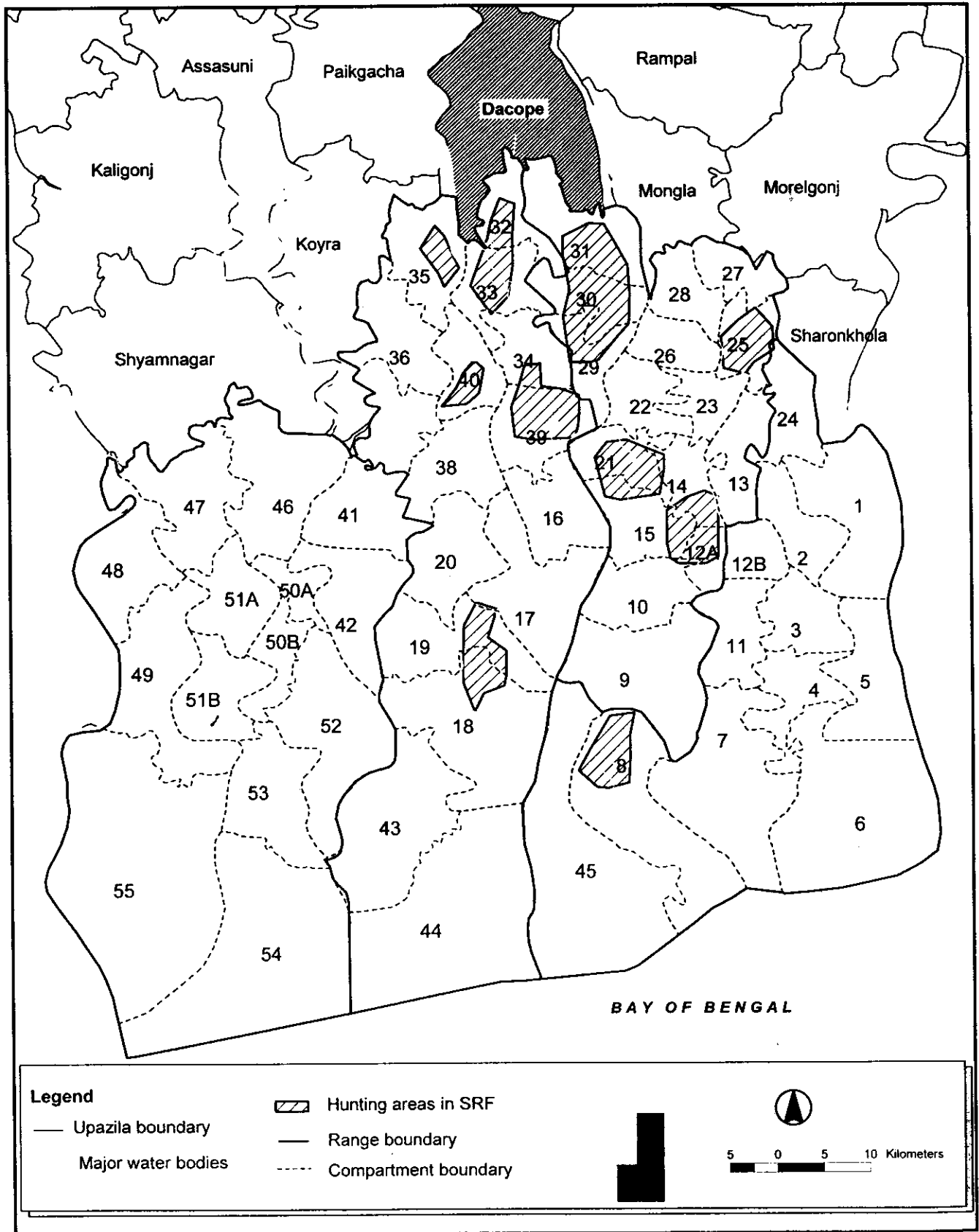


Figure B. Hunting zone of SRF used by the hunters from Koyra upazila

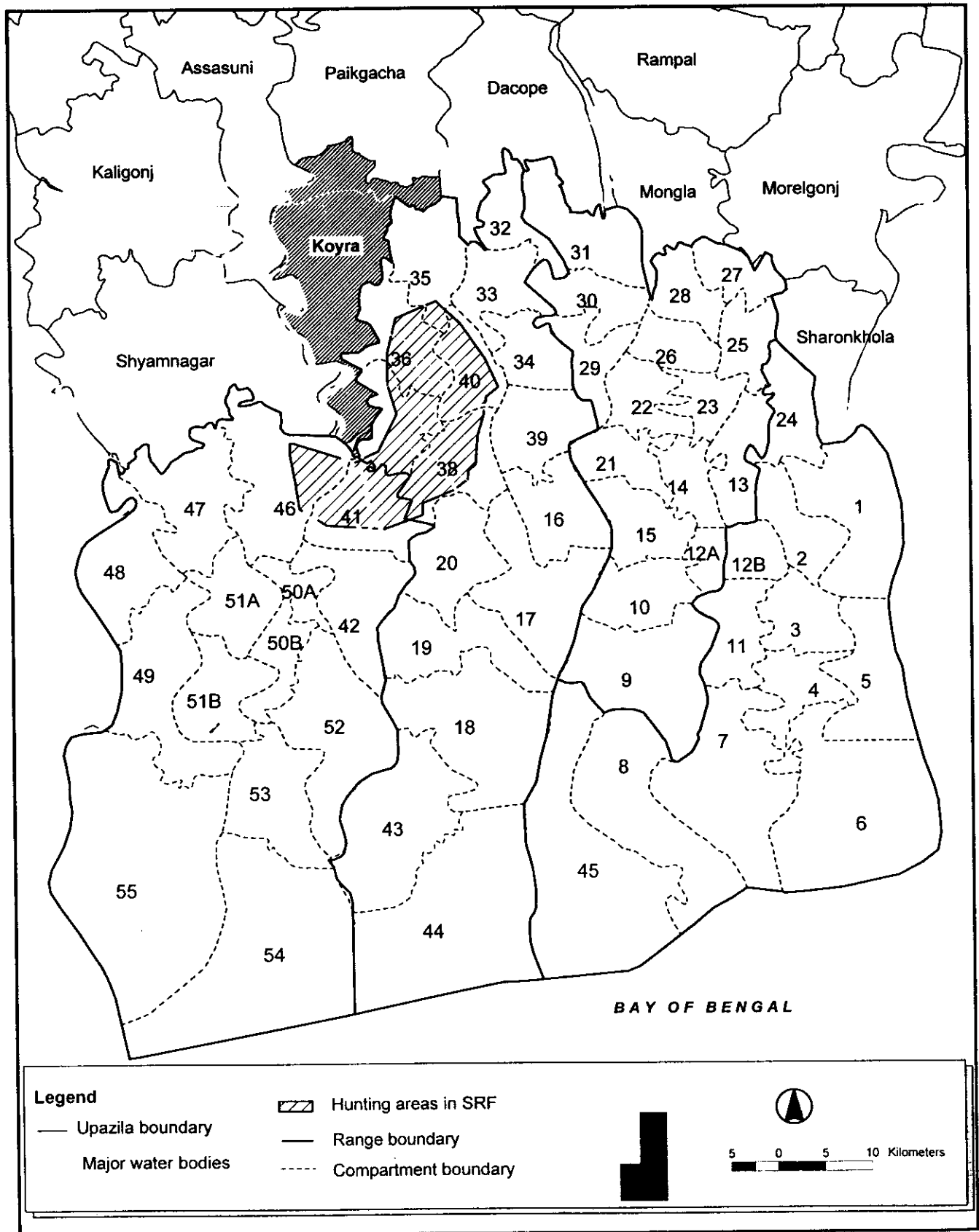


Figure C. Hunting zone of SRF used by the hunters from Paikgacha upazila

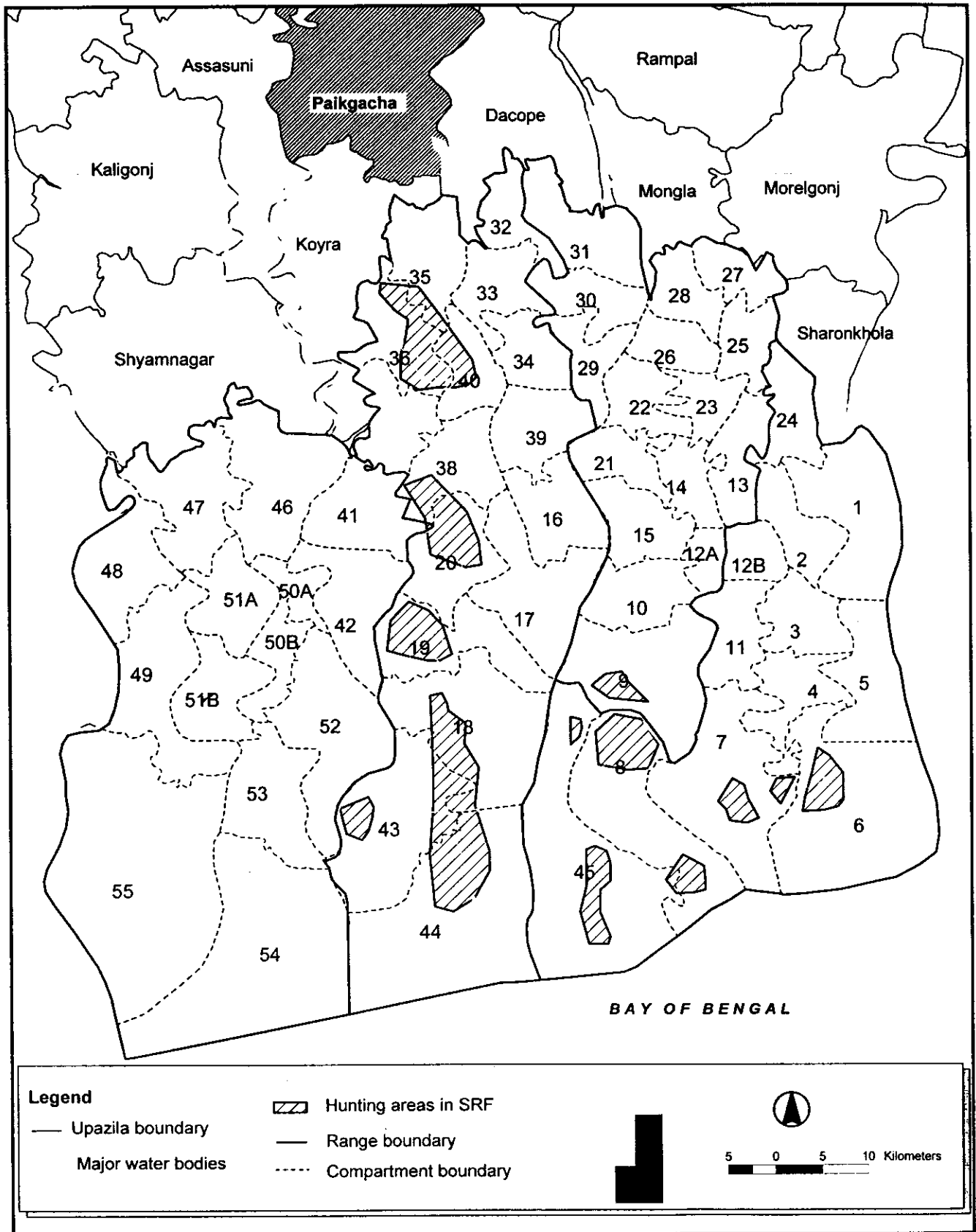


Figure D. Hunting zone of SRF used by the hunters from Mongla upazila

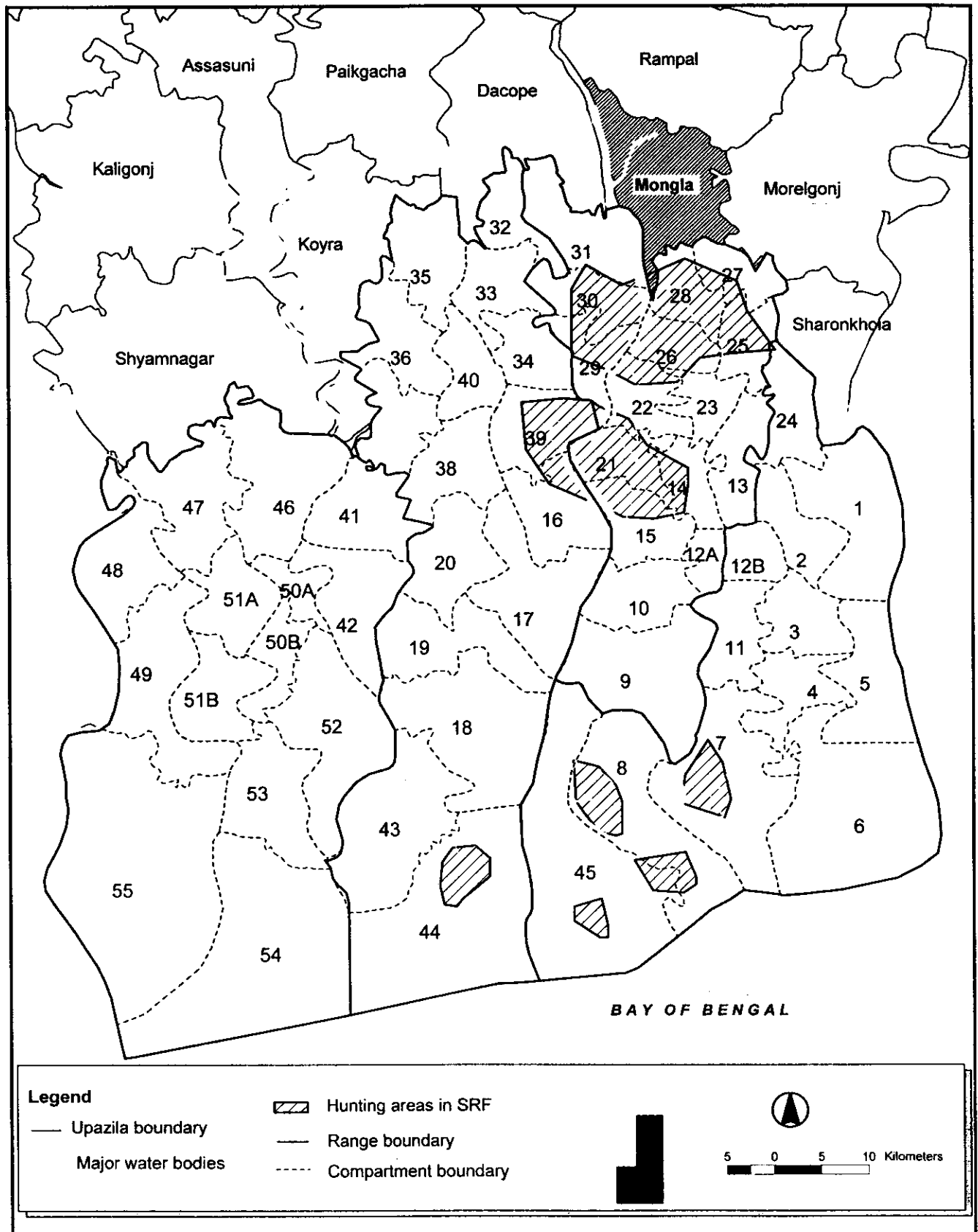


Figure E. Hunting zone of SRF used by the hunters from Shyamnagar upazila

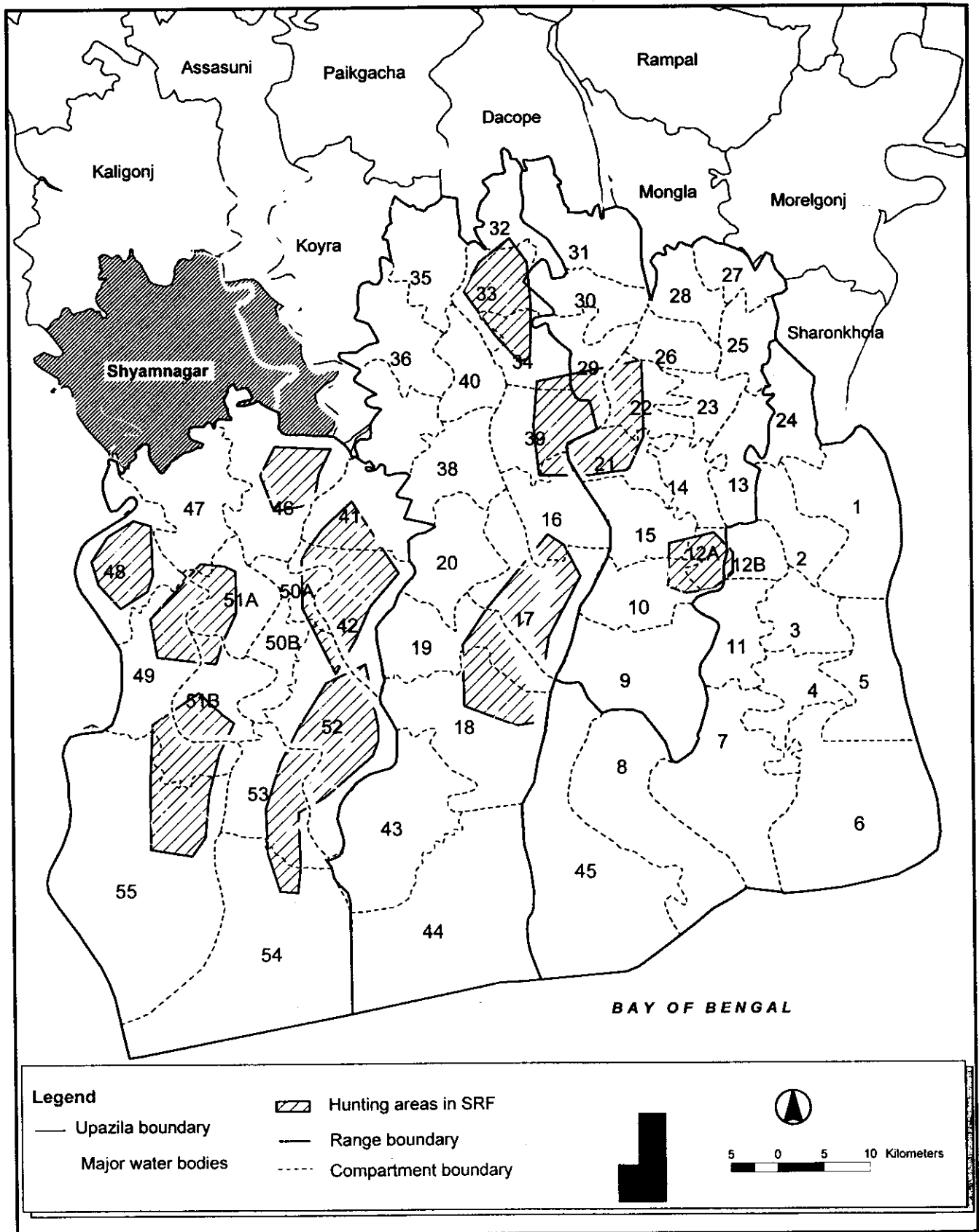
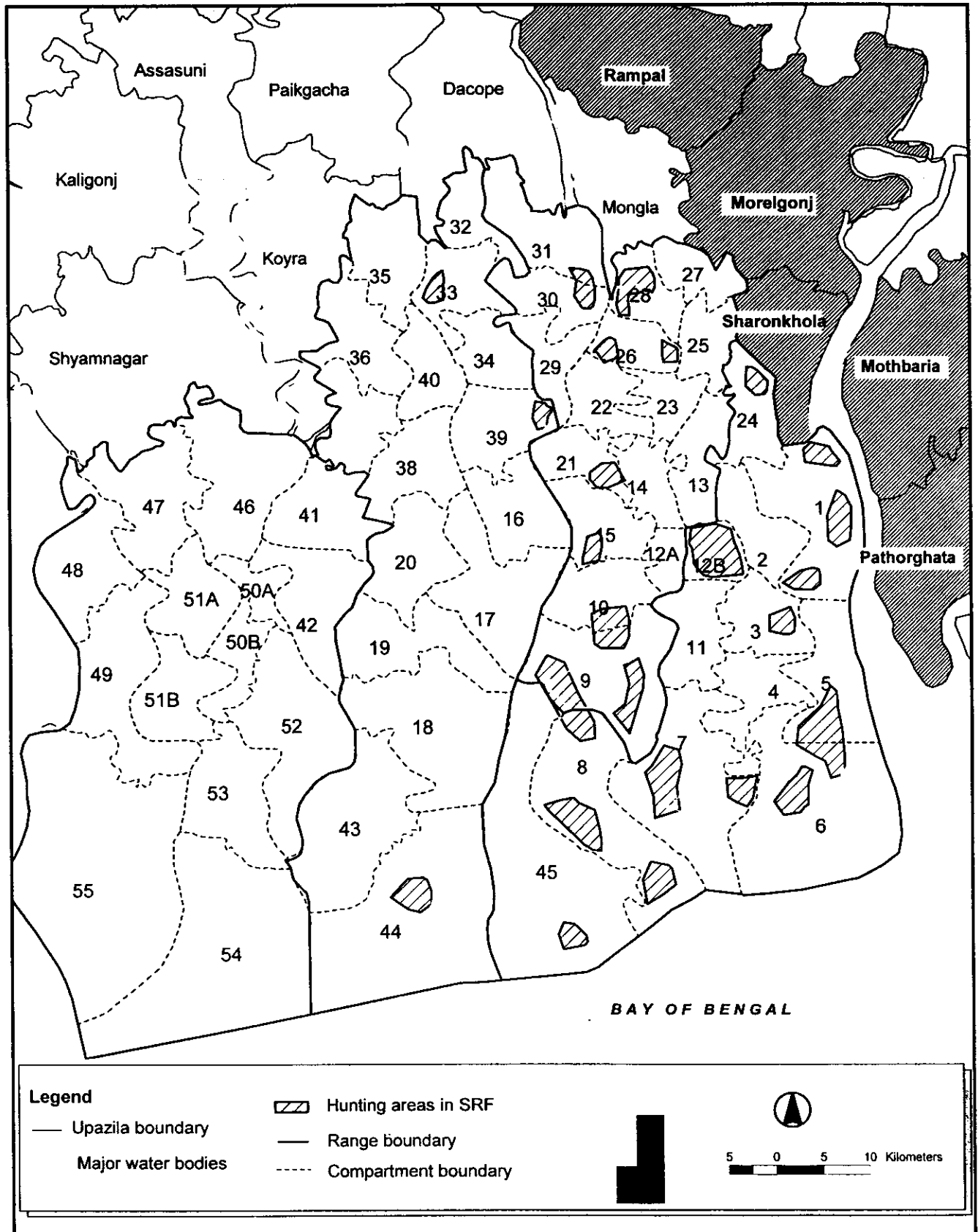


Figure F. Hunting zone of SRF used by the hunters from Rampal, Morelgonj, Sharonkhola, Pathorghata & Mothbaria upazilas



ANNEXURE 2

DATA COLLECTION TOOLS AND THEIR APPLICATION

Overall methodology of the study

Special qualitative techniques have been followed in carrying out empirical observations: *Participant Observation* and *Ethnographic Observation*. The rationale for participant observation lies with experience in conducting human studies. These include (a) we have almost no control over respondents in survey research; (b) people, universally react when they know that they are being studied and thus immediately create an artificial environment culturally appropriate for an outsider; (c) the social differentiation between the researcher and the study population in survey research makes total participation impossible. This behavior of the study population has a significant bearing upon the validity of data gathered in this manner. In this context, in order to significantly overcome these barriers, the study has used a strategy called Participant Observation that in practice has proved its efficacy. Being Participant observation, the foundation of anthropological research, it requires not to study people from a far, rather to go to the subjects in their locality and to live among them for long enough period to earn trust that people require to behave in the ways they usually do when strangers, or outsider are not present. This further ensures access to the natural setting of the life of the study population.

Being there with an attitude of a learner it is also possible to do intellectualization of what are being learned, put it into insider's perspective, formulate sensible question in the local dialects and intuitively understand what is going on in the culture studies. To find out why people (hunters and traders of wildlife products) do what they do, it was necessary to ask questions in addition to observing and imitating the behavior of others. Some modes of interviewing were, therefore, an essential complement to action; this interviewing was informal and unstructured. There was, of course, also the persistent problem of trying to close the gap between what people say should be done and what they actually do, conceptualized as the difference between the ideal social structure and the empirical social organization, respectively.

This is a problem for analysis rather than investigation itself, but it is essential, knowing that this gap exist, to record both what is said and what is done. Therefore, there was a need, in addition to a finely tuned social sensitively, for a good memory based on the ability to concentrate selectively on what is going on around the study team for later recollection, when immediate recording was not possible.

While participant observation has facilitated data collection in the field of all kinds of data both qualitative and quantitative, we needed to use further methods for data gathering capable to take internally valid data.

Other techniques of data collection used

Ethnographic Interview

Ethnographic interviews and discussions often resemble day-to-day conversations. Instead of throwing out question in rapid succession, as in informal interview surveys, an ethnographic interview allowed for longer question probing. It also allowed the interviewer to go back and review points that were not clear. Often the informant asked questions to the ethnographer as well. This approach has been used to explore explanations and views of the study population that does not generally depend on statistical analysis other than, at most, frequencies of taxonomic categories identified by different informants.

Individual Interview

Individual interview is a face-to-face conversation followed by a schedule or questionnaire. The interviewer sat with a single informant. The interviewer has more control over the interviewee than in an ethnographic interview.

Group Interview

Group interview is a group conversation followed by a very small number of questions on a few issues. This technique is more used for acquiring qualitative data. In this technique, interviewer has less control on the participants. Such interviews were conducted with a focus group with at least one homogeneous socio-economic characteristic.

In-depth Interview

It is similar to an individual interview, but is more elaborate. No questionnaire is used; rather a checklist or schedule is followed over the interview period and after the interview. This type of interview takes longer time. More liberty and control is in the hand of interviewer. The level of authority is higher to the interviewee. The interviewee frequently asked question, and the interviewer provided scope and explained the background of the question to the interviewee. Many irrelevant issues came into the discussion, but it helped the interviewer to investigate in-depth insight. Frequent probing was one of the key characteristics of this interview.

Social Waves for Identifying Study Population

This has been an important method used in the study in the stage of initial contact with the study population. This method started with some known people. The known people were socially connected with the member of the study team. These people provided information about some of their social networks. The people who were in their social network, considered the second wave of social networking. Thus, third and fourth waves were used for identifying the hunters. These people provided more information about the research question and helped identifying the hunters. Even the first social wave told about the name and address of the hunters. In this process, we were able to identify the approximate idea and proportion of the hunter and nature of hunting.

Social Mapping:

This is a tool of PRA. This tool was used to allow the hunters and other resource users to show the locations of areas where they usually go for hunting forays.

Seasonal Diagram:

This PRA tool has been used to distribute the days or months of hunting, amount of hunted wildlife, prices, income, and labour.

Observation:

This technique was used simultaneously with other techniques during participant observation.

Case Study:

This method was used to project a single instance by covering the entire relevant research questions.

Content Analysis:

This technique was used to analyse the secondary sources by finding out the content of the document and sorting contents in different category.