



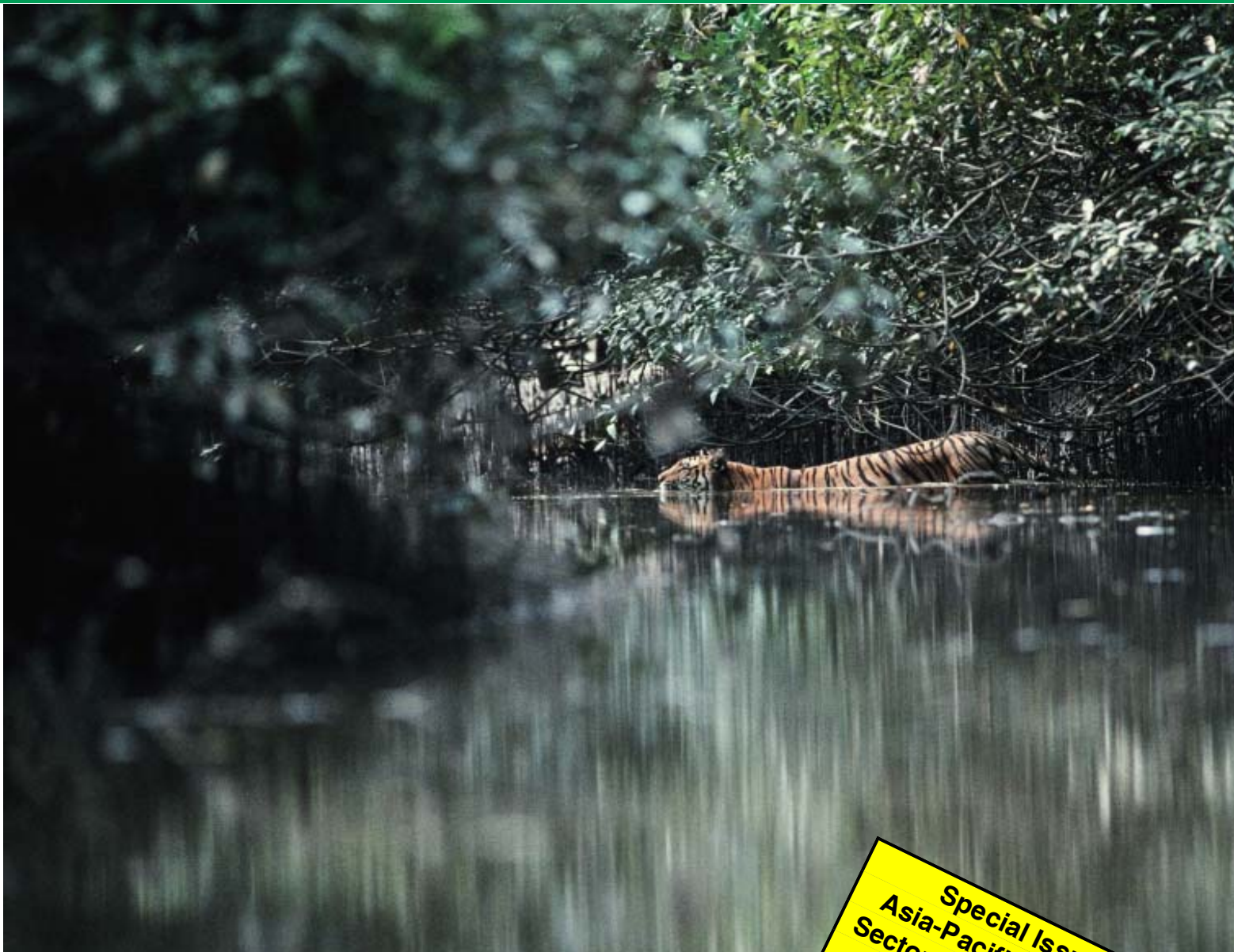
REGIONAL OFFICE FOR ASIA AND THE PACIFIC (RAP), BANGKOK
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

July-September 2010

TIGER PAPER

Regional Quarterly Bulletin on Wildlife and National Parks Management

Vol. XXXVII : No. 3



Special Issue
Asia-Pacific Forestry
Sector Outlook Study II

Featuring

FOREST NEWS

Vol. XXIV: No. 3

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TIGERPAPER



REGIONAL OFFICE FOR ASIA AND THE PACIFIC

TIGERPAPER is a quarterly news bulletin dedicated to the exchange of information relating to wildlife and national parks management for the Asia-Pacific Region.
ISSN 1014 - 2789

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TIGERPAPER

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Front cover: Tiger crossing a creek in the Sundarbans in Bangladesh (same picture as used on the book cover of 'Living with tides and tigers - the Sundarbans mangrove forest', Mowgliz Production, Dhaka. Photo: Gertrud & Helmut Denzau

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EXAMINING CERTAIN ASPECTS OF HUMAN-TIGER CONFLICT IN THE SUNDARBANS FOREST, BANGLADESH

by Gertrud Neumann-Denzau and Helmut Denzau

Introduction

In the Sundarbans mangrove forest in the Gangetic delta (10,284 km²: 58.5% in Bangladesh, 41.5% in India) human-tiger conflicts are more frequent than in any other tiger area of the world. Only a limited number of tiger victim cases reach the public. The term victim is used here for people injured or killed by a tiger attack within the forest area.

In a previous paper Neumann-Denzau and Denzau (2010) analysed reports of tiger attacks based on two independent data sets, listings of the Bangladesh Forest Department (BFD) and newspaper clippings, for the period 2003-2005 (36 months). One hundred seventy-seven casualties were reported, each identified by the name of the victim, age, profession, home village, as well as date and location of the incident. The listings of the BFD contain only cases of people who entered the forest with legal permission; the newspapers report without such limitation. A comparison of these data sets consisting of individual casualties allowed us to develop an extrapolation of the total number of tiger victims in the Bangladesh Sundarbans, which was found to be 168 as the annual average for the years 2003-2005. A high percentage were illegal entrants.

In this paper we used the same data base as in Neumann-Denzau and Denzau (2010). Our next aims were to localize the places of incident and discuss the different reasons for tiger attacks, e.g., disturbance by human intruders, changes in salinity and vegetation, tiger and prey densities, etc.

Furthermore, we considered the locations of the homes of the victims, used different sources to estimate the number and origin of resource extractors, and looked into peculiarities of the area most afflicted by human-tiger conflicts (i.e., Shyamnagar upazila). In addition to our two data sets for 2003-2005, we consulted an extended data base of the BFD for the period 1984-2005 to examine temporal changes of the places of incident.

Places of incidents

The Sundarbans Reserve Forest (SRF) belongs to 3 zilas (administrative units): Satkhira (I), Khulna (II) and Bagerhat (III), subdivided into 5 upazilas: (I) Shyamnagar; (II) Koyra, Dacope; (III) Mongla, Sarankhola. The Sundarban Impact Zone (5,128 km², BPC, 2005-2007b) consists of 17 upazilas belonging to 5 zilas (Satkhira: Assasuni, Kaliganj, Shyamnagar; Khulna: Batiaghata, Dacope, Koyra, Paikgachha; Bagerhat: Morrelganj, Rampal, Sarankhola, Mongla; Pirojpur: Bandaria, Mothbaria, Nessarabad; Borguna: Bammna, Borguna, Pathergatha) and was defined by the BFD (SBCP Baseline Study 2001) as the area surrounding the forest where most of the Sundarbans resource users live (Fig. 1). The forest itself is divided into 4 forest ranges (FR): Satkhira FR, Khulna FR, Chandpai FR and Sarankhola FR. The boundaries of the forest ranges are not congruent with the zila boundaries. For example: the Sathkira FR exceeds the boundaries of Satkhira zila and covers parts of Khulna zila.

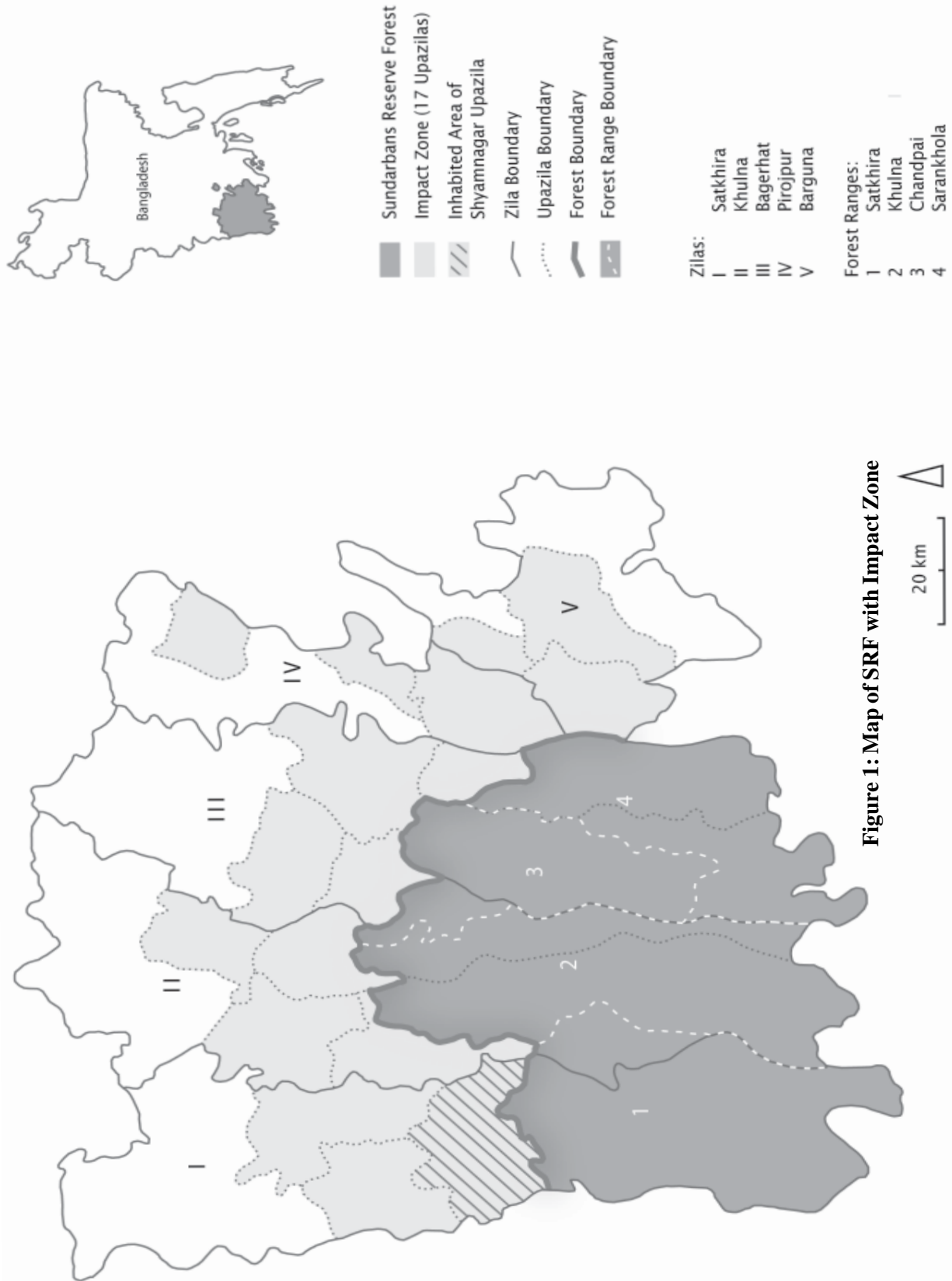


Figure 1: Map of SRF with Impact Zone

Most of the available reports on casualties are accompanied by the name of the place of the incident. These names are not always correct. They might be also distorted by verbal transmission or by translation into English. We have used a combined approach to locate place names, taking into account the compartment numbers given by the BFD and references from 1: 50 000 maps (Curtis, 1933; BFD, 2002).

The majority of place names (164 out of 177 individually known casualties or 92.7%) could be localized either by compartment number or at least by forest range. For our data set for 2003–2005, we found that a high percentage of cases (94.5%) happened in Satkhira FR; 155 cases in total.

In order to find out if the number of tiger attacks in Satkhira FR was always higher than in other parts of the Bangladesh Sundarbans, data for 50 years (1956-2005) were analysed. Old FD data may sometimes include casualties from the fringe area. In the BFD data (1984-2005) used in this study we have considered only data from inside the forest.

Hendrichs (1975) reported 392 casualties between 1956 and 1970. Out of these, 365 were known by place of incidence with 198 (54.2%) occurring in Satkhira FR.

Reza *et al.* (2002), basing their results on records of the BFD, found that 401 people were killed between 1984 and 2000; 45% in Satkhira FR.

JJS (2003) reported 181 casualties between January 1999 and March 2002 (39 months). One hundred and six (58.6%) of the victims were domiciled in the reclaimed region of Satkhira zila. Out of these, 96 (53.0% of the total victims) belonged to Shyamnagar upazila. One hundred and seventy-three of the attacks could be located by range and compartment, revealing that 111 (64.2%) occurred in Satkhira FR.

Islam *et al.* (2007) analyzed data of the BFD between 2000–2004 and found that 79.1% (87 out of 110) victims were killed in Satkhira FR.

The available data for certain time sequences are listed in Table 1.

Table 1: Casualties in Satkhira Forest Range (1956-2005)

| Period | Number of casualties with known place of incident | Number of casualties in Satkhira FR* (absolute) | Number of casualties in Satkhira FR* (in %) | Type of Data | Source |
|-----------------|---|---|---|--------------|--|
| 1956-1970 | 365 | 198 | 54.2 | FD | Hendrichs (1975) |
| 1956-1983 | 554 | 265 | 47.8 | FD | Siddiqi & Choudhury (1987) |
| 1971-1983 | 189 | 67 | 35.4 | FD | Difference between Hendrichs and Siddiqi & Choudhury |
| 1984-2000 | 401 | 180 | 45.0 | FD | Reza <i>et al.</i> (2002) |
| 1999-March 2002 | 173 | 111 | 64.2 | FD+NP+IN | JJS (2003) |
| 2000-2004 | 110 | 87 | 79.1 | FD | Islam <i>et al.</i> (2007) |
| 1984-1992 | 259 | 128 | 49.4 | FD | This study |
| 1993-1999 | 104 | 20 | 19.2 | FD | This study |
| 2000-2005 | 127 | 110 | 86.6 | FD | This study |
| 2003-2005 | 164 | 155 | 94.5 | FD+NP | This study |

(FD = Forest Department, NP = Newspapers, IN = Interviews, FR = Forest Range)

*Satkhira FR differently defined (Comp.46-55 by Hendrichs (1975), Comp.41-44, 46-55 by Siddiqi and Choudhury (1987), Comp.41-42, 46-55 by all others) and therefore not entirely comparable.

At first sight (upper part of Table 1) it would seem that the portion of casualties in the Satkhira FR has always been high and has increased slowly since the investigations by Hendrichs (1975). When examining the available FD data in detail (see lower part of Table 1) it becomes evident that the percentage of casualties in Satkhira FR remained constant at c. 50% until about 1992. In the period 1993-1999, it dropped quite low (to c. 20%). Beginning in 2000, it has increased dramatically, reaching more than 90% for the first time in 2002.

From our 2003-2005 data we found that 94.5% of the casualties occurred in Satkhira FR. Table 1 shows that the portion of tiger incidences in Satkhira FR has fluctuated over a period of c. 50 years (1956-2005) between 19% and 94% and was by no means always the highest within the Sundarbans. What has caused these temporal changes?

Discussion of reasons for tiger attacks

First of all, it should be recognized that due to the amount of freshwater inflow, the salinity in the Bangladesh Sundarbans is increasing from east to west and from north to south. Satkhira is the forest range with the highest salinity and covers 32% of the Bangladesh Sundarbans forest (Hussain and Acharya, 1994).

Human intruders

The correlation between the number of resource extractors and tiger attacks has been discussed by different authors.

Hendrichs (1975) was the first to notice an increased percentage (54.2%) of casualties in this FR and suspected the higher degree of salinity as one possible reason for tigers showing abnormal behaviour. He deduced this idea from his data, gathered by personal communication, revealing that only 10% of the people (1,000 of about 10,000) inside the forest were found in Satkhira FR. He concluded that utilization of forest by men increases from west to east; occurrences of tiger casualties (except for man-eaters) increase from east to west and from north to south; while the salinity increases from northeast to southwest.

“The distribution of casualties during the day – highest in early morning and afternoon – and during the year – highest in winter and in the months of honey collecting – is clearly related to the utilisation of the forest, i.e., to the availability of human prey.” He also considered another factor at work besides this causal correlation, giving him occasion to classify tigers into categories for debating the man-eater phenomenon. After comparing the relative number of casualties in each forest compartment, he claimed that the number of men engaged in forest operations in low salinity areas showed that the killing rate is not a question of availability of men, but that inside the high salinity zones the killing of men is correlated with their availability. We are not sure if Hendrichs’ discussion is based on correct information regarding the number of people working at that time in each forest range. Even nowadays it is quite impossible to find complete temporal and spatial data along with the scale of all forest activities – a fact which prevents a direct correlation between the number of tiger attacks and the disturbance level.

In 1970/71, a high number of casualties occurred in connection with timber cutting operations in the low salinity zone. Hendrichs (1975) developed the theory that a single male tiger (Mara Passur man-eater), responsible for a series of 32 casualties in 13 months in an area of about 150 km², might have moved in from the high salinity zone. Chakrabarti (1978) was another supporter of the roving man-eater thesis, which was deduced from the analysis of the most vulnerable blocks regarding human casualties before and after ‘Project Tiger’ started functioning in the Indian Sundarbans. After the core area was closed for human access the most vulnerable blocks in the core area were replaced by blocks in the buffer zone. Chakrabarti believed that the man-eaters had followed the people in search of human prey. We think that another interpretation is also possible: due to the disturbances caused by increased human activities a local tiger could have turned into a man-eater. This would be contrary to Hendrichs’ and Chakrabarti’s theory of the migratory nature of man-eaters.

Migratory or transient tigers (males as well as females) are found in each tiger population. For instance, they were found to form a mean

abundance of 7% of a well-studied tiger population in Chitwan, Nepal (Barlow *et al.*, 2009a). As transient tigers have not established their own territory they may face problems in hunting prey or in approaching sweet water ponds in the Sundarbans. This needs to be studied further.

Siddiqi and Choudhury (1987) found casualties in the high salinity zone of SRF to be significantly higher than those in the medium and low salinity zone for the period 1956-1973. But during the period 1974-1983, the differences in casualties between the low and high salinity zones became insignificant and the casualties in the medium salinity zone were significantly higher than those of the other two zones. They concluded: "This trend does not justify the hypothesis that the salinity of the water causes tigers to develop man-eating behaviour." The number of casualties among the Golpatta cutters was high throughout all forest ranges, while honey collection and Goran cutting logically revealed a strong correlation between yield per range and casualties, as the latter two are not practised in all ranges.

Salter (1984), after analysing another data set, found indications that "the frequency of man-killing is highest in areas and at times of heaviest concentration of people, suggesting that the man-killing and the frequency of man-tiger contacts are directly correlated".

JJS (2003): "... seems to suggest that there is a direct relation between the number of attacks and the number of people accessing these areas."

From our own observations in the Bangladesh Sundarbans, including 3 visits to working coupes of the Khulna Newsprint Mill (KNM) at Chora Betmore (headquarters at Comp. 4,7) and Ghushiangra (headquarters at Comp. 10,15) in 1992 and 1993, we know that Gewa (*Excoecaria agallocha*) cutting was often done in small and isolated sub-units and that the Gewa woodcutters were very often confronted with repeated tiger attacks, even in low and medium salinity zones. Before the Khulna Newsprint Mill closed in 2002, about 1,000 Gewa woodcutters were said to be under contract at the same time. The data obtained from the BFD show a killing series of 38 victims, most of them woodcutters, in Comp. 5,6 in the

low salinity zone, between 6 February 1988 and 14 March 1989. From Mr. Daruzzaman (KNM), we came to know independently about 22 tiger victims that correlated with Gewa cutting (1982: Comp. 18,19; 1983: Comp. 16; 1988: Comp. 5; 1989: Comp. 4,5; 1991: Comp. 12 A+B). The KNM shifted the headquarters of the felling activities from Chora Betmore to Ghushiangra in 1992. After March 1989, there were no more incidents in Comps. 4,5,6,7 until November 2005. We therefore conclude that a high level of disturbances by forest resource users may provoke man-eating behaviour among local tigers even in the low salinity zone. The series of killings 1988/89 in Comp. 5,6 listed by BFD directly correlates with our information regarding Gewa cutting operations by KNM in this area.

Salinity and vegetation

Besides salinity, additional environmental factors that influence the soil, water and vegetation are manifold such as geomorphological and hydrological components, chemicals, (including nutrients), pH value, tidal water flow and flooding, sediment load, and micro climatic factors. The vegetation is less diverse in high salinity zones, poor in the interior and richer at the forest margins. Floral composition and growth affect faunal composition and dynamics. The vegetation/herbivore relationship is a key for understanding the tiger/prey relationship.

Goran (*Ceriops decandra*) is a typical small mangrove of high salinity zones and forms dense thickets. Chakrabarty (1978) identified the habitat formation 'pure *Ceriops*' for the highest records of human casualties in the Indian Sundarbans, together with high records in pure and mixed Hental (*Phoenix paludosa*) stands. Deodatus and Ahmed (2002), who analysed the preference of tiger and prey for different forest types in the Bangladesh Sundarbans, found a high occurrence of tiger crossings in dense vegetation of Goran, Hental and some mixed forests as well. Dense undergrowth would require another kind of hunting strategy by the tiger than an open forest floor, if used for hunting at all, and not for prey consumption, birth giving, rearing and resting. Satkhira FR, rich in Goran and Hental, calls for inquiries into the activities, densities and links of tigers, prey and

people in this vegetation type. The outcomes could result in a recommendation for resource users to avoid entry into certain forest types. This would benefit tiger conservation and save human lives.

It has often been suspected or claimed that the physiology of Sundarbans tigers is affected by high salinity. But as far as we know there is no scientific proof of this. It has to be kept in mind that inner organs like the kidneys can be investigated histologically only by pathologists, not by the local veterinaries who are usually called in for the autopsy of Sundarbans tigers. It is quite possible that Sundarbans tigers in high salinity zones suffer from hypertonicity, causing increased activity and aggressiveness. In order to detect hypertonicity it would be required to measure the blood pressure of live wild Sundarbans tigers for comparison with the blood pressure of tigers from other regions. This could be carried out when wild tigers come into the hands of man after narcosis for medical treatment, radio-collaring or translocation. In this connection, it is also recommended to check if Sundarbans tigers with easy access to sweet water ponds within the forest attack people less often than tigers with no such access.

Tiger and prey density

Three independent surveys investigated the banks of creeks to record the tiger crossing frequency in the Bangladesh Sundarbans. Deodatus and Ahmed (2002) covered big parts of all forest ranges (766 km along creeks). Two surveys conducted in 2007 and 2009 (Barlow *et al.* 2008, 2009b) covered the entire area of 1,201, resp. 1,207 creek km. All surveys found high track rates per creek kilometer in Satkhira FR. These were interpreted as an index of relative tiger abundance only. Another possible interpretation could be increased activity, meaning that the tigers are more frequently on the move as a result of hypertonicity, variations in prey availability, different hunting techniques or due to other factors, including human disturbance level. Either higher tiger abundance or different tiger behaviour, natural or man-induced, could explain the higher rate of tiger attacks in Satkhira.

Deodatus and Ahmed (2002) have investigated the relative density of spotted deer (*Axis axis*) and wild boar (*Sus scrofa*) – the most important tiger

prey species – counting footprints and pellets on transects and plots in many parts of the Sundarbans. They found an increase towards the west, with a relatively high abundance of both species in Satkhira FR. The wild boar track density in the northern fringes of Satkhira FR was remarkably high, while the deer track density decreased here. A more detailed relative prey abundance survey for the Bangladesh Sundarbans is in progress. Tiger density, prey density, frequency of human activities, kind of human activities, and human casualties can't be correlated as long as sufficient data are not available.

Presumably there is a coinciding of relevant factors which causes the high level of human-tiger conflict in certain areas of the Sundarbans.

Homes of victims

Out of our data source (2003–2005) the home places of the tiger victims were sorted according to zila for the Impact Zone (Table 2). The home villages of 138 victims are known, of whom 117 are from Satkhira zila. Of the victims known by their village, 78.3% come from the inhabited area of Shyamnagar upazila (hatched area in Fig 1).

Number of resource extractors

After learning of the high concentration of tiger victims living in Shyamnager upazila, it seemed reasonable to ask if an over proportionate number of people of this upazila enter the forest. In order to ascertain the total number of resource extractors of the SRF, we consulted the SBCP Baseline Study (2001) and different volumes of the Bangladesh Population Census (BPC).

The aim of the SBCP Baseline Study was to analyse the socio-economic conditions in the Impact Zone of the Sundarbans, which has a population of about 3.5 million people. The study consists of two parts, a village census and a household survey. The village census was conducted among 54 surveyed villages with 22,099 households being interviewed. As a result, 3,996 households (heads) were found to be dependent primarily on SRF resources. Out of these, 790 households were selected for a representative

Table 2: Tiger victims' home places (2003-2005)

| Year | Reported cases | Known villages of victims | Satkhira Zila | Khulna Zila | Bagerhat Zila | Pirojpur Zila | Barguna Zila | Outside Impact Zone | Shyamnagar upazila in Satkhira |
|-------------------------|----------------|---------------------------|---------------|-------------|---------------|---------------|--------------|---------------------|--------------------------------|
| 2003 | 83 | 49 | 45 | 3 | 0 | 0 | 0 | 1 | 43.0 |
| 2004 | 47 | 46 | 37 | 7 | 1 | 0 | 0 | 1 | 33.0 |
| 2005 | 47 | 43 | 35 | 5 | 2 | 0 | 0 | 1 | 32.0 |
| Total number of victims | 177 | 138 | 117 | 15 | 3 | 0 | 0 | 3 | 108.0 |
| % | | 100 | 84.8 | 10.9 | 2.2 | 0 | 0 | 2.2 | 78.3 |

household survey. It was found that more than 68% of the households extracting the Sundarban resources were also involved in secondary occupations (also based on Sundarban resources).

In Bangladesh, the BPC for 2001 was held in zilas and upazilas. The results of the zilas and upazilas in the Impact Zone were published in 2005-2007. This is the latest statistical data set for the population of the Impact Zone.

The number of households depending on SRF was determined in the following way: for each of the 17 upazilas of the Sundarban Impact Zone, the population and total number of households were taken from BPC data. The percentage of households depending on SRF was taken from the SBCP Baseline Study (2001). This percentage is used to calculate the total number of households depending on SRF. The results are compiled in Table 3, zila-wise for the total Impact Zone and for Shyamnagar upazila in particular.

**Figure 2: Woodcutters entering mangrove forest (Photo: Gertrud & Helmut Denzau)**

Table 3: Population and households in the Sundarbans Impact Zone (SIZ) according to Bangladesh Population Census 2001 (BPC 2005, 2006a, 2006b, 2007a, 2007b) and percentage of households depending primarily on Sundarbans resource extraction, calculated with data from the SBCP Baseline Study 2001.

| | Total SIZ 5 Zilas, 17 Upazilas | Satkhira Zila 3 Upazilas | Khulna Zila 4 Upazilas | Bagerhat Zila 4 Upazilas | Pirojpur Zila 3 Upazilas | Barguna Zila 3 Upazilas | Shyamnagar Upazila in Satkhira Zila in particular |
|--|--------------------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------------|-------------------------------|--|
| Population in the SIZ | 3,449,741 | 819,409 | 738,709 | 791,167 | 631,015 | 469,441 | 313,781 |
| Households in the SIZ | 712,977 | 163,333 | 150,080 | 166,320 | 132,801 | 100,443 | 58,885 |
| % of households depending primarily on SRF within the SIZ of each Zila | average 15.9 | 20.2 | 23.8 | 14.2 | 4.4 | 15.3 | 20.4 |
| Number of households depending primarily on SRF as portion of the total SIZ | 113,534 100.0 % | 32,921 29.0 % | 35,787 31.5 % | 23,574 20.8 % | 5,876 5.2 % | 15,376 13.5 % | 12,013 10.6 % |

To estimate the total number of forest resource users nowadays, the data of Table 3 have to be used. Fifteen percent of all household heads in the Impact Zone (113,534 households total) declared earning their primary income from activities inside the forest. There are, however, four factors of uncertainty: a) it remains unknown how many members of the primary dependent households enter the forest for how many days per year; b) the group of secondary resource users, whose main income is generated outside the forest but who enter the forest occasionally, was not analyzed in the SBCP Baseline Study (it might be the bulk); c) the number of illegal entries is not available; and d) the number of persons who enter the forest from outside the Impact Zone is not recorded. The border of the Impact Zone was set up according to the distance from the forest (with the exception of Nessarabad in Pirojpur Zila) and is not a sharp dividing line between forest resource users and non-users. Furthermore, deep-sea fishermen employed in the winter season at Dublar Island

(within the Sundarbans) are mainly recruited from the Chittagong area in south-east Bangladesh, far away from the Impact Zone.

Kabir and Hossain (2007) found from interviews with honey collectors in the Impact Zone that there were 1.47 earners per household. Due to all these uncertainties, the attempt to estimate the number of people who enter the Bangladesh Sundarbans to earn their livelihood varies widely, amounting to a figure somewhere between 200,000 and 500,000 people (annual average).

According to Table 3, 12,013 households in Shyamnagar upazila are primarily dependent on Sundarbans resources; that is 10.6% of all forest resource users in the Impact Zone. Taking the same uncertainties into calculation as in the previous paragraph, the number of forest resource extractors in Shyamnagar roughly amounts to a figure between 20,000 and 50,000 people (annual average).

The data in Table 3 disprove that the absolute number of legal SRF resource extractors from Satkhira zila is higher than in the direct neighbourhood, although it is generally higher in the west of the Impact Zone. But what is different about Shyamnagar upazila? We investigated several aspects from within both the inhabited area and the forested area.

Peculiarities of Shyamnagar

Shyamnagar upazila has an area of 1,968.24 km² (437.71 km² inhabited area and 1,530.85 km² forested area). It has a population density (outside the forest) of 717 persons per km². That is 1.07 times larger than the average population density (673 persons per km²) in the Impact Zone. Shyamnagar covers 8.53% of the Impact Zone area and is inhabited by 9.1% of the Impact Zone population. The population densities for Shyamnagar upazila and the total Impact Zone were calculated using the population figures along with the size of the upazilas minus the size of the forested areas as published in the Bangladesh Population Census 2001 (BPC 2005-2007b, consulting tables C01 and not the erroneous upazila summary findings).

The population growth from 1991-2001 in Shyamnagar was listed as 18.4%; the average literacy rate was 39.7% for 2001, with a growth of 40.7% over 10 years (BPC 2007b). The population characteristics do not show any peculiarities.

The conversion of agricultural land into saltwater shrimp farms in the previous decades has been associated with serious negative environmental and social impacts.

The inhabited zone of Shyamnagar is delimited by the international border with India in the west and the SRF in the south. As the international border is officially closed, the region is an isolated pocket with an underdeveloped infrastructure. These factors result in a high poverty level in Shyamnagar.

The following outlines indicate that illegal activities in Shyamnagar upazila are more frequent than elsewhere.

Illegal activities

The aquatic resource users (fishermen, collectors of shrimp fry, crabs and shells) are obviously the resource users with the highest disposition for illegal activities. In a cross-tabulation of activity with profession, JJS (2003) found that 45.0% of the fishermen (48 cases in the period 1999-2001) were actually extracting wood at the time of the tiger attack. According to the SBCP Baseline Study (2001) 33% of the aquatic resource users admitted entering the forest without taking a permit. The same study brought to light that 41.7% of all resource users admitted to gathering firewood from the forest.

In the period 2003–2005, we identified 90 aquatic resource users among 126 tiger victims with known occupations. Seventy-four out of 90 casualties happened in Satkhira FR. Sixty-six of the 74 aquatic resource user victims had their domicile in Shyamnagar upazila and 8 in other upazilas of Satkhira zila. This means that 73% of the attacked aquatic resource users came from Shyamnagar upazila.

Poaching is obviously another precarious issue. In their interviews, JJS (2003) came across 160 deer hunters (amateurs, semi-professionals and professionals – all illegal) and found that Shyamnagar upazila had more hunters (40), than any other of the 9 upazilas in the Impact Zone. They go hunting deep in the westernmost parts of the Bangladesh Sundarbans where most of the tiger attacks occur. According to the collected newspaper reports covering deer poaching in Bangladesh Sundarbans between 2003-2008, 74% of the poachers (14 out of 19 cases) were based in Shyamnagar upazila. In a discussion on nature conservation in 2009, about 80% of approximately 100 students in a school in Burigoalini (Shyamnagar upazila) said that they had eaten deer meat in their lifetime. A scarcity of herbivorous prey, caused either by poaching or environmental factors, might increase the tiger's interest in human prey.

Satkhira is the only forest range in Bangladesh Sundarbans which attracts migratory wild honey bees (*Apis dorsata*) in considerable numbers. The season to harvest honey and wax is usually opened

by the BFD on 1st April. When following the permit holding honey collectors in Satkhira FR a high percentage of honey combs were found to have been harvested before 1st April, indicating that other forest resource users gather honey illegally as a profitable main or by-product. While following the honey collectors into the interior of the forest, a vast number of valuable Passur trees were found to have been felled. There was a rumour that the frontier defence authority, whose mission is to patrol the border in Satkhira, is involved in illegal timber felling. Both facts could also explain a higher human disturbance level and thus a higher number of tiger attacks in this forest range.

An unknown number of Bangladeshi nationals are crossing the border for illegal forest resource extraction in the Indian Sundarbans. This has been proven for the honey collectors. In a case witnessed in April 2009, a Bangladeshi honey collector was killed by a tiger on the Indian side, but the Bangladeshi news reported that it happened in Satkhira FR, which means that the authorities or media obviously try to suppress the sensitive issue of frontier violation. This case could signify that the locations of tiger attacks on Bangladeshis in the Indian Sundarbans are being projected into Satkhira FR, falsely inflating the number of incidences here.

Unequal management realities may give rise to increased legal or illegal resource exploitation and thus create higher disturbance levels in certain forest areas. It is unknown if the high number of tiger attacks in the Satkhira FR is due to management deficiencies.

Summary

The high level of disturbance by forest resource users seems to provoke man-eating behaviour among local tigers, despite all other aspects mentioned before. Therefore, the number of tiger victims can only be reduced if less people enter the forest.

Poverty is the most dominant factor for which all types of resource extractors are involved in their present jobs. When asked about what steps should be taken to reduce threats to the Sundarbans the most common answers were: stop illegal tree

felling; enforce laws; create alternative jobs; and increase supervision. About 91% of the Sundarbans resource extractors expressed positive responses in favour of their interest to be involved with alternative jobs; then they would not need to go into the forest (SPCP Baseline Study, 2001).

Shyamnagar upazila as the hot spot of human-tiger conflict requires particular attention. The socio-economic and ecological situation of this problem zone will be examined in greater detail in a forthcoming paper. One of the most important issues for the locals here is juridical help for regaining control over the utilization of the land, now widely leased for shrimp production. The conversion of rice fields into shrimp farms in the previous decades has been associated with serious negative environmental and social impacts. The land is suitable for a sophisticated mixture of agriculture, aquaculture and tree plantations as a source of alternative incomes. The required reformation of land use should be as eco-friendly and labour intensive as possible. It needs to be accompanied by additional measures such as the construction of solid embankments, efficient drainage systems, ponds or tanks for rainwater harvest, the introduction of salt-tolerant crops, investments into education and training, and a general improvement of the infrastructure, which could inspire the foundation of new enterprises for the benefit of human resources.

Keeping people out of the tiger's habitat can be achieved by human resource management in addition to forest resource and wildlife management. The separation of tigers and humans in the Sundarbans forest is not only a question of nature conservation, but also a question of humanity.

Acknowledgements

We are grateful to numerous individuals and institutions for the collection of data and translations of relevant information from Bengali into English language. We would like to thank Guenter Loew for improving our English.

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NEORA VALLEY - A NEW SHORT-LISTED WORLD HERITAGE SITE

by Jayanta Kumar Mallick

Introduction

The pristine forest of Neora Valley National Park (NVNP) in Kalimpong hills, Darjeeling district, which has formed an ecological trijunction with Sikkim and Bhutan, is the last virgin wilderness in West Bengal. It is one of the oldest (1881) reserve forests in India. Since this area has been put under protection and is an unworkable working circle, the high forest remains intact. Besides, due to its inaccessibility and difficult terrain, biotic pressures are not very acute. Hence, NVNP is a well-preserved serene wildlife habitat. But the rich heritage of NVNP was unknown to the external world up until December 1982, when the Himalayan Club, along with Zoological Survey of India, Department of Botany, Calcutta University, West Bengal Forest Development Corporation and Indian army organized the first expedition to the then uncharted Neora Valley forest from Lava. As an outcome of this expedition there was a sustained campaign later on to save its pristine character. In 1985, Ghose also reported on ecological observations on Neora Valley. It was notified as a protected area of national importance in April 1986 and finally gazetted in December 1992. In May 2009, NVNP was also been included in the shortlist of World Heritage sites (UNESCO World Heritage Centre, 2009).

NVNP lies in the biogeographic province 2C of the Central Himalayas (Rodgers *et al.*, 1988, 2002). The park spreads over 88 km², located between latitudes 26°52'03"N-27°7'35"N and longitudes 88°45'E-88°50'E; however, the actual surface area available to the wild denizens is, in fact, much greater owing to its undulating terrain. The highest point is Rechila danda peak (3,170 m) bordering Sikkim.

Biodiversity values

Neora Valley is recognized as a global biodiversity hotspot for its unique ecosystem, where tropical,

sub-tropical, temperate and sub-temperate forests represent a wealth of biodiversity. It is designated as one of the key biodiversity areas in the Eastern Himalayas for mammals and birds (WWF-US, Asia Program, 2005). This area is included in one of the 25 Global Hotspots (Myers *et al.*, 2000), the Global 200 forest eco-regions (Olson and Dinnerstein, 1998), two endemic bird areas (Stattersfield *et al.*, 1998) and several centers for plant diversity (Davies *et al.*, 1995). It is also an integral part of the Kanchenjunga landscape (Sharma and Chettri, 2005; Chettri *et al.*, 2007a). NVNP is considered as West Bengal's crowning glory because of its wide range of environment gradients (183 m – 3,200 m) and climatic conditions, supporting a unique and ecologically important undisturbed patch of late succession forest. In spite of being located in the Oriental Region, this park has some floral and faunal similarities with the Palaearctic Region of the adjacent zoogeographic zone. Moreover, it has characteristics of all the three sub-regions, namely the Himalayan Montane System, the Indian Peninsular sub-region and the Malayan sub-region. NVNP, along with its adjoining forests of Kalimpong Forest Division, is also an important ecological corridor in Eastern Himalayas for movement of long-ranging animals to and from other contiguous protected areas (PAs) in northern Bengal (e.g., Gorumara National Park, Mahananda and Chapramari Wildlife Sanctuaries), Sikkim (Pangolakha Wildlife Sanctuary) and Bhutan (Torsa Strict Nature Reserve, Jigme Dorji, Thrumshingla and Bomdeling National Parks) linking Arunachal Pradesh (India) (Chettri *et al.*, 2007b; Wangchuk, 2007).

Habitats

NVNP exhibits a rich variety of habitats, as the area comprises the catchment and watershed of the Neora River, which is fed by nine main streams and sixteen subsidiary streams. There are

also a few wetlands like Jorepokhri (latitude 27°8'N and longitude 88°44'E), below the Rechila danda, Panchpokhri in West Nar-5 compartment and Tempola Khola at East Nar-22 compartment. Four habitat types are recognized in NVNP, namely: i) Subtropical Mixed Broadleaf Forest; ii) Lower Temperate Evergreen Forest; iii) Upper Temperate Mixed Broadleaf Forest; and iv) Rhododendron Forest. The density of vegetation is generally >0.4, except at Rechila Chawk, which was deforested in 1879 (Singhal and Mukhopadhyay, 1998). NVNP is extremely rich in flora and fauna, which have recently been studied in parts of this park.

Flora

Forty-five fern, 154 angiosperm and 1 gymnosperm species were enumerated in the virgin Neora valley (Majumdar *et al.*, 1984). Eighty-three medicinal, 59 edible, 18 ornamental, 21 poisonous (irritants and lethal) and 11 plants having fascinating assorted ethnic uses have also been identified (Rai and Das, 2004). NVNP is home to 52 orchid species, including some endemics (UNESCO World Heritage Centre, 2009). The common species of rhododendrons found here are *Rhododendron arboruem*, *R. barbatum*, *R. falconeri* and *R. dalhousiae*.

It is also famous for the medicinal plants found there (PRAGYA, 2007) including *Swertia chirata*, *Lycopodium* spp., *Aconitum* spp., *Aristolochia* spp., *Berberis cristata*, *Costus speciosa*, *Didymocarpus pedicellate*, *Rouwolfia serpentine*, etc. Jaributi valley of Upper Neora is famous for producing the most important medicinal plants. Cryptogams of this park are little known, but approximately 20% of the total species known till now [680 angiosperms (flowering plants), about 23 Pteridophytes (vascular plants), 4-5 species of Gymnosperms (seed-bearing plants)] are extremely rare and face the threat of extinction (Singhal and Mukhopadhyaya, 1998). These include *Arisaema griffithii*, *Balanophora neorensis* (a unique species of parasitic angiosperm), *Balanophora polyandra*, *Begonia gemmipara*, *Betula utilis*, *Botrychium* sp., *Cardamine macrophylla polyphylla*, *Cinnamomum impressinerum*, *Cyathea* sp., *Digitalis purpuria*, *Eleocarpus lanceifolius*, *Gentiana pedicellate*, *Geranium nepalense*, *Ilex*

hookeri, *Ilex odorata*, *Monotropa* sp., *Partia monlana*, *Ranaculus ficarifolius*, *Ranunculus tricuspis*, *Rhododendron arboreum*, *Rhododendron barbatum*, *Rhododendron dalhousiae*, *Rhododendron falconeri*, *Rhus* sp., *Ribes glaciata*, *Schisandra neglecta*, *Swertia bimaculata*, *Swertia chirata*, *Swertia dilatata*, *Swertia nervosa*, *Taxus baccata*, *Thalictrum foliolosum*, *Utricularia* sp., *Viburnum cotinifolium*, *Viburnum grandiflorum*, *Viburnum stellatum* and all species of orchids.

Fauna (mammals)

Biswas *et al.* (1999) identified 32 species of mammals in the upper NVNP, belonging to 16 families and 5 orders, representing more than 17% of the total mammalian diversity in West Bengal. Of these, 9 species are protected under Schedule I of the Indian Wildlife (Protection) Act, 1972. Some other records of species richness in NVNP are also available (Sharma, 1990; Mukhopadhyay, 1996; Singhal, 1999; Chakraborty *et al.*, 2008a, 2008b; UNESCO World Heritage Centre, 2009; Anonymous, 2010). A compilation of all these documentations shows that the registered species diversity in both the upper and lower NVNP is 65.

Populations of some of these species have been assessed like Red panda *Ailurus fulgens fulgens* (28-32), Himalayan black bear *Ursus thibetanus laniger* (18), Gaur *Bos gaurus gaurus* (81), Himalayan tahr *Hemitragus jemlahicus schaeferi* (32), Goral *Naemorhedus goral hodgsoni* (73), Serow *Capricornis sumatraensis jamrachi* (89), Sambar *Rusa unicolor niger* (286), Barking deer *Muntiacus muntjak vaginalis* (590) and wild boar *Sus scrofa cristatus* (615). Some other important species, the populations of which could not yet be assessed, are Clouded leopard *Neofelis nebulosa macrosceloides*, Leopard *Panthera pardus fusca*, Leopard cat *Prionailurus bengalensis horsfieldi*, Marbled cat *Pardofelis marmorata charltoni*, Indian pangolin *Manis crassicaudata*, Chinese pangolin *Manis pentadactyla aurita*, Malayan giant squirrel *Ratufa bicolor*, Hodgson's flying squirrel *Petaurista magnificus*, Wild dog *Cuon alpinus primaevus*, Elephant *Elephas maximus indicus*, Fishing cat *Prionailurus viverrinus viverrinus*, Assamese macaque *Macaca assamensis pelops*, Rhesus macaque *Macaca*

mulatta mulatta, Moupin pika *Ochotona thibetana sikimaria*, Rufous tailed hare *Lepus nigricollis ruficaudatus*, etc. Discovery of tiger *Panthera tigris tigris* (20) in 1998 prompted the forest department to include NVNP as a sensitive wildlife zone. The population of long-ranging mammals in NVNP like tigers, elephants and Indian bisons or gaurs, fluctuates seasonally due to inter-PA and trans-boundary migration through the identified corridors, particularly along the riverbeds. Hathi danda was a traditional elephant route up to 1940 (Anonymous, 1010). Rechila (Chawk) including Jaributi valley (latitudes 27°05'-27°07'N and longitudes 88°43'-88°45'E) and Alubari (latitude 27°07'N and longitude 88°43'E) are two ideal sites for viewing the wildlife movements.

Aves

NVNP, including Lava, is a birders' paradise. One hundred and six species belonging to 22 families and 8 orders have been recorded (Singhal and Mukhopadhyay, 1998). The semi-evergreen forests between 1,600 m and 2,700 m are home to several rare species like Rufous-throated partridge, Satyr tragopan, Crimson-breasted woodpecker, Darjeeling woodpecker, Bay woodpecker, Golden-throated barbet, Hodgson's hawk cuckoo, Lesser cuckoo, Brown wood owl, Ashy wood pigeon, Mountain imperial pigeon, Jerdon's baza, Black eagle, Mountain hawk eagle, etc. (Anonymous, 2010).

Amphibians

Fifteen species of amphibians are recorded in NVNP (Mukhopadhyay, 1996; Singhal and Mukhopadhyay, 1998).

Reptiles

Twelve species of lizards and 47 species of snakes have been identified in this park (Mukhopadhyay, 1996; Singhal and Mukhopadhyay, 1998).

Fishes

Thirty-one species of fishes have been recorded here (Mukhopadhyay, 1996; Singhal and Mukhopadhyay, 1998).

Insects

There are 276 species of insects (118 genera, 89 families and 17 orders) and 38 species of other invertebrates (mollusks, arthropods and annelids), including 6 species of leeches, that have been identified in NVNP (Mukhopadhyay, 1996; Singhal and Mukhopadhyay, 1998). The Neora valley is richly blessed with a medley of beautiful butterflies like the Kaiser-i-Hind and Krishna peacock.

Eco-tourism

The nearest railhead of NVNP is New Jalpaiguri (132 km) and the nearest airlink is Bagdogra airport. On procuring an entry permit after payment of requisite fees, the park may be approached either from Lava on the west (30 km from Kalimpong) or from Samsing on the east (80 km from Siliguri). NVNP is an adventurous place for hard-core nature lovers and trekkers because it is a virgin natural forest with dense bamboo groves, a colourful canopy of rhododendron trees, lush green valleys and meandering rivers and streams with snowcapped mountains in the backdrop forming a picturesque landscape. Starting from Lava, the first night halt is at Chaudapheri (2,372 m), a distance of 14 km. The second destination is Alubari via Zero Point and PHE source [16 km (13 km through dense forest and 3 km through undulating valley)]. Next camping is at Jorepokhri or twin ponds (2,782 m), after trekking through bamboo and rhododendron forest (8 km). Then halt at Bhottekharag on the bank of Bhote Khola (stream), about 30 km away via Mouchaki. Samsing is only 20 km from Bhottekharag. These trails are often difficult with steep descents (600/700) and slippery. There is no watchtower in NVNP for viewing wildlife. Moreover, the visibility in dense forest is not more than 5 to 10 m and often less than 2 m on either side of the trekking route. So, the chance of sighting an animal, other than some avifauna, is almost zero, unless they cross the trail. The only threat in the forest is the possibility of a sudden attack by the Himalayan black bear. Trekking in the mysterious NVNP is a life-time experience.

Acknowledgements

The author is grateful to Mr. Indranil Mitra for providing the G.I.S. maps of the study area and Mr. Somnath Chakraborty for retrieving relevant data. Thanks also to those field staff and officers of the Forest Department, particularly Mr. N.C. Bahuguna, I.F.S., Chief Conservator of Forests, North Bengal and Shri Subrata Pal Chowdhury, Technical Assistant (Wildlife Wing, Headquarters).

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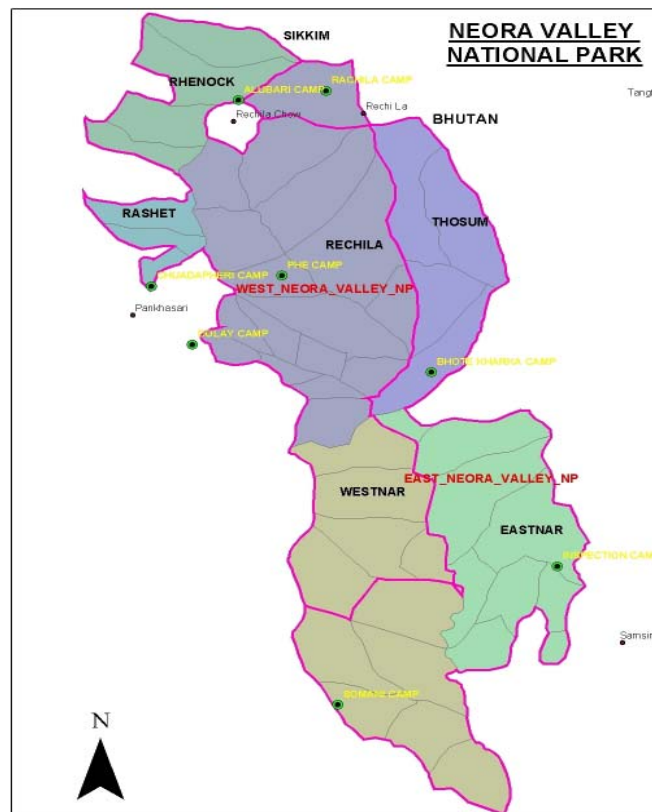
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BEHAVIOURAL OBSERVATIONS ON FREE-RANGING RHESUS TO PYTHON DUMMY

by P.S. Bhatnagar and R. Mathur



Introduction

Rhesus macaque (*Macaca mulatta*) has a zoogeographic distribution in India and some of the neighbouring countries. Roonwal and Mohnot (1977) and Fooden *et al.* (1981) have redefined the rhesus macaque-bonnet macaque boundaries in peninsular India.

Pythons are non-venomous constricting snakes that are found from Australia through New Guinea, Indonesia, southern Asia to Africa (Rawlings, 2003; Zug, 1993). Thus, both rhesus macaque and python are eurytopic species, with the zoogeographic distribution of python overlapping that of rhesus.

Earlier, Makwana (1977) observed the response of langurs to snakes (both alive and dead). Barrett *et al.* (2004) in their study on chacma baboons (*Papio hamadryas ursinus*) reported that a Cape cobra had bitten two female baboons who died, while a third, who recovered, had venom sprayed into her eyes. In Africa, studies using dummies of lions have also been carried out (Grinnell *et al.*, 1995).

Methods

The observations in the present study were made at the Ambagarh Reserve Forest, about 7 km from Jaipur (75° 55' E, 26° 55' N) in North India. The

area has a village and few temples. Monkeys are provided with food by devotees on auspicious days. There are seven rhesus groups in the Ambagarh Reserve Forest, Jaipur, with a density of 20 per km².

The adult python dummy used in the observations was brown-black in colour and about 8 feet long and 4 inches in diameter. The observations were recorded *ad libitum* (Altmann, 1972) in the morning of 27 November 2001.

Results

At 8.30 a.m., a group of rhesus macaques looked at the python dummy from a distance with alarm. At 9.15 a.m. when the snake was dragged by a white thread on the road, the group ran away. Later, a sub-group of rhesus followed the snake. When snake was stopped moving, several rhesus came and looked at the python dummy from a distance of about 5 feet. After about 10 minutes, their curiosity was gone and the rhesus returned to other activities. Female rhesuses were more cautious, as their infants are more vulnerable. However, males would get closer to inspect the snake dummy.

Discussion

As reptiles, snakes may have signified deadly threats in the environments of early mammals.

Intense snake fear is prevalent in both humans and other primates. Humans and monkeys learn snake fear more easily than fear of most other stimuli through direct or vicarious conditioning (Ohman and Mineka, 2003). It is worthwhile to mention that observational fear has also been documented in birds (Curio, 1988), rodents (Kavaliers *et al.*, 2001) and cats (John *et al.*, 1968). Classical fear conditioning has been used as a model paradigm to explain fear across species (Olsson *et al.*, 2007).

In the present observations, the response of the rhesus group to the python dummy can be described as first alarm, then curiosity, and then indifference, where they turned to other activities (e.g., resting, feeding). The observations can be compared to that of Makwana (1977) at Jodhpur in western Rajasthan, India, with langurs and snakes. The langurs were alarmed on seeing the snake initially and when it moved. Some langurs also examined the snake.

Mineka (1987) has done interesting experiments on laboratory-bred rhesus monkeys (*Macaca mulatta*) in which monkeys who were initially not afraid of snakes acquired an intense fear when they watched a wild-reared monkey behaving fearfully in response to a toy snake (Cook *et al.*, 1985; Mineka *et al.*, 1984; Cook and Mineka, 1989, 1990).

In addition, monkeys regularly failed to acquire fear towards artificial flowers or a toy rabbit using the same paradigm, but they may acquire fear to stimuli such as toy crocodiles, which more directly resemble snakes (Cook and Mineka, 1989). Since the observer monkeys were bred in the laboratory and had never seen a snake, crocodile or flower before, the conclusion drawn by Cook and Mineka (1989) was that "it seems highly likely that the difference in the associability of toy snakes versus artificial flowers and toy rabbits derives from phylogenetic rather than ontogenetic factors. In the present observations, free-ranging rhesus showed behaviour similar to laboratory-bred rhesus exposed to wild-reared monkeys behaving fearfully in response to a toy snake in experiments done by earlier workers (Cook *et al.*, 1985; Mineka *et al.*, 1984; Cook and Mineka, 1989, 1990). However, mobbing of poisonous snakes by langurs is also

known, which is similar to mobbing displays of birds and some other primates (Srivastava, 1991).

Acknowledgements

Thanks are due to the Director, Zoological Survey of India, as well as to the Discovery Channel team who brought the python decoy. Thanks are also due to the Forest Department.

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PERAMELIDAE MAMMAL SPECIES IN THE NORTHERN PART OF MANOKWARI, WEST PAPUA

by Sepus Fatem, Hermanus Warmetan and Petrus Izak Bumbut

Introduction

New Guinea Island is the world's second largest island and has a very rich biodiversity. The marsupials of Australia and New Guinea are descended directly from ancestors isolated on Sahul or Greater Australia (continental crust represented today in New Guinea and its nearby islands, mainland Australia and Tasmania) when the final fragmentation of Gondwana occurred about 55 million years ago (Ashwell, 2007).

In West Papua, tropical forest ecosystems are especially represented and a high biodiversity of flora and fauna occurs. These complete ecosystems, from coastal to alpine zone, are home to numerous mysterious species, many of which haven't even been properly identified yet. The terrestrial mammal species in New Guinea (Papua island) have special characteristics that differentiate them from other areas in Indonesia, and indeed other regions in the world. Petocz (1994) noted that terrestrial mammals in Papua consist of three classes, namely protheria, marsupialia and eutheria. Based on dental identification, the subclass marsupialia is categorized into 2 orders: 1) polyprotodonta, which are carnivores; and 2) diptorodonta, which have herbivore characteristics.

The bandicoot is endemic to New Guinea and has a broad distribution. It is categorized into Family: Peramelidae, Subclass: Marsupialia, Order: Diptorodonta. The main characteristics of the Diptorodonta are the pouch and the syndactylly in the second and third digits of the hind foot.

The forest that is the main habitat of fauna has been currently degraded as a result of agriculture activities and settlement areas. Even though the bandicoot population in nature is abundant, the human population growth will eventually affect the bandicoot population by indirect processes. Furthermore, the development of Manokwari as the capital city of West Papua province has several consequences impacting the forest such as development of infrastructures, entertainment facilities, settlements, public offices, roads and agriculture reconversion. Under the urban development planning of Manokwari region, the northern part of the city is going to be converted into new settlement areas. This area is also currently the site for a major road project connecting several districts together like Manokwari-Sorong-Bintuni. As a result, it will have a considerable impact on the biodiversity composition. Diamond (1989) explained that

alteration and fragmentation of pristine habitat by human activities are two of the greatest threats to the maintenance of biodiversity. Saunders *et al.* (1991) and Forman (1995) noted that landscape and forest fragmentation is now recognized as one of the major threats to the conservation of biodiversity. In addition, there is a crucial lack of information relating to the biodiversity in this area, due to the fact that no research has been conducted.

According to Anderson *et al.* (1988), some kinds of the New Guinean bandicoots are locally abundant and easily trapped, but because of the animal's nocturnal activity and location in forest areas, no information exists on its behavior and ecology. Therefore, basic information needs to be collected in terms of bandicoot species composition to provide data in order to further manage this species in this area. This research was conducted in order to identify bandicoot species in lowland forest in the northern part of Manokwari. It also provides general information about biodiversity in Papua, especially related to bandicoots. In a further step it will be useful for the prospect of captive management.

Methods

This research was conducted in the lowland forest among 4 main villages namely: Pami, Sairo, Breml and Nuni in northern part of Manokwari. Data was collected over a period of two months from mid-May to mid-July 2007. The object was to carry out research on bandicoots and to measure certain variables used by some tools. Menzies (1991), Petocz (1994), Flannery (1995) and Mack (2002) were the key guides used to identify this species. Field observations and descriptive methods were used in this research. Morph metric variables were analyzed.

Results and discussion

Based on the description of morphological characteristics and color patterns from 15 bandicoot samples captured during this study in the lowland tropical rain forest area of the four villages in North Manokwari District, all belong to one genera, namely *Echymipera* that consists of two species, *Echymipera rufescens* and *Echymipera kalubu*. The number of samples and bandicoot species found during the study are shown in Table 1.

Table 1: Species and number of bandicoots encountered in the tropical lowland rain forest of Nuni, North Manokwari District

| Bandicoot species | female | male | total sample/pair |
|-----------------------------|--------|------|-------------------|
| <i>Echymipera rufescens</i> | 1 | 9 | 10 |
| <i>Echymipera kalubu</i> | 1 | 4 | 5 |
| Total | 2 | 13 | 15 |

From Table 1 it can be seen that ten *Echymipera rufescens* were caught, including one female and nine males, while five *Echymipera kalubu* were caught, consisting of one female and four males. The two female bandicoots captured were both rearing offspring in their pouches. The *Echymipera rufescens* female had two juveniles in her pouch while the *Echymipera kalubu* female had three juveniles in her pouch. Manufandu (2000) noted that female bandicoots show higher activity in searching for food compared to the male bandicoots. However, data from the capture

showed that many more males are being captured than females (thirteen males compared to only two females). Menzies (1991) and Flannery (1995) stated that in general, after a short gestation period, four juveniles are found in the pouch, but usually only three or mostly two juveniles survive, which means that juveniles bandicoots show a high mortality rate in the pouches. Our observation indicates that the only danger from predators is from the monitor lizards (*Varanus* spp.); however, their population is quite low and not threatening.

Morphological characteristics

The bandicoot family Peroryctidae (Groves and Flannery, 1990), established largely on the basis of derived skull characters, including a tube-like foramen rotundum, comprises four genera of mainly forest dwelling animals—*Peroryctes*, *Microperoryctes*, *Rhynchomeles* and *Echymipera*.

Next are the morphological characters of bandicoots found in North Manokwari District, based on the color pattern of their skin or fur, and their body size.

1. *Echymipera rufescens*



Size: Large, total body length 320 mm – 510 mm; body weight 500 gram – 2,500 gram.

Eyes: Round shaped and black colored.

Ears: Pointed and black colored; length 20 mm – 32 mm.

Snout: Elongate, black.

Teeth: Four incisors at the upper jaw, no incisors at the lower jaw, one pair of canine, premolar three pairs, four pairs of molars, length of incisors 6 mm, lower jaw molars 6 mm and upper jaw molars 5 mm.

Color of skin/fur: Dorsal blackish brown mixed with yellow color at the points of hair. Ventral of males and females white colored to grayish while in male bandicoots the white to grayish color experiences a change of color, where in juvenile male bandicoots the color expands or widens to the dorsal, while in adult males the stripe is thin/small and is restricted to the ventral; lateral is blackish brown.

Pelage structure: Dorsal 10 mm, ventral 7 mm, lateral 10 mm.

Pelage texture: Dorsal rough, ventral smooth, lateral rough.

Breast circle: 140 mm – 380 mm.

Tail: Length 35 mm – 100 mm black and no hairs at the tips. Adult bandicoots have no hairs on the tail, which feels rough, grooved and fissured.

Feet: Length of the hind feet 50 mm – 80 mm and fore/front feet 30 – 55 mm, with five toes white colored, hind feet four toes, black colored and hairless.

The female *E. rufescens* captured in the study had four pairs of nipples and was carrying two baby bandicoots in her pouch. The babies were very young and without hair, their eyes are still closed and they were still attached at the nipples of their mother; the pouch opened backward. Nine males of this species were captured/collected.

Menzies, 1991 stated that the body color pattern of *Echymipera rufescens* is as follows: light brown to dark brown and at the tips of the hairs is a mixture of brown and black. It is the largest species compared with *Echymipera kalubu* and *Echymipera clara*, with a body weight 3.4 kg in males, and 2.5 kg in females. The head/skull shape is slender with a longer snout. Compared with the species encountered at North Manokwari District lowland rain forest area, the body measurements shows similarities, the head/skull is slender and snout long; the color pattern on the upper part (dorsal) is brown to blackish and the tips of the hairs is a mixture of yellowish brown to black color. The body weight is 0.5 kg to 2.5 kg. Characteristically, the pouch of the mother bandicoot opens backward, compared with other marsupials like **Phalangeridae** (cuscus) and **Macropodidae** (kangaroo and wallaby) in which the pouches open forward.

1. *Echymipera kalubu*

Size: small to intermediate; body length 305 mm – 470 mm; body weight 750 gram – 1900 gram.

Eyes: rounded and black colored.

Ears: Rounded, black color, with the length of 17 mm – 30 mm.

Snout: Short and pointed with black color.



Teeth: There are four incisors at the upper jaw, the lower jaw has no incisors, there is one pair of canine, three pairs of premolars, four pairs of molars, the length of lower incisors is 7 mm and upper incisors 6 mm, while the lower molars are 6 mm long and the upper molars 6 mm long.

Pelage color: Blackish brown dorsal with hairs with a mixture of colors, yellowish at the tips; ventral of males is dark brown or rather reddish, while in females is ivory yellow or not as reddish as the males; lateral is blackish brown.

Pelage structure: Dorsal 9 mm, ventral 6 mm, lateral 9 mm,

Pelage texture: Rough dorsal, smooth ventral, rough lateral.

Breast circle: 190 mm – 250 mm.

Tail: Length 50 mm – 90 mm black color; going to the tips hairs become scarce and the tips become hairless (for adults), while in the young ones, the tails are fully covered with hairs up to end/tips.

Feet: Length of hind feet 46 mm – 75 mm and front feet 25 mm – 40 mm. The front feet have five toes, with hairs reddish brown color, while the hind feet have four toes with black color and sparse hairs. The female captured/collected had four pairs of nipples and in her pouch were three sucklings about one month of age, their bodies already covered with hairs, the eyes are already opened. Occasionally they would leave the pouch and come back to feed at the nipples. The pouches are open to the back. Four males were collected from this species.

Menzies, 1991 noted that *E. kalubu* has a body length of 40 cm or 400 mm with a short tail; the shape of the skull is narrow and pointed; the nose tends to be longer/elongated. The color of the upper body/dorsal is light brown to dark brown, formed by the mixture of hairs with yellow and black tips, and the lower parts (ventral) are an ivory yellow color. There are four incisors on the upper jaw. A comparison of the results of *E. kalubu* from the lowland rain forest of North Manokwari District, shows similarities, e.g., the dorsal shows a light brown color to reddish dark brown color, while at the ventral the color is ivory yellowish color to reddish. Comparing the body length, this bandicoot can reach 47 cm; the length of the snouts is intermediate and not as long as that of *E. rufescens*. The female bandicoot of this species has three juveniles and 8 pairs of nipples and the pouch opens backward similar to that of *E. rufescens*.

The genus *Echymipera* includes 5 species (*E. clara*, *E. davidi*, *E. echinista*, *E. kalubu*, and *E. rufescens*) that are difficult to distinguish from one another morphologically. *E. echinista* is very rare and *E. davidi* is very locally distributed, but *E. kalubu* and *E. rufescens* are widespread. Of the latter two, *E. kalubu* is thought to comprise four subspecies—*E. k. kalubu* found over most of the New Guinean mainland; *E. k. cockerelli* from the Bismark Archipelago; *E. k. oriomo* from the Fly River Plateau; and *E. k. philipi* from Biak and nearby islands (Flannery, 1995). *E. rufescens* is thought to include only two subspecies, one of which is widespread over most of New Guinea and the other found only on the Cape York Peninsula of Australia (Flannery, 1995; Westerman *et al.*, 2001)

Moreover, Westerman *et al.* (2001) by their research and other studies suggest that the complex geological history and current geographic diversity of New Guinea have produced a much more diverse fauna of endemic marsupials than is reflected in current classifications. This is true for the New Guinean dasyurids and diprotodontians as well. More detailed investigations that include morphological and genetic analyses of marsupial populations from across New Guinea (especially Irian Jaya) are urgently needed in order to delineate

species boundaries and elucidate the biology of these little-known mammals.

Conclusion

Two species of bandicoots has been encountered in the tropical lowland rain forest of North Manokwari District, namely *Echymipera rufescens* and *Echymipera kalubu*. Both species belong to the Genus *Echymipera*. Fifteen bandicoot specimens were captured in the study consisting of *Echymipera rufescens* (10: 1 female and 9 males) and *Echymipera kalubu* (5: 1 female and 4 males). Based on the color pattern there are differences where male and female *E. rufescens* have dorsals of brownish black mixed with yellowish tips of hairs, white to gray ventrals, and laterals of blackish brown. This differs from male and female *E. kalubu* where the dorsal is brownish black mixed with yellowish tips of hairs, ventrals are reddish brown mixed with yellowish color at tips of hairs, and laterals are blackish brown. Morphological measurements show that *E. rufescens* is larger in size compared with *E. kalubu*, with a body weight 1,500 – 2,500 gram; total body length 320 – 504 mm; Skull/head length 85 – 115 mm; body length 185 – 355 mm; tail length 35 – 100 mm; breast circle 140 – 380 mm; length of hind feet 50 – 80 mm. *E. kalubu* is smaller in size with a body weight of 750 – 1900 gram; total body length 320 – 470 mm; skull/head length 73 – 100 mm; body length 170 – 280 mm; tail length 50 – 90 mm; breast circle 190 – 250 mm; and length of hind feet 46 – 75 mm. Further study is needed to determine why the male population far out-competed the female population.

Acknowledgements

The authors gratefully thank the local people who supported this research by permitting access to the area and local guides contributing to the field survey, namely Mandacan Anji, Ergor Hans-Luis, Isir Agus, Krenak Anton and Simbiak Victor.

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MATERNAL ATTACHMENT-DEAD INFANT CARRYING IN HANUMAN LANGUR AROUND JODHPUR (RAJASTHAN)

by Gautam sharma, Devilal, Prateek Vijay, Bharti Swami and L.S.

Rajpurohit



Introduction

The young of many mammalian species provide a variety of stimuli which influence vital parental responses. Bell & Harper (1977) revealed that primate and other mammalian young “must emit the appropriate cues and possess the necessary response capabilities to insure that care giving is released and functional”. Ethologists and comparative psychologists have long recognized that proper care of dependent young requires that parent-offspring interactions be regulated by reciprocally exchanged signals, and it is becoming increasingly clear that both parent and young are endogenously tuned to detect and react to each other’s signals. In neonate mammals, behavior is typified from birth by reciprocal simulative relationships between parents and young, whereby the neonate attracts the female, and the female presents a variety of primarily approach-inducing stimuli (Schneirla & Rosenblatt, 1961). Alley (1980) states that the distinctive markings and coloration found

in young infants of many primate species function as signals which tend to “release” care giving responses. Jay (1962) suggests that three important elements viz. coat color, vocalization and quality of movements in the infant’s appearance and behavior are essential in releasing maternal behavior of the mother or of other adult females in langurs; thus, the body of a dead infant may continue to elicit maternal behavior from its mother (such as carrying, grooming) and other adult females for several days after death occurs. The carrying of dead infants has been reported for several primate species in the wild by Van Lawick-Goodall (1967) in chimpanzee, Schaller (1963) in gorilla, DeVore (1963) in savannah baboon, Kummer (1968) in hamadryas baboon, Prakash (1962) and Alley (1980) in rhesus macaque, Rahman & Parthasarathy (1969) in bonnet macaque, Merz (1978) in barbary macaque, Bowden *et al.*, (1967), Cleve (1969) and Kaplan (1973) in squirrel monkey and Jay (1962, 1963), Mohnot (1974 & 1977), Hrdy (1976), Rajpurohit (1987 & 1992), Winkler, Sommer, Bornes and Paul (pers. comm.) in Hanuman langur.

Materials and methods

The Hanuman langur (*Semnopithecus entellus* Dufresne, 1797) is the best studied and the most adaptable South Asian Colobine. They live in a wide range of habitats from the Himalayas and peninsular forests to semiarid lands, in villages and towns and on cultivated land (Roonwal & Mohnot, 1977).

Data presented here are from a long-term study of the free-ranging langurs around Jodhpur (India). Jodhpur is located in Rajasthan at the eastern edge of the Great Indian Desert. In and around this town surrounded by semi desert plateau is a geographically isolated population of about 1,850 langurs comprising 32-34 one-male bisexual troops and 12-14 unisexual all-male bands. The climate is dry, with maximum temperatures about 48°C in May/June and minimum temperatures around 0°C in Dec/January. Jodhpur receives 90% of its scanty rainfall (annual average 360 mm) during the monsoon (i.e., July-September).

The natural open scrub vegetation is dominated by xerophytic plants, including *Prosopis juliflora*, *Prosopis cinararia*, *Acacia senegal*, and *Euphorbia caducifolia*. The langurs feed on about 190 wild and cultivated plant species (for ecology see Mohnot, 1974; Winkler, 1981; Srivastava, 1989). For religious reasons, local people provision most of the groups with vegetables, fruits, nuts, and cooked or uncooked food. In some groups the provisioning accounts for about two-thirds of the total feeding time. Some groups raid crops and orchards, but because they are considered to be sacred, are never hunted. Apart from feral dogs, there are no natural predators found in this area. The animals are easy to observe since they are not shy and spend most of the daylight hours on the ground.

The reproductive units are bisexual one-male troops with a single adult resident male. As a rule, in this species, males never carry or feed infants. Each troop occupies its own home range of about 0.5-1.5 km². Females remain in their natal troops for life with few exceptions. Males emigrate, usually as juveniles, to unisexual all-male bands, whose home ranges can be as large as 20 km². According to censuses carried out in 1983-1986, 1990, 1997-

2001 and 2005 (Mohnot *et al.*; 1987; Rajpurohit & Sommer, 1991; Rajpurohit, 1992, Rajpurohit *et al.* 2006), the number of bisexual troops varied between 32 and 34. The mean troop size was 38.5 members (range 7-124 animals). The number of all male bands was about 13, which averaged 11.8 members (range 2-47 members). The mean annual population consisted of 101.4 adult males (age < 7-8 years) and 500.5 adult females (age > 3-4 years), yielding a mean of 17.4 reproductive females per troop. Male-female sex ratio at birth was 1.1:1, which later at the adult stage is female biased, i.e., 1:4.1 (Rajpurohit & Sommer, 1991). All-male bands invade home ranges of bisexual troops in an unpredictable pattern, sometimes resulting in rapid or gradual replacement of the resident male (see also Sommer & Rajpurohit, 1989).

The Hanuman langur infant-I stage lasts from birth to 5-6 months and the infant-II stage lasts until weaning ends at about 12-15 months, when the infant is almost independent from its mother (Rajpurohit & Mohnot, 1991). Theoretically, the age of mother, age of an infant (on death), cause of death, and to some extent the type of habitat should be responsible factors affecting the duration of keeping infants after their death. Predictions are that mothers would carry a dead infant longer in the case it died at an early age; if death is natural or due to some unknown cause, it is predicted that the mother would carry the corpse longer than in cases of accidents (e.g., electrocutions or falls); and third is that older mothers would carry their dead infants for longer periods than the young females would. All these predictions are tested in this paper.

Whenever a dead infant was observed being carried by its mother in this study site, further observations continued every day until the carrier finally abandoned the corpse. Ten cases were observed from July 2005 to June 2006 (see Table 1).

Observation and results

Langurs at Jodhpur breed throughout the year as births occur year round but are not uniformly distributed. During this study, ten cases of dead infants being carried by their mothers were observed, except in one case, when an infant was killed in an infanticidal attack (in Kailana, B-19)

during the resident male's take-over of this troop. After this it was observed that the mother carried her infant for 6 days and after that the corpse was left on a tree branch, completely decomposed. Mothers were frequently noted sitting near the decomposed body of their infants for about a week. Out of 10 infant deaths, 4 were newborn deaths (considered as stillbirths), 6 were natural deaths due to unknown causes or by mishandling (e.g., by suffocation or choking due to inexperienced mothers pressing the infants hard during nursing and 'kissing', and during infant transfer from one female to another). In Kaga (troop-B-12), an older female was noted carrying a dead infant for 27 days. The infant had died a natural death at 3 months old. The dead infant was completely dry and decomposed. In other case of Kadamkhandi (troop-B26), a female was observed carrying dead infant for 17 days.

In 4 cases, the ages of infants on their deaths were less than three months, two were of 4 and 5 months of age and the remaining 4 were stillbirths. The causations of death were categorized into three main reasons viz. accidents, stillbirth and natural or unknown causes. In this study it was noted that after changes of natal coat color, dead infants are not carried any longer. However, the other factors like the age of the mother and causation of death may also affect the duration of carrying dead infants. We have observed the range of carrying dead infants was 3-27 days and the average was 9.4 days.

Behavior of mother

The behavior of the mother with their dead infants has been observed from the day the observer encountered a female carrying a dead infant. The mother managed to walk on three limbs. At feeding time the mother put the dead infant on the ground and then picked it up again. During the first 2-3 days the mother treated the dead infant very carefully. She would watch the eyes and the face of dead infant again and again. Sometimes she groomed and kissed the corpse of the infant. But after decomposition began and the body dried out, she was less careful about the corpse. In some cases when it started to smell the mothers were observed to defend the body against crows that tried to approach the corpse.

In troop Kaga in March 2006, an older female was observed carrying a dead infant for 27 days. This was the maximum time period observed for this behavior. She kept infant's body under her legs at feeding time and kept it very carefully from outer interaction. In troop Daijar-I in February, 2006 a female carried her stillborn baby with the placenta still attached for four days. In January 2006, an older female carried a dead infant for 17 days (in Kadamkhandi).

Behavior of other troop members towards a dead infant -

The resident males of the troop ignored the dead infants in the same manner in which they do for live ones. But other adult females approached the body, touched it, and sometimes groomed it. They responded this way only for few minutes. The female juveniles and older infants of troop were also observed smelling and touching the corpses. However, the subadults and juveniles were observed smelling and carefully watching the dead infants. Sometime juveniles would try to take the dead infants but in few minutes they would leave it on ground. In the first 2-3 days other females of troop showed sympathy towards the mothers of dead infants.

Duration of carrying or keeping a dead infant

The age of the carried dead infants varied between stillbirths to 9 months, although in 7 cases their ages were less than 4 months. There was no correlation found between the age of an infant on death and the duration the corpse was carried. However, in two cases of infants aged seven and nine months old on death, the body was not carried by mothers for more than one and half hours. We have also not found any correlation between the cause of death and the duration of carrying corpses.

Discussion

These fairly prolonged observations made over two seasons suggest that at least some mothers show blind attachment to their dead infants, keeping them in their arms for surprisingly long periods (3-6 days in the mating and 9-29 days in non-mating season). This may at first suggest, as be-

lieved by Zuckerman (1932) regarding primates, that langurs do not recognize the phenomenon of death, and this suggestion would seem to be supported by the continued attachment of the mother to the dead infant for long periods. However, it should be noted that the other members of the troop do seem to make a distinction between the dead and the living infants.

Jay (1962) with regard to the langur *Semnopithecus entellus*, and Prakash (1962) and Koford (1965) with regard to the rhesus monkey *Macaca mulatta*, also observed mothers carrying dead infants. Koford stated that the corpse continued to be carried even after it had decayed, though the period it was kept was not mentioned.

Jay (1962) mentioned that mothers should carry dead infants longer in the case that they died at an early age because an infant may persist without the mother's support when they are alive. As the infant's color changes, the interest of adult females declines and they no longer seek out the infant to hold it and groom it as often. It is Jay's (1962) speculation that the natal coat of a dead infant is sufficient to initiate approach and grooming by adult females.

Van Lawick-Goodall (1967) reported that Mandy, a female chimpanzee, carried her dead infant after birth for three days. Schaller (1963) saw a gorilla mother carry her dead infant (died two days after birth) for four days before leaving it behind. A case of a free-ranging group of rhesus macaques in the Jackoo Forest, Simla, was reported by Ciani (1984) in which a one-year-old male infant died due to an adult male's attack and the supposed mother took the dead body and carried it 400 m into the forest and sat there without following rest of the troop. Severely injured infants (due to infanticidal attacks) in Hanuman langurs at Jodhpur were also observed being carried by their mothers or allomothers (Agoramoorthy and Mohnot, 1988; Rajpurohit, 1987; Sommer, 1987). Angst & Thommen (1977) also reported mothers carrying freshly injured infants in a semi-free-ranging colony of barbary macaques. Alley (1980) suggests that macaque mothers quite commonly protect and transport even dead infants. Rahaman & Parthasarathy (1969; p. 157) reported that "a dead baby is carried for several days by its mother in

bonnet macaques". On the other hand, a study of a free-ranging population of *Macaca sylvanus* (Merz; 1978) reports that members of all age (juvenile onwards) and sex classes will carry dead infants.

Rumbaugh (1965) reported a case in which a mother squirrel monkey continued to respond to her stillborn infant for more than six weeks while the infant remained in the cage with the mother and three other monkeys. Clewe (1969, p. 154) has suggested the presence of hair may be the crucial stimuli, since squirrel monkeys born without hairs are dropped to the floor, whereas those born with it are held.

Kaplan's (1973) results indicate that the response of the male squirrel monkey to a dead infant depends partly on the age at which her infant dies. This kind of maternal behaviour has also been reported in savannah (DeVore, 1963) and hamadryas baboons (Kummer, *et al.*, 1970). A second hypothesis is that if the infant's death is due to some accident (e.g., electrocution or a fall), mothers should not carry a dead infant for as long a period as in case of natural deaths because in an accident she has seen the incident and probably would understand that there was something wrong, but in the case of natural deaths the mother may not understand what is wrong with her infant and therefore keep carrying it for some time believing there is a chance for the infant to recover. However, it may be, as believed by Zuckerman (1932) regarding baboons, that the langurs also do not recognize the phenomenon of death, and this suggestion would seem to be supported by the continued attachment of the mother to the dead infant for long periods.

The older females should carry dead infants (believing it to be unconscious) for longer periods than young females do because they are more worried about their reproductive success than young females. In this study it was observed that two old females carried their dead infants for longer periods. Jay (1963) though, also in regard to langurs, reported without mentioning the age of the females that the dead infants were carried until they decomposed. However, the other adult and juvenile females approach dead infants less frequently than live infants. For langur mothers to

carry and protect their dead infants for days after their death suggests that there are probably other reasons or factors than vocalization or movements which are responsible for this kind of maternal behavior. It might be the natal coat color, as the coat color of new born infants of all species of Old World monkeys is different from that of an adult of the same species. But it is not clear then why females other than the mother do not carry or groom a dead infant still having the natal coat color as they would do with live infants.

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ANTHROPOGENIC THREAT TO GAUR (*Bos gaurus*) IN BAISIPALLI WILDLIFE SANCTUARY, EASTERN GHAT, INDIA

by D.P. Sahoo and S.K. Das

Introduction

The Indian Subcontinent is one of the most fascinating ecological and geographical regions in the world and remarkable for the variety of its large mammals with a richness in species exceeded by few countries in the world (Schaller, 1967). But the increasing human populations, urbanization, industrialization, deforestation and various other anthropogenic developmental activities have led to the rapid depletion of this magnificent biodiversity hotspot and the habitats of wildlife. India's Eastern Ghat is one of the key biodiversity areas that is facing high anthropogenic disturbance from different sites. Baisipalli Wildlife Sanctuary in Orissa is considered as the gateway to Eastern Ghat and one of the major conservation areas of this region. The vegetation of the sanctuary largely comprises northern tropical moist deciduous and dry deciduous forests and moist peninsular low level Sal (*Shorea robusta*) forest. It is also a good habitat for gaur (*Bos gaurus*), which is listed under Schedule-I of the Wildlife (Protection) Act, 1972. But this area is highly affected by different human activities which are causing the gradual depletion of habitat of wild animals including Gaur. Previously, Rout (2005) studied the anthropogenic disturbances in Similipal Biosphere Reserve of Orissa. Studies on threats to gaur date back to Duckworth *et al.* (1999), Sankar *et al.* (2000), Choudhury (2002), Steinmetz (2004) and Pasha *et al.* (2004). In Eastern Ghat, Baisipalli is an unexplored area. There is no information available on threats towards gaur or about the local community's attitude towards its conservation. Therefore, the present study aimed to document the baseline information on threats to the studied species and to create awareness among different levels of society to conserve this vulnerable species (Duckworth *et al.*, 2008).

Methodology

The study was carried out from January to June 2010. To evaluate different threats to gaur within the sanctuary, two methods were used during the field survey, i.e., interviews with local people and site condition monitoring. During the interviews the people were asked questions about the causes of the gradual decline of the gaur population within the sanctuary. Through site condition monitoring, types of disturbances such as human encroachment into the core area (for timber, bamboo, fuel wood, different forest products like resin, honey, fruits, flowers, seeds, leaves, poaching purpose), types of habitat degradation (like forest fires, logging, developmental works, etc.) and the effects of grazing were noted.

Results and discussion

Site condition monitoring

During the study period twenty selected sites were visited, each site covering 10-15 km. Gaur sightings and evidences were found in 9 sites (45%). Out of the 9 sites of gaur-occupied areas, 7 sites (77%) were affected by forest fires. Most of the forest fires were found to be man-made. People set fires for collection of mahul flower (*Madhuca indica*), for hunting purposes, and in some cases as mischief. People of BWLS were also dependent on the forest for wood and bamboo. Outside people were also involved in transporting timber from the sanctuary to the outside with the help of local poor tribals. Five sites (55%) were found to be mostly affected by such felling activities. Livestock grazing in the forest is a common feature of BWLS. In places where gaur evidences were found, evidence of hoof marks and cattle dung were also found at the same or nearby places. It was found that livestock are the main competitors of gaur in its

habitat. Eight (88%) out of nine sites were found to be affected by livestock grazing.

Interviews with local people

From interviews with the local people the following information was gathered. As gaur meat was eaten by the Harijan people, these people were involved in gaur poaching. Gaur poaching in 3 out of 9 sites was recorded by the local people during the study period. They also said that contagious diseases like Foot and Mouth Disease (FMD) are one of the main causes of the reduction of the gaur population in BWLS. Pasha *et al.* (2004) considered that 'in fact, no wild animal in India is so profoundly influenced by transmitted infection from domestic livestock as Gaur'.

Local people's attitude towards gaur conservation

In Baisipalli Wildlife Sanctuary (BWLS), a mixed reaction towards gaur conservation was found among local community. A total of 109 people were interviewed where the male-female ratio was 2.2:1.1. Almost all were farmers and also dependent upon forest products for their livelihoods. The people considered gaur to be a dangerous animal because there were previous records of humans killed by this animal in the sanctuary. Among the respondents 46.78% had positive feelings towards gaur conservation, but 31.2% were found to have negative feelings; 21.1% had no opinion about this aspect.

Suggested conservation measures

The following conservation measures were suggested for better conservation of the species within the Sanctuary.

- People should be encouraged to plant trees around the periphery of their villages to fulfill their requirements and should be permitted to collect firewood, NTFP products, and bamboos from those periphery jungles, but their encroachment into the core forest should be strictly prohibited.
- Poaching should be strictly prohibited through stringent legislations and offenders should be punished.
- A boundary should be marked in each village beyond which livestock grazing should not be

permitted and the grazer disobeying this should be punished.

- A vaccination program for livestock should be encouraged to prevent livestock from transmitting diseases to gaur. Steps should be taken to minimize disturbance in areas inhabited by gaur.
- Research should be conducted in different seasons to study the ecology of gaur in BWLS for better management of the species within the sanctuary.
- The awareness level about wildlife conservation among the local community in and around the sanctuary is very low. Therefore, awareness-raising programs are necessary up to the grass roots level to motivate people towards the wildlife conservation and protection.

Acknowledgements

The authors are grateful to the Forest Department of Orissa for granting permission during the study period to collect the baseline information. The first author would like to acknowledge Mr. P. Mishra, Secretary, Sanchar Organization, for his hospitality during the field work. Both authors also give special thanks to Dr. H.K. Sahu, Reader, Zoology Department, North Orissa University, Orissa, Dr. S.D. Rout, Reader, P.G. Department of Wildlife and Conservation Biology, North Orissa University and Dr. L.A.K. Singh for their inspiration to carry out this research work.

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FIRST RECORD OF EURASIAN OTTER (*Lutra lutra* L.) IN RAJIV GANDHI ORANG NATIONAL PARK, ASSAM

by Chatrapati Das

The Eurasian otter (*Lutra lutra*) historically occurs throughout the northeast India (Ruiz-Olmo *et al.*, 2008.) This species has been reported from Barail Reserved Forest (RF), Innerline RF, Manas National Park (NP), Nameri NP and Kaziranga NP by Choudhary (1997). In this note, I present a new sighting record of Eurasian otter in Rajiv Gandhi Orang National Park. On 20 April 2008, I, along with a forest staff official (Lachit Borgayari), went to Dighali *beel* (= wetland) to install a camera trap in front of an otter holt (N26° 32' 17.1" E92° 19' 41.1") on the bank of the wetland. The long rectangular wetland is flooded by the river Brahmaputra during the monsoon. The holt was built on the ground in the northeast corner of the wetland, and was well covered by *Narenga porphyrocoma*. At that point the width of the wetland was 20m. As we were preparing to install the camera at 12.15 h, I noticed some movement on the other bank about 25 m distance from us. I saw a small group of ten otters and managed to take video shots of them. The leader of the group was approaching, probably towards the holt along the bank, and other individuals were following it, but sensing our presence the leader ran back again, and the entire group vanished into the cover. However, there was no record of otter in the camera trap, which had been kept for three days. That means they did not visit the holt thereafter. We observed that the holt was active, which was evident by the presence of fresh sprint and foot prints.

Later on, from the video tape, I observed the following characteristics: the otters had very dense coarse fur which was dark olive brown on the back, lightening to a silvery brown on the throat and chest. The tail was thick and muscular at the base and the tip was flat and paddle-shaped. Paws were large and webbed between digits. Nostrils were W-shaped, an important feature distinguishable from *Lutra perspicillata*. These confirmed the identity of the animals as Eurasian otters. The presence of Smooth-coated otter *Lutra perspicillata* is mentioned by Talukdar & Sharma (1995) in Rajiv Gandhi Orang National Park. However, there was no record of Eurasian otter in this park hitherto. Therefore, it is the first sighting report of Eurasian otter in the Rajiv Gandhi Orang National Park.

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FOREST NEWS

Vol. XXIV: No. 3 Jul-Sept 2010

THE FUTURE OF FORESTS AND FORESTRY IN ASIA-PACIFIC?

What will the forests of Asia and the Pacific look like in 2020? Will negative trends of deforestation and forest degradation finally be reversed across the region? Will there be enough timber to meet expanding regional demands in the coming years? What will be the key priorities for forest management? What impacts will REDD+ and payments for environmental services have on how forests are valued and managed? Who will be making key decisions about forests in ten years time?

These are just a few of the numerous questions that were explored in great depth by the recently completed Second Asia-Pacific Forestry Sector Outlook Study (APFSOS II). Spanning nearly four years of effort, the outlook study involved all Asia-Pacific Forestry Commission (APFC) member countries and various international partner organizations in a wide-ranging initiative that gathered information, examined key forestry issues, identified important drivers of change and reviewed major trends. The study identified a range of outcomes and implications for forestry that may arise from actions taken in the near future, with the purpose of supporting policy review and reform. The study was coordinated and supported by the FAO Regional Office for Asia and the Pacific, working in collaboration with staff from the FAO Forestry Department in Rome, and numerous regional partners.

The main report of APFSOS II was launched in June 2010, at the twenty-third session of APFC, convened in Bhutan. The report takes a major stride in mapping out the future of Asia-Pacific forests and forestry towards 2020.

The final reports of APFSOS II are being released some 12 years after completion of the first Asia-Pacific Forestry Sector Outlook Study in 1998. Since then, it has become increasingly clear that a regional perspective is essential in negotiating a better position for forestry and the values with which it is associated. With the advancement of globalization, some of the most important effects on forests and forestry in many countries in the region are the result of international and regional developments. Countries and their forestry sectors are becoming ever more closely linked as economic liberalization and regional integration accelerate.

The past decade has been a period of unprecedented change in Asia and the Pacific. The recovery of Asia from economic crisis, the emergence of China as an economic superpower, accelerating demands on the region's forests and unprecedented levels of international interest in forest conservation and management are just a few of the major developments that are shaping the prospects for forestry to 2020.

The flagship regional report *Asia-Pacific forests and forestry to 2020* synthesizes observations and findings from 45 country and thematic reports. It provides analyses of the status and trends of all aspects of Asia-Pacific forestry. The publication also analyzes key driving forces in forestry and presents various scenarios of development to 2020.



Subregions and countries included in the study

| Subregion | Countries |
|----------------|--|
| East Asia | Democratic People's Republic of Korea (DPRK), Japan, Mongolia, People's Republic of China, Republic of Korea (ROK) |
| South Asia | Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka |
| Southeast Asia | Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Viet Nam |
| Oceania | Australia, Fiji, Kiribati, New Zealand, Papua New Guinea (PNG), Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu |

The implications of these scenarios are mapped out in detail to develop a broad picture of the likely state of forestry in the region. Major priorities and strategies are identified through which the region's forestry sector may be steered towards a more sustainable footing.

Subregional reports for South Asia, East Asia, the South Pacific, Southeast Asia and the Greater Mekong Subregion form another dimension of the outlook study and examine in more detail national developments and the evolving interactions between neighboring countries.

Policy briefs and regional workshops help to bring the results of the study directly to those most able to influence national level forestry policy and sector activities.

Heightened awareness of the values of forests and their greater inclusion in international climate change agreements has increased the importance of linking spatial levels and broadening understanding of issues and opportunities likely to affect forestry in the coming years. Identification of key trends in forestry – both physical and political – and construction of scenarios for the future adds a valuable dimension to regional forestry discussions. Building responsiveness into institutional mechanisms and adapting to change constitutes one of the most important steps in creating a robust sector in a fast-evolving world.

The collegial nature of the process through which this outlook study was developed gives credence to the success of collaborative regional action and sharing in a common future. By openly contributing information, the countries and organizations

involved in the outlook study have demonstrated their commitment to the future of forests and forestry and their desire to improve upon the benefits from forests that the current generation has received.

The first Asia-Pacific Forestry Sector Outlook Study provided a benchmark in regional and global forestry and was followed by a series of regional outlook studies around the world. We hope that this study will be as well received as the first and that this contribution to the region's forestry sector is both timely and appropriate and will challenge countries to build forests that future generations will value.

Excerpts from the EXECUTIVE SUMMARY of *Asia-Pacific forests and forestry to 2020*

Since the completion of the first outlook study in 1998, the Asia-Pacific forestry sector has undergone major changes in response to larger societal transformation within and outside the region. A better understanding of what is likely to happen in the context of such changes is essential in choosing options and developing plans and policies to create a robust forestry sector. It is in this context that the 21st Session of the Asia-Pacific Forestry Commission (APFC) recommended conducting this second outlook study to assess the likely changes to the year 2020, focusing on policy options and implications.

Asia and the Pacific: the least forested region in the world

With only 0.2 hectares of forest per person, the Asia-Pacific region is, per capita, the least forested

region in the world. Uneven forest distribution means there are a number of countries and subregions where per capita forest area is far lower than the regional average. For example, South Asia, with 23 percent of the world's population, has only 2 percent of the world's forests; these amount to only 0.05 hectares per person and signify the enormous pressure these forests must bear.

Deforestation continues in many countries

Deforestation is a major issue faced by many countries in the region. At the aggregate level, there has been a positive trend, from an annual regional loss of over 0.7 million hectares of forests during 1990 to 2000 to an annual increase of 2.3 million hectares during 2000 to 2005. Recently – between 2005 and 2010 – the rate of increase in forest area has declined to just under 0.5 million hectares per year. The increase over the last decade is primarily due to large-scale afforestation in the People's Republic of China. In addition to China, forest area has increased in Bhutan, Fiji, India, the Philippines, Sri Lanka, Thailand and Viet Nam. If gains in these countries are excluded, deforestation elsewhere remains high. Major areas of forest loss are evident in Southeast Asia – particularly in Indonesia and Myanmar – and large reductions have also been reported in Australia.

Forest degradation – the hidden problem

Forest degradation and declining health and vitality remain major problems confronting Asia-Pacific forests. The definition of forests as areas with at least 10 percent canopy cover fails to capture the extent and severity of degradation. Growing stock per hectare continues to decline in several countries. Fire – most of which is human-induced – and uncontrolled logging remain major factors contributing to degradation in most countries.

Trees outside forests – the silver lining

An important positive trend is the expansion of trees growing outside forests under a wide array of farming systems. Home gardens and tree planting under agroforestry have become important sources for industrial roundwood and woodfuel supplies. In several countries, forest industries have entered into contractual arrangements with farmers

to supply pulpwood. A substantial quantity of wood is also produced in cash crop plantations, notably rubberwood and coconutwood.

Implementation of sustainable forest management remains challenging

Despite a wide range of supporting initiatives and much discussion, implementation of sustainable forest management continues to be a challenge. Undefined or overlapping property rights, weak governance and high demand for wood and wood products have led to high levels of unsustainable logging. Agricultural, industrial and urban encroachments remain problems in many areas and excessive pressures on forest resources are causing extensive degradation. There are very few instances of balanced approaches where various forest management objectives are integrated and clear trade-offs established between divergent goals. At the same time, more wood is produced from plantations and trees outside forests and dependence on natural forests as a source of wood supply is on the decline.

Catastrophic environmental problems – especially floods and landslides – have often led to radical responses; logging bans in particular. Although generally reducing deforestation rates in the country of origin, logging bans have often had perverse effects, including the 'exporting' of deforestation to other countries. Without sound accompanying measures to satiate wood demand and effective enforcement measures, logging bans have generally been ineffective in stemming deforestation and degradation.

Potential of planted forests remains unrealized

The Asia-Pacific region accounts for about 45 percent of the world's planted forests. With the exception of a few countries, plantation productivity remains far below its potential. Public sector forest plantations are particularly prone to low productivity, largely on account of inadequate management. The potential wood production from planted forests in 2005 was estimated at 542 million m³ but total industrial



Forest area change in the Asia-Pacific region

| Subregion | Area (million ha) | | | | Annual change (1 000 ha) | | | Share of global population in 2010 (%) | Share of global forests in 2010 (%) |
|----------------|-------------------|--------|--------|--------|--------------------------|-----------|-----------|--|-------------------------------------|
| | 1990 | 2000 | 2005 | 2010 | 1990-2000 | 2000-2005 | 2005-2010 | | |
| East Asia | 209.2 | 226.8 | 241.8 | 254.6 | 1761.7 | 3005.3 | 2556.9 | 22.6 | 6.3 |
| South Asia | 78.2 | 78.1 | 79.8 | 80.3 | -6.5 | 346.6 | 95.6 | 23.4 | 2.0 |
| Southeast Asia | 247.3 | 223.0 | 219.5 | 214.1 | -2421.5 | -709.8 | -1086.4 | 8.5 | 5.3 |
| Oceania | 198.7 | 198.4 | 196.7 | 191.4 | -36.2 | -327.4 | -1072.1 | 0.5 | 4.7 |
| Asia-Pacific | 733.4 | 726.3 | 737.9 | 740.4 | -702.5 | 2314.7 | 494.0 | 55.1 | 18.4 |
| World | 4168.4 | 4085.2 | 4061.0 | 4033.1 | -8323.0 | -4840.8 | -5580.9 | 100 | 100 |

Source: FAO (2010)

roundwood production (including production from natural forests) in 2005 was only about 273 million m³.

Many challenges plague management of protected areas

The provision of ecosystem services is gaining importance and increasingly large tracts of natural forests are being withdrawn from production and set aside as protected areas. Since 2002, the extent of protected areas has remained stable as potential limits to their expansion are neared. Management of protected areas remains problematic on account of encroachment and poaching of animals and plants; human-wildlife conflicts remain a major problem in many countries. Mining and infrastructure development pose significant threats to protected areas across much of the region. Nonetheless, protected areas remain the mainstay of biodiversity conservation and continued support is essential.

Forest policies revised, but implementation lagging

Most countries in the Asia-Pacific region have revised their forest policies to incorporate sustainable forest management. The provision of ecosystem services has become a primary goal in most policies, with a lessening of the dominant focus applied to wood production. There has also been increased emphasis on the involvement of stakeholders in policy formulation and implementation. However, the wide gap between

what is visualized in policies and what is actually practiced persists. With a host of forest-related initiatives – poverty reduction, biodiversity conservation and climate change mitigation in particular – traditional sectoral boundaries have become less relevant and forestry institutional arrangements have become increasingly fragmented.

Forest ownership remains contested

While there is a preponderance of private ownership in the developed economies, in others (with the exception of the Pacific Island countries) public ownership dominates. Forest ownership has been a contentious issue in several countries, especially in the context of appropriation of forests by governments from traditional owners. Efforts are underway in several countries to restore the traditional rights of indigenous and other forest-dependent communities and to allocate forest land to families and individuals. The region has also been a pioneer in a number of initiatives to enhance the involvement of local communities, for example through Forest User Groups in Nepal and Joint Forest Management arrangements in India. These efforts, however, face a number of challenges, including economic viability, equitable distribution of benefits and sustainability.

Changing patterns of production and consumption of wood and wood products

Industrial roundwood production has remained stable

Officially reported industrial roundwood production has remained relatively stable since 1980, increasing from about 248 million m³ to 274 million m³ in 2007. In several countries there has been a significant decline in wood production, either because of exhaustion of forest resources or due to increasing concern about environmental protection. One of the steepest declines in production has been in Japan, where cheaper imports have made domestic production uneconomical. Oceania is the only subregion that has registered a significant increase in industrial roundwood production, largely accounted for by Australia and New Zealand.

Unclear trends in sawnwood production

Production and consumption of sawnwood in the Asia-Pacific region have fluctuated erratically since 1980 and the available statistics indicate a production decline from about 95 million m³ in 1980 to 91 million m³ in 2008. As in the case of industrial roundwood, sawnwood production statistics fail to capture a significant part of the real situation in view of the preponderance of small- and medium-sized sawmills, many of which operate in the informal sector.

Spurred by production growth in China, Asia and the Pacific has become the top producer of wood-based panels

In contrast to declining sawnwood production, wood-based panel production has increased significantly, from about 19 million m³ in 1980 to over 114 million m³ in 2008, with China accounting for most of this increase. China's share in the region's production increased from 12 percent in 1980 to about 70 percent in 2008, making it the top global producer of wood-based panels. This has also enabled China to become a major exporter of wood-based panels.

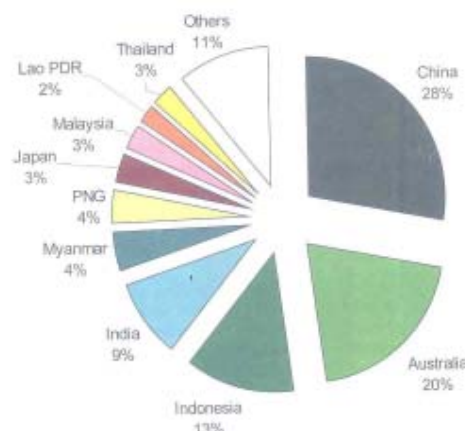
Rapid growth in paper and paper board production

Production of paper and paper board has increased rapidly during the last two decades, increasing from about 31 million tonnes in 1980 to 147 million tonnes in 2008. Investments in new capacity have continued until recently, suggesting continued

growth in production. Although consumption is likely to increase with increases in population, incomes and levels of education, much depends on the future state of the economy and trends toward increased use of electronic media, while increased use of recycled fibre could affect volumes of wood used in paper manufacture.

Domination of the world's furniture market

During the last two decades, the Asia-Pacific region, led by China and Viet Nam, has emerged as a major producer and exporter of wooden furniture. The surge in production is evident from the rapid increase in the value of furniture exported from the region, which increased from



Distribution of forest area by country

Source: Global forest resources assessment 2010. FAO, Rome.

US\$1.56 billion in 1990 to about US\$17.7 billion in 2007, with the region's share in global exports increasing from 9 percent to 33 percent in the same period. Much of this is accounted for by China, whose exports increased from US\$111 million in 1990 to US\$10.7 billion in 2007, making it the world's largest exporter.

Exports shift to higher value-added products

One of the major changes in the forest products sector in the region is a shift from being a regionally focused exporter of industrial roundwood and other less-processed items to

being an internationally focused exporter of more value-added items, especially wood-based panels, paper and paper board and furniture. China is also the main driver of this trend, clearly indicating that even in the absence of a domestic wood surplus a competitive industry can develop if other competitiveness conditions are satisfied.

Sources of industrial roundwood imports are changing

During the last decade there has been an important shift in the sources of industrial roundwood supplying the major importing countries: China, Japan and India. The Russian Federation, Australia, New Zealand and South Africa have become prominent as supplies from tropical countries have fallen and capability to mobilize wood on a large scale in countries like Russia has grown.

Wood: from an inferior fuel to a modern environmentally-friendly fuel

More than three-quarters of all wood production in the Asia-Pacific region is used as fuel, and wood continues to be the main source of energy in many developing countries. Available data suggest that production has remained relatively stable during the last 15 years, at slightly less than 800 million m³. Increases in income and improved availability of more convenient fuels have led to a reduction in the proportion of people using wood as a primary source of energy. However, there are signs of change in this trend as the virtues of woodfuel are being rediscovered in the context of climate change and energy policies, while improved technologies are enhancing efficiency and convenience of use.

Many non-wood forest products will no longer be forest-derived

Non-wood forest products (NWFPs) continue to play an important role in the economic and social well-being of many people in the Asia-Pacific region. Many NWFPs cater to subsistence needs of forest-dependent communities and contribute significantly to poverty alleviation. Management of forests for the production of NWFPs continues to pose major challenges. Increased demand has led to overexploitation, especially in the context of

ill-defined tenure and weak institutional arrangements, while potential income opportunities have led to domestication of a number of products. There have also been significant improvements in processing technologies, resulting in a wide array of new products.

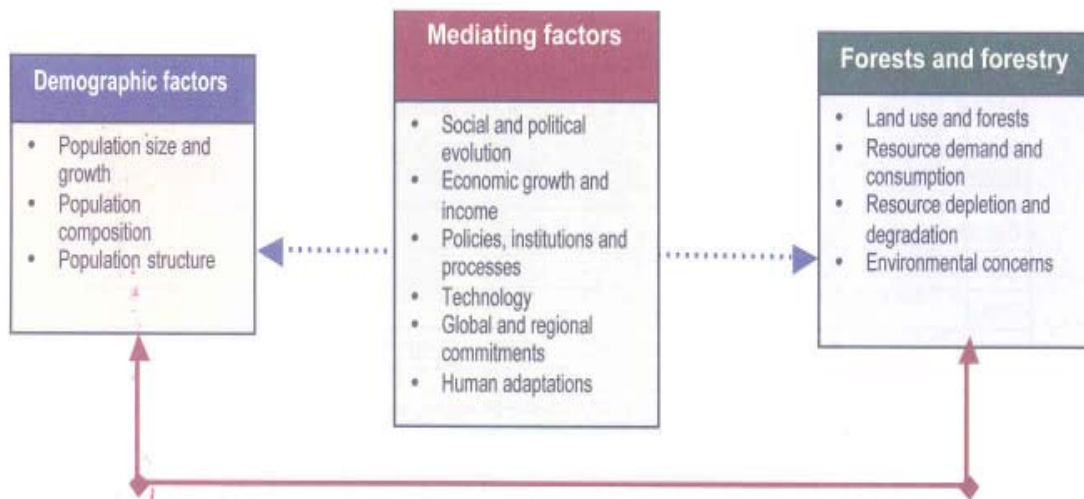
Increased interest in forest-derived ecosystem services not yet matched by willingness to pay

Conservation of biological diversity, maintenance and improvement of watershed values, combating desertification and land degradation, and climate change mitigation and adaptation are key ecosystem services provided by forests. With climate change becoming a critical global issue, the role of forests in climate change mitigation and adaptation has become one of the most discussed topics in recent times. Continued deforestation and degradation for timber and land has resulted in significant environmental degradation. However, slow declines in ecosystem services often go unnoticed, delaying appropriate responses. Meanwhile, systems of payments for ecosystem services (PES) remain in their infancy.

REDD to the rescue?

With climate change becoming one of the most critical environmental issues, forests and forestry are gaining increasing attention in mitigation strategies, especially as deforestation and forest degradation accounted for about 17 percent of global carbon emissions in 2004. Forestry's role in climate change mitigation largely depends on progress in arresting deforestation and degradation to reduce carbon emissions and stepping up of afforestation and reforestation to enhance carbon stocks.

The proposed programme for Reducing Emissions from Deforestation and Degradation (REDD) envisages payment of compensation to forest owners in developing countries for conserving forests. However, there are considerable uncertainties as to how REDD will evolve and to what extent it will become an important component of climate change mitigation strategies.



Conceptual framework supporting analysis of demographic changes and forests and forestry

Source: Modified from Hunter (2000)

Larger societal changes will have profound impacts on forests

A host of factors outside the forestry sector – demography, economy, political and institutional conditions and technological progress – collectively affect forests and forestry. Growing concern about the provision of ecosystem services, especially in the context of climate change mitigation and adaptation, has added a new dimension. At the same time, changes in society's behaviours alter patterns of goods and services demanded and how these are produced and consumed. These societal changes also affect policies and programmes in other sectors, impacting forests and forestry through backward and forward linkages.

Demography will have a critical impact on forests and forestry

By 2020, the population in Asia and the Pacific will be 4.2 billion (an increase of 600 million from 2005), accounting for about 60 percent of the world's population. While population growth is slowing and some developed countries will see population reductions, many developing countries are on high population growth paths and much of the growth is in countries where population densities are already very high. South Asia remains

the most densely populated subregion, almost three-times higher than the regional average.

Multiple impacts of economic changes

High economic growth rates will continue, increasing demand for food, fibre and fuel. Rapid growth in countries such as China and India is bringing about fundamental changes in production, consumption and trade of all forest products and services. The GDP of the region is expected to increase from about US\$10.7 trillion in 2006 to US\$22 trillion by 2020. Continued growth implies a surge in demand for all products, including wood and wood products.

Poverty to decline, but the number of poor will remain high

Rapid economic growth in the past has led to significant reductions in poverty, but in many countries, especially in South Asia, high levels of poverty are likely to persist despite high economic growth rates. In many countries, rapid growth has exacerbated disparities, especially between rural and urban areas. The trickling down of benefits has been extremely slow, ensuring that dependence on natural resources will persist. However, international migration and associated flow of remittances are having an

impact on land use in the region. Remittances have been a major source of income to many families, reducing the pressure and dependency on natural resources.

Structural changes in economies and a growing middle class

Rapid growth of the manufacturing and services sectors has reduced the share of agriculture in national incomes and employment. Between 1990 and 2007, agriculture's share in Asia-Pacific's GDP declined from about 25 percent to 12 percent; however, agriculture remains the most important sector for rural employment. The Asia-Pacific region will witness a major surge in numbers of middle-income households with attendant changes in values, perceptions and demands for goods and services. In particular, pressures to focus resources on environmental conservation are likely to increase.

Globalization will alter the opportunities and challenges for forests

The rapid growth in Asia-Pacific economies has been primarily due to globalization, involving increased flows of investments, trade, technology and management practices across national borders. The forest sector will continue to be influenced by globalization as it changes the nature of forest product value chains and the nature of trade and cooperation relationships, while investments shift among countries in response to shifting competitiveness.

Shifts in the political and institutional environment

Asia-Pacific countries are witnessing major shifts in the overall policy and institutional environment, reflecting larger political and social changes. Notable trends include greater demands for social justice and participation in governance and in public policy decision-making, increased plurality and wider involvement of civil society and private sector organizations. Devolution of resource management responsibilities to local levels and to families and individuals in particular has become another growing trend.

Forest governance under increased public scrutiny

Poor governance and inability to resolve resource-use conflicts are major problems in some countries. Forest governance continues to be a major challenge where overall political and institutional frameworks remain undeveloped. New international initiatives in the European Union and the United States aimed at supporting sustainable forest management by preventing entry of illegal forest products into markets are likely to redefine aspects of international trade.

Growing environmental concern a major driver of change

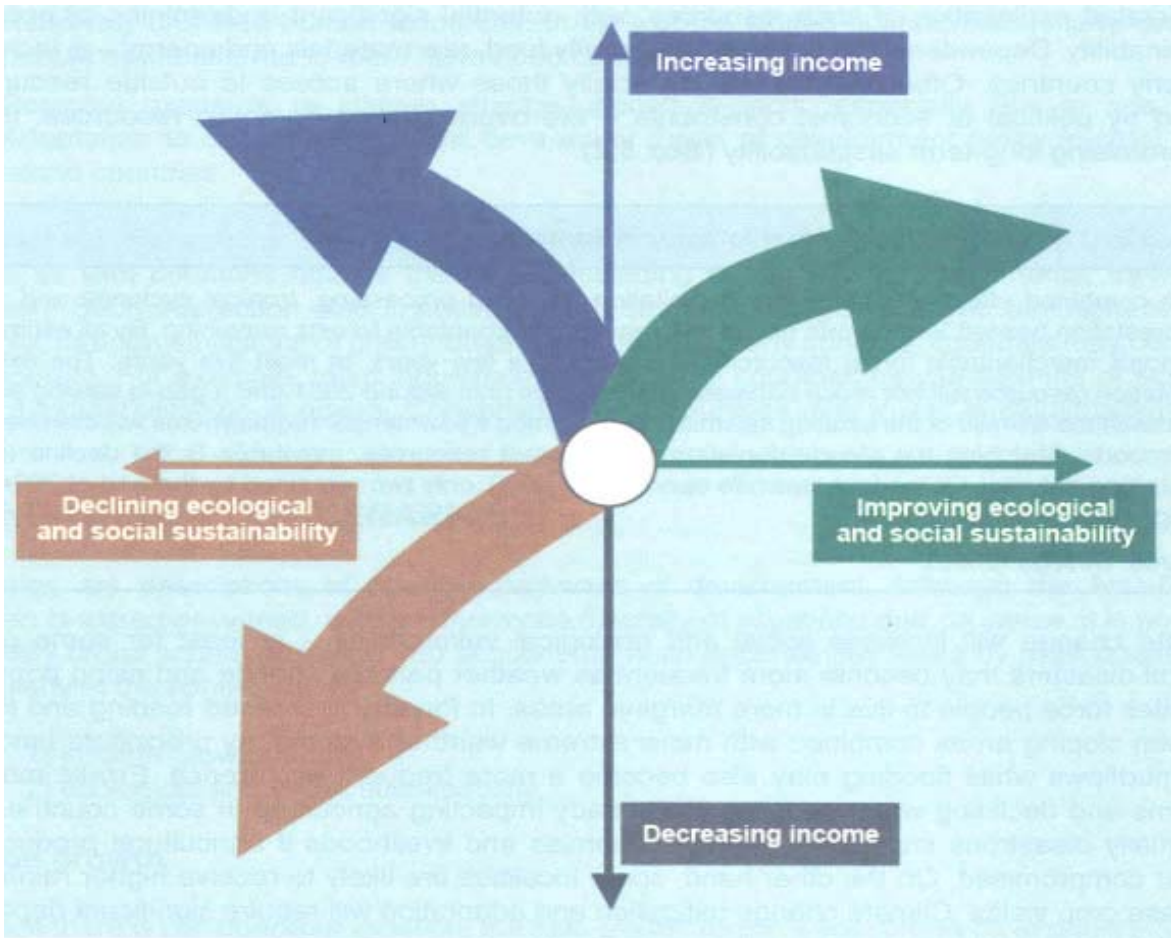
Increasing awareness about the environmental roles of forests has brought forestry and other related land uses under greater scrutiny. Already a number of local, national and global environmental issues have changed the course of forestry in unprecedented ways. With climate change becoming a critical environmental issue, forests and forestry are at centre stage of global political discussions with considerable potential for reshaping the future of the sector.

Emerging technological changes

Notwithstanding the various uncertainties, developments in science and technology could significantly impact the forest sector. These include technologies for improved management, productivity-enhancing technologies (for example tree improvement) and the development of new products and processes. Remote sensing technologies are revolutionizing abilities to monitor resources, helping to track changes on a real time basis. Ongoing efforts to develop commercially viable cellulosic biofuel and 'biorefinery' technologies could have major impacts on the use of wood by 2020.

Three probable scenarios based on future economic growth and social and ecological sustainability

During the next one to two decades, the major uncertainties relating to overall social and economic development of the Asia-Pacific region will be



determined by: (a) economic growth; and (b) social and economic sustainability. Most Asia-Pacific countries will likely move along one of three broad paths of development:

The high economic growth “boom” scenario is one under which countries pursue rapid economic growth rates, overlooking critical social and ecological problems.

The low growth and stagnation “bust” scenario presents a future restrained by weak economic performance with low priority given to social and ecological sustainability in many countries

The ‘green economy’ scenario envisages changes leading to balance between growth with social and ecological sustainability. This is increasingly becoming the vision for a number of countries, especially in the context of the economic and climate change crises.

Most of the middle-income and emerging economies will apply some effort towards developing green energy, in the context of increasing costs of fossil fuels and concerns over

energy security. Developed countries – with relatively well-developed policies and institutional frameworks, and greater ability to invest in science and technology – have greater potential to shift towards a ‘green economy’ scenario. Several emerging economies will also have good prospects to leap-frog into ‘green economy’ positions, especially if inspired by visionary leadership and empowering policies. Sustainability is, however, unlikely to receive great attention, especially in resource-rich, low-income countries with weaker policies and institutions and enormous imperatives to maintain economic growth and development.

FORESTS AND FORESTRY IN 2020

Forest area to stabilize regionally, but losses in Southeast Asia, South Asia and Oceania to persist

At the aggregate level, forest area in the Asia-Pacific region will increase or stabilize largely on account of the significant increase in afforestation and

reforestation in China, India and Viet Nam. Rapid economic growth and increases in income will help to bring about forest transition in a number of countries. However, the loss of natural forests through clearance to meet growing demand for food and fuel will continue, especially across Southeast Asia, South Asia and some of the Melanesian countries.

Forest degradation will persist in most of the densely populated low-income countries

Forest degradation is expected to remain a major problem in more densely populated low-income countries, especially in South Asia where dependence on land and forests is high. Considering the high rates of population growth in many countries, a scenario of low economic growth could aggravate degradation. Uncontrolled logging in resource-rich countries to supply export markets will also continue to damage forest health and vitality.

Policy and institutional constraints will continue to hinder sustainable management of natural forests

While adequate technical knowledge exists on approaches to sustainable forest management – including, for example, reduced impact logging – implementation of such measures will be constrained in many countries by weak policies and institutional arrangements. Throughout the region most easily accessible natural forests have already been logged. In the future, managing natural forests for wood production may be increasingly seen as too complicated, too controversial and too costly – resulting in many areas being withdrawn from production and often any formal management.

Planted forests and trees outside forests are increasingly important sources of wood

Forest plantations in countries such as Australia, China, India, Indonesia, Malaysia, Thailand, New Zealand and Viet Nam increasingly dominate wood supplies along with farm level plantings in China and India. Even slight increases in productivity of the current area of planted forests could significantly increase wood supplies. However, in

many countries this will depend on improving enabling incentives for planted forest management and the creation of favourable policy and institutional environments.

Demand for industrial roundwood to increase

Considering population and income growth in the region, demand for wood products, especially panel products and paper and paper board, will increase significantly from the current relatively low levels. Demand for industrial roundwood will increase from 317 million m³ in 2005 to 550 million m³ in 2020.

Major changes in the use of non-wood forest products

With some exceptions, subsistence production, processing and utilization of NWFPs are expected to decline. A number of products will be cultivated on a commercial scale and will cease to be “forest-derived” products. Improved processing and marketing technologies will bring about significant changes to the NWFP sector, especially as the market reach of traditional producers expands.

Mixed situation vis-à-vis forest-derived ecosystem services

The provision of ecosystem services – including conservation of biological diversity, watershed protection, land degradation and desertification, and climate change mitigation – will vary markedly (in terms of efficiency, quality and magnitude) across the region in view of differing resource situations and policy and institutional environments.

- *Developed economies able to improve the provision of ecosystem services*
In view of high incomes and greater willingness to pay, developed countries will give greater attention to the provision of ecosystem services. This will be facilitated by better-developed policy and institutional frameworks and stronger technological capacities.
- *Emerging and middle-income economies will face a mixed situation*
With most emerging and middle-income countries putting high priority on economic growth, environmental issues could receive

secondary attention. Nevertheless, many are moving or have moved towards improving the flow of ecosystem services, especially through afforestation and reforestation.

▪ *Low-income countries will face the biggest challenges*

Forest-related environmental problems will be acute in all low-income countries, both forest-rich and forest-poor. The forest-rich countries will be under pressure to clear forests to raise incomes and to clear land for alternative uses. In forest-poor countries degradation and impoverishment of forest resources will be a major problem. All of these countries face severe policy and institutional constraints in managing forests sustainably.

▪ *Small island countries*

Small island countries are extremely vulnerable to changes in their economic and ecological conditions. Many of the changes are largely exogenous and domestic capacities to handle them are limited. Improved management of uplands (where they exist), especially to provide high-value watershed services, and coastal vegetation management (to minimize the impacts of storm surges) will be major priorities. Dependence on remittances, external assistance and tourism will persist. Several countries have unique opportunities to shift to a 'green economy' through green tourism initiatives and development assistance interest in mitigating climate change impacts.

PRIORITIES AND STRATEGIES

Focus on social and ecological sustainability

Priorities and strategies for the forest sector will have to be country- and scenario-specific. Countries are passing through divergent development paths with high and low economic growth rates and varying levels of social and ecological sustainability. For most countries, accomplishing high growth rates remains the priority. However, increasing social and ecological vulnerability is encouraging countries to shift to green pathways.

Overall priorities

The focus of international discussions on forestry reflect only a small portion of overall forestry activity, but often consumes a disproportionate amount of attention and energy, especially of government forestry officials. The vast majority of on-the-ground forestry-related activities are often seemingly overlooked and although the international focus can eventually have major positive implications for forestry, practical management aspects should not give way completely to more distant goals.

Rebuilding the natural resource base and conserving existing resources

Although the Asia-Pacific region is unlikely to face any critical wood shortages in the near future, rebuilding the natural resource base and conservation of existing resources will remain a high priority. As countries develop, the demand for wood and wood products is expected to increase considerably. More importantly, there will be a rapid increase in demand for ecosystem services. Considering that populations will continue to grow and levels of consumption will surge, it is imperative that the Asia-Pacific region invests in conserving and enhancing the natural asset base.

Rural development and poverty alleviation

Although the Asia-Pacific region is urbanizing rapidly, it will still remain largely rural and rapid economic growth in urban areas is widening the rural-urban divide. With low incomes from agriculture, poverty will remain a major issue, especially in South Asia. Although forestry itself may not be able to lift people out of poverty, it will be important for providing basic needs, especially for forest-dependent communities.

Enhancing raw material and energy-use efficiency

With burgeoning demand for various products, it is imperative that the Asia-Pacific region pays greater attention to enhancing efficiency in the use of raw materials and energy. Efficiency in wood energy use particularly requires improvement. A



wide array of technologies is already available and, with greater attention to policies and other incentives, it is possible to significantly improve the output of products and energy. Enhanced use of wood residues for local processing and energy generation also warrants more attention. Expanded recycling of fibre would help satisfy the growing demand for paper and paper products while reducing the need for more forest plantations and fibre production from natural forests.

Governance

There is an overarching need to strengthen governance; generally and within the forestry sector. Attention to reducing or eradicating corruption, including endemic bribery and extortion, will be important in improving investor confidence and creating efficient industries. Better governance will also be a prerequisite to continuing to export to some developed country markets and in attracting carbon-financing. Countries with poor governance will be severely disadvantaged in competing for carbon funds, with money gravitating to where investors have confidence.

Strategies

Several broad areas will require renewed attention in the coming decade: (a) improvements in policy, legal and institutional frameworks; (b) building capacities for grassroots forestry; (c) strengthening science and technology capacities; (d) improving education and awareness related to forests and forestry; (e) developing societal consensus; and (f) strengthening leadership and communication.

Policies and institutional changes essential

Policies, legislation and institutional arrangements should empower people to undertake individual and collective actions, helping to resolve conflicts and establish acceptable trade-offs among competing and conflicting objectives. Issues that will require immediate attention include:

- Tenure reform. Secure tenure will remain one of the core issues in empowering local communities and in motivating them to undertake activities that could help address natural resource degradation and poverty.

- Reform of public sector agencies with emphasis on facilitation and regulatory functions and shifting managerial functions to the private sector, including farmers and communities.
- Improved land-use planning and careful management of land conversion programmes. Enforcement of decisions will also need to accompany improved planning, such that institutional frameworks effectively correspond to ground-level jurisdictions.
- Creating enabling environments. Policies and legislation need to be structured to ensure they create enabling environments in which incentives reward 'good' behaviours and penalize the 'bad'.

Grassroots forestry

While theory, science and policy may advance, at grassroots levels lack of capacity and knowledge are often highly constraining. International agreements and policy development need to be accompanied by practical steps towards improvements in forest management. Forestry extension and major attention to training, capacity development and enforcement of regulations are sorely needed if hopes are to become realities.

Investments to improve science and technology

Enhancing social and ecological sustainability requires major improvements in science and technology capacities. To change the current pattern of resource use, stronger inputs from science are necessary. The focus is, however, not so much towards research, but in translating existing knowledge into technologies that are more energy and material efficient.

Investment in human resources

The region's growing population and increased desire of diverse segments of society to be involved in forest-related decision-making places greater emphasis on the need for improved education and awareness related to forests and forestry. An 'environmentally smarter' population of consumers and decision-makers will be essential to reverse trends of forest loss and degradation and move toward truly sustainable resource management in the future.

Societal consensus

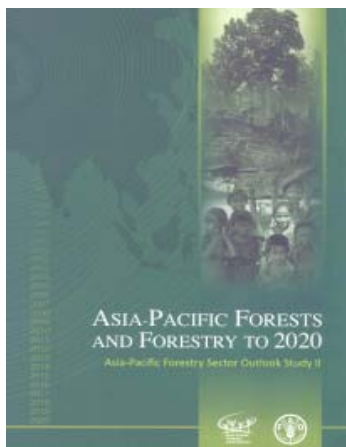
Continuation and acceleration of efforts towards achieving societal consensus in how forests should be managed, and for which purposes, will be a key element in effective forest management in the coming decade. Greater efforts are required to integrate public opinion into decision-making and build levels of awareness in relation to forests and forestry so that policies are appropriate, widely supported and can be easily implemented with broad community support. Increased attention to

national forest programmes can contribute to these aspects.

Leadership and communication

A major challenge for forestry is to strengthen its sectoral profile and to develop more powerful champions, advocates and leaders. Provision of specialized training opportunities, greater encouragement and empowerment of staff, and significant institutional culture changes could assist this development. The emergence of stronger

NEW ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY PUBLICATIONS



Asia-Pacific forests and forestry to 2020 (Asia-Pacific Forestry Sector Outlook Study II) RAP Publication 2010/06

Great changes have occurred and major advances have been made in Asia-Pacific forestry since the first outlook study was published. Significant challenges remain in many parts of the region and it is increasingly evident that countries cannot develop forestry policies in isolation – rights and responsibilities are increasingly spilling across borders and across sectors as populations increase, demands on resources heighten and economies

integrate. The collegial nature of the process through which this outlook study was developed gives credence to the success of collaborative regional action and sharing in a common future.



Forest policies, legislation and institutions in Asia and the Pacific – Trends and emerging needs for 2020 (Asia-Pacific Forestry Sector Outlook Study II) RAP Publication 2010/10

Identification of key trends in forestry – political as well as physical – adds a valuable dimension to regional forestry discussions. This report, carried

out under the umbrella of the second Asia-Pacific Forestry Sector Outlook Study, represents a collaborative effort between FAO, The Nature Conservancy's Responsible Asia Forestry and Trade Program and the Center for People and Forests (RECOFTC). The report focuses on 12

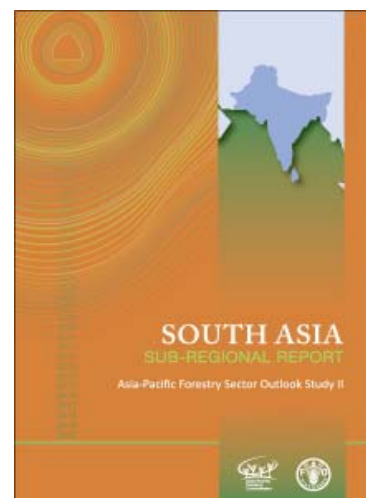
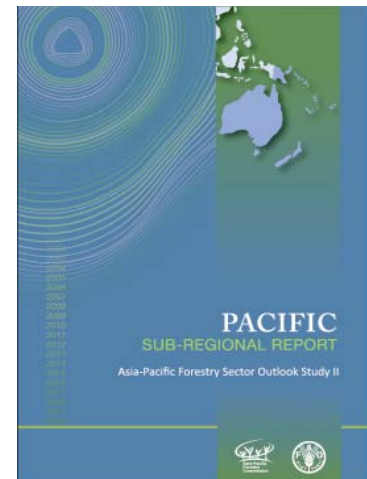
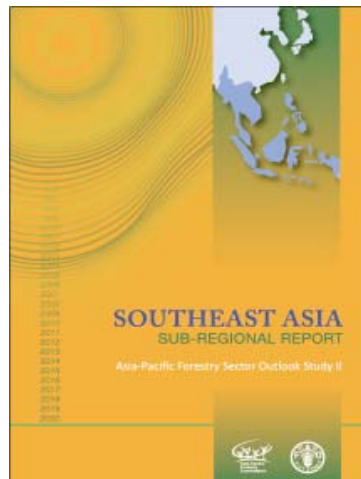
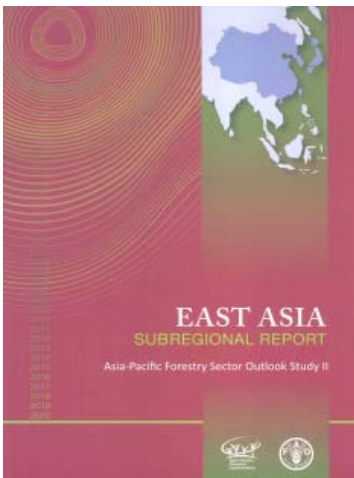
countries (Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, the Philippines, Papua New Guinea, Thailand and Viet Nam) and draws upon papers prepared for and discussions held during a workshop in Khao Yai National Park, Thailand, 6-7 October 2008.

Asia-Pacific Forestry Sector Outlook Study Subregional Reports

Five subregional reports for South Asia, East Asia, Southeast Asia, the Greater Mekong subregion and the Pacific form another dimension of the outlook study and examine in more detail national developments and the evolving interactions between neighbouring countries.

Each subregional report summarizes the key findings and results collated under the second Asia-

Pacific Forestry Sector Outlook Study – a comprehensive effort spanning nearly four years and involving all member countries of the Asia-Pacific Forestry Commission. The subregional reports synthesize observations and findings from country reports, numerous thematic reports and a review of current and past publications in providing analyses of the status and trends of forestry and forestry in the five subregions.



Asia-Pacific Forestry Sector Outlook Study II Working Papers

- Samoa Forestry Outlook Study (APFSOS II-2009-01)
- Malaysia Forestry Outlook Study (APFSOS II-2009-02)
- Maldives Forestry Outlook Study (APFSOS II-2009-03)
- Bhutan Forestry Outlook Study (APFSOS II-2009-04)
- Nepal Forestry Outlook Study (APFSOS II-2009-05)
- India Forestry Outlook Study (APFSOS II-2009-06)
- Myanmar Forestry Outlook Study (APFSOS II-2009-07)
- Bijendra Basnyat (2009) (APFSOS II-WP-2009-08)
- Viet Nam Forestry Outlook Study (APFSOS II-WP-2009-09)
- Philippines Forestry Outlook Study (APFSOS II-WP-2009-10)
- People's Republic of China Forestry Outlook Study (APFSOS II-WP-2009-11)
- The relevance and impact of gender issues on the outlook for forestry to 2020 in North Asia (APFSOS II-WP-2009-12)
- Indonesia Forestry Outlook Study (APFSOS II-WP-2009-13)
- Assessing the protection of forest-based environmental services in the Greater Mekong sub-region (APFSOS II-WP-2009-14)
- The situation and prospects for the utilization of coconut wood in Asia and the Pacific (APFSOS II-WP-2009-15)
- Valuing services: an analysis of the ability and willingness to protect forest-based environmental services in the Asia-Pacific (APFSOS II-WP-2009-16)
- Lao People's Democratic Republic Forestry Outlook Study (APFSOS II-WP-2009-17)
- The outlook for non-wood forest products in Asia and the Pacific (APFSOS II-WP-2009-18)
- Papua New Guinea Forestry Outlook Study (APFSOS II-WP-2009-19)
- Fiji Forestry Outlook Study (APFSOS II-WP-2009-20)
- Mongolia Forestry Outlook Study (APFSOS II-WP-2009-21)
- Thailand Forestry Outlook Study (APFSOS II-WP-2009-22)
- Where is the future for cultures and forests? (APFSOS II-WP-2009-23)
- Is there a future role for forests and forestry in reducing poverty? (APFSOS II-WP-2009-24)
- National competitiveness index of the forest products industry in the Asia-Pacific region (APFSOS II-WP-2009-25)
- Biomass energy in the Asia-Pacific region: current status, trends and future setting (APFSOS II-WP-2009-26)
- Macro-economic trends and their impacts on forests and forestry in Asia and the Pacific to 2020 (APFSOS II-WP-2009-27)
- Pakistan Forestry Outlook Study (APFSOS II-WP-2009-28)
- Sri Lanka Forestry Outlook Study (APFSOS II-WP-2009-29)
- Japan Forestry Outlook Study (APFSOS II-WP-2010-30)
- Solomon Islands Forestry Outlook Study (APFSOS II-WP-2010-31)
- Cambodia Forestry Outlook Study (APFSOS II-WP-2010-32)

For copies please write to: Senior Forestry Officer for Asia and the Pacific, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand. Or visit the FAO website for an electronic version: <http://www.fao.org/world/regional/rap/nre/links/forestry-outlook/en/>

FAO ASIA-PACIFIC FORESTRY CALENDAR

12-14 January 2011. **Seventh APFC Executive Committee Meeting and Partners Meeting. Bangkok and Hua Hin, Thailand.** Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

25 January 2011. **Forestry Sector Support Partnership Annual Meeting.** Hanoi, Vietnam. Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

11 February 2011. **Promoting climate friendly bioenergy and food security in the Greater Mekong Sub-region.** Bangkok, Thailand. Contact: Beau Damen, Consultant, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Beau.Damen@fao.org

16-18 February 2011. **Strategic planning for South Asian forestry.** Thimphu, Bhutan. Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

21 February 2011. **Post COP-16 consultation on implications of Cancun for forestry.** Chiang Mai, Thailand. Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

2-4 March 2011. **Regional workshop on strategic planning in forestry and poverty alleviation.** Chiang Mai, Thailand. Contact: Jeremy Broadhead, Consultant, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Jeremy.Broadhead@fao.org

7-10 March 2011. **Regional workshop on strategic planning in forestry and poverty alleviation.** Chiang Mai, Thailand. Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

7-11 November 2011. **Second Asia-Pacific Forestry Week and 24th session of the Asia-Pacific Forestry Commission.** Beijing, China. Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

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