EVALUATING THE STATUS OF FORESTS AND RELATIVE ABUNDANCE OF WILDLIFE: A RAPID SURVEY FROM A REMOTE AND LITTLE EXPLORED TROPICAL EVERGREEN FOREST OF NORTH-EAST INDIA[1]

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This survey was aimed at evaluating methods that could be used to assess the status of forests and the relative abundance of mammals in a remote and little explored tropical evergreen forest of north-east India. The survey was carried out by walking along forest trails for assessing the status of forests and mammals, and through the village surveys to assess the status of wildlife. About 58% of the forests surveyed were under open forest and 27% under partially open cover, indicating the region has more open forest while the closed forest was only 15% The species encounter rate/km was high in an open forest (1.6 (SE=0.22)/km, 0.8 (SE=0.7)/km for a partially open forest and for a closed forest it was 0/km), and the results for the open and partially open forests were not statistically significantly different (Hc=0.39, p=0.73) Out of the 23 mammal species reported for the region, only 26% of the 23 species were encountered during the trail surveys, and only after spending 95% of the total time (56 hours) with the villagers, information on all the species was obtained. The number of species obtained for the survey region complies with the results of other regions that have comparable attributes. When areas with similar affinities are compared, the variance around the mean was only 7%, but in areas that are dissimilar, the variance around the mean was 13%. As compared with the other regions, only 0.37% of the total man-hours were spent to obtain the number of species for the current survey. The village survey appears to be a robust method for a basic or advanced species list, but it may not be an appropriate method to evaluate the forest status.

Key words: trail and village surveys, evaluation, forest canopy and wildlife abundance

INTRODUCTION

Arunachal Pradesh, in the north-east of India, is known for its rich biological and cultural diversity, and has been recognised as one of the 34 biodiversity hotspots of the world (Myers *et al.* 2000). It is also a home to around 26 ethnic human communities with distinctive cultures and rich traditions (Shukla 1965). Unlike the other regions, forests in some areas of Arunachal Pradesh at present do not suffer much from major developmental activities, such as the hydroelectric, irrigation projects and road networks. But the heavy dependency on forests by local communities through shifting cultivation and other livelihood practices is the major conservation concern (Ramakrishnan 1992; Raman *et al.* 1998). The communities are also known for their active involvement in hunting of wildlife for ornamental, medicinal, edible and commercial uses (Aiyadurai and Varma 2003).

There are only a few studies that have been carried out in this region due to the remoteness, ruggedness and incidences of cerebral malaria in the region. High rainfall, frequent landslides, lack of infrastructure facilities and an assumed unfriendly nature of the local communities have also contributed to this. These areas are important for many species of conservation interest and the proposed survey region was particularly reported to have seven species of major large carnivores (Aiyadurai and Varma 2003), three of which (Tiger, Clouded Leopard and Asiatic Black Bear) are categorised in the Vulnerable to Endangered category of the IUCN Red List of threatened species (IUCN 2007), and the remaining four are listed under the Schedule I of the Wildlife (Protection) Act of India 1972 (Menon 2003). The area is also one of the contiguous habitats for the Asian Elephant *Elephas maximus*; conserving these flagship species (Sukumar 1989) or charismatic flagship species (Karanth 1995) or their habitat may eventually protect a considerable amount of biodiversity. However, the Elephant and some carnivore species have become a cause for human-animal conflict, resulting in negative conservation interests. Such problem animals, particularly some carnivore species are being hunted either as a conflict mitigation measure or as a source of food. Under these circumstances the understanding of the status of these species and developing mitigation measures will not only provide knowledge about the species but also receive support from the local communities for their conservation. Secondly, when there is a constraint of time and other resources or manpower, there is a need to identify a robust way of collecting information and this is possible only through adopting all existing methods or through developing new

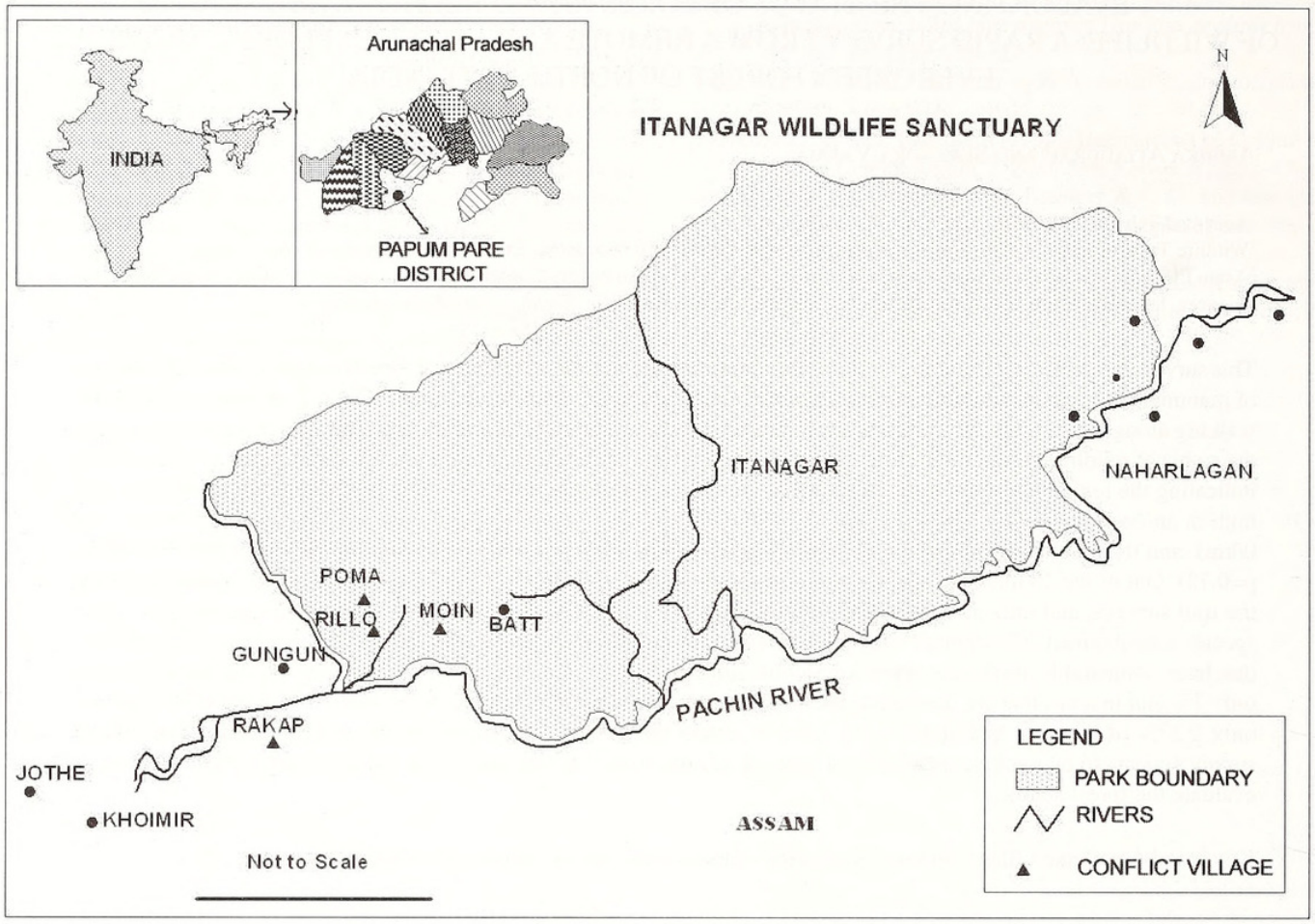

Fig. 1: Map showing Itanagar Wildlife Sanctuary and survey villages in Arunachal Pradesh, north-east India

approaches to data collections (Varman and Sukumar 1995; Varma 2000).

Our initial interest was to evaluate methods that could be followed and eventually be used to assess the status of forests and the relative abundance of wildlife, particularly mammals. Our interest was restricted by the constraints imposed by the landscape features, availability of time and other resources, and non-availability of specific methodologies. However, these limitations did motivate us to identify methods for documentation, compare and review methodologies adopted, and numbers reported from similar landscapes elsewhere. A review and comparison of methodologies adopted provided us with insights into the merits and demerits of each methodology, and comparison of the results with other regions helped us in identifying the accuracy of the knowledge that was gained through this short-term survey.

STUDY AREA

Itanagar Wildlife Sanctuary (Fig. 1), covering an area of 140.30 sq. km, is a part of a contiguous forest cover and one among the notable biodiversity areas of north-east India. The region is mostly hilly (precipitous hillsides are a common feature of this area), and the average altitude of the terrain is 1,000 m above msl. The terrain slopes gently towards south and is highly rugged with mountainous ranges.

The monsoon begins around March-April, and continues till September-October (Anon. 2006). The annual average rainfall is approximately 2,500 mm with June and July as the wettest months. A large number of rivers drain into the area, most of which run from north to south. The landscape is difficult to traverse due to the rugged terrain and dense vegetation. Geologically, the forest area is prone to landslides during summer and is quite unstable.

The forest can be classified mainly as the North Bank Tropical Evergreen (Nahor-Jutuli), Tropical Semi-Evergreen and Secondary forests (Champion and Seth 1968; Kaul and Haridasan 1987). At places, the evergreen and semi-evergreen forests merge with one another and cannot be described separately. The North Bank Tropical Evergreen (Nahor-Jutuli) forests occur at an elevation of 900 m above mean sea level. The tropical semi-evergreen forests occur up to an elevation of 600 m above msl. This type of forest can be further classified into low hills, and plain semi-evergreen and riverine

semi-evergreen forests. Secondary forests occur due to both man-made (mainly shifting cultivation) and natural (mainly landslide or fire) reasons. This type could be further classified into a degraded forest, bamboo forest and grasslands (Kaul and Haridasan 1987)

No survey has been carried out on the status of species not even to generate a species list; however, the region is expected to have a number of mammalian species. Notable among the expected species are Sambar *Cervus unicolor*, Barking Deer *Muntiacus muntjak*, Wild Pig *Sus scrofa*, Indian Elephant *Elephas maximus*, Tiger *Panthera tigris*, Leopard *Panthera pardus*, Clouded Leopard *Neofelis nebulosa*, Jackal *Canis aureus*, Dhole *Cuon alpinus* and small cats. Among the primates, Assamese Macaque *Macaca assamensis*, Rhesus Macaque *Macaca mulatta*, Capped Langur *Trachypithecus pileatus* and Stump-tailed Macaque *Macaca arctoides*.

METHODOLOGY

General

This rapid survey was carried out in March 2003. As an initial approach, a pilot survey was carried out to understand the landscape and socio-economic status, and the information was associated with the status of the forest and wildlife found here. Forest officials were interviewed for specific information on the condition of forests, status of wildlife and information related to the cultural and economic status of the villagers. The survey adopted two approaches in the field.

a) 'Forest trail' survey for assessing the status of the forest and some species of wildlife

b) Village survey for assessing status of some species of wildlife.

Status of Forests

There are well-established forest trails, which are normally used by villagers. Some of these trails were considered for sampling and a total distance of 21 km was surveyed by foot. These trails are located close to villages such as the Rillo, Khoimir and Moin, and were referred as the Rillo, Khoimir and Moin trails. The walks were restricted to the trails as the undergrowth around them was thick and could not be explored. The forests within a 2 km radius from the villages were heavily cultivated (*jhum* cultivation); the forest type within these regions was secondary. After every 20 minutes four nearest trees, type and status of the forest, and observed anthropogenic disturbances were recorded.

Names of the tree species were noted down to associate with the forest types surveyed. The forests were classified into three categories; open, partially open and closed based on the canopy cover. When there was no canopy overhead, it was termed as open; when the canopy of adjacent trees overlapped, with the sky still showing through it was considered as partially open; and when the sky was not visible overhead, it was considered as closed forest (Raman *et al.* 1998; Varma pers. obs.).

Forest Trail Survey

Experienced individuals of the *Nishi* tribe were employed as trackers, and the forest trails were surveyed for animal presence through direct and indirect signs. Before starting the trail survey, information on species that could be encountered was collected from the trackers. This information was later compared with the species encountered during the survey. Trails were walked for direct sightings or indirect evidence such as pellets/scats/hoof marks, feeding and other signs. On sighting an animal sign or on any direct sighting, information on the time of sighting, number of signs (or individuals) and other related information were recorded.

There were a number of constraints as it was not easy to spot and identify footprints and tracks of animals because of the heavy litter on the ground. Care was taken in the identification of scats, as there were chances of encountering domestic dog *Canis familiaris* scats, especially at the periphery the Sanctuary.

Survey through village visit

Information on wildlife and its presence or absence was collected from the villagers. The villagers were able to provide reasonable information that was based on their visits to the forest, time spent, reasons for visiting and other related aspects. It was established that men spend more time in the forest than women, and it was planned to interview two individuals each from three age classes (old and experienced persons, middle aged persons and individuals from the age class in which they start going to forest) from each village. Selecting specific age classes of people was not possible as most of the men were in the forest during the day. People were interviewed randomly as and when they were available. All these approaches were helpful in establishing the socio-economic and cultural profile of the local communities, and its association with the villagers' dependency on the forest and its resources. The knowledge on wildlife species obtained from the villagers helped in developing the questionnaires based on which the interviews were carried out. The time spent on collecting information from each villager and the morphological and behavioural description of each animal by the villagers was noted down. Pictorial guides (Prater 1971; Menon 2003) were very useful for identification, both in the field and while processing data.

Most of the villagers could understand Hindi, and some could also speak English. The young villagers were especially well-versed with Hindi though there were some problems interacting with the older *Nishis*.

Data processing

The data on the occurrence of forest categories was converted into percentages, and the overall, as well as trail-wise, percentage of signs of each category was calculated. The number of signs, relative percentage, mean number of signs, and an overall and mean encounter rate of signs/km were calculated.

Statistica 5.5 (StatSoft Inc. 2001) and PAST (Hammer *et al.* 2001) software packages were used to carry out statistical tests. Non-parametric statistical tests were carried out for the current data set because of the low sample size. To test the relationship between the forest categories and the overall encounter rate for each trail, the expected and observed frequencies of the signs were calculated and this was tested using Chi square test. Shapiro Wilk's W test was used to test the normality of the data, and a Spearman rank correlation test was used for testing the correlation between the encounter rate and canopy cover. The Kruskal-Wallis test was used to test the statistical significance of the number of sightings of each category.

The number of species and their relative frequencies were calculated for the village surveys. The total number of man-hours spent during both trail and village surveys was calculated to develop species-time area curves for both the methods. For comparison of the results with Bago Yoma, Rakhine Yoma, Alaungdaw Kathapa National Park of Myanmar, Mudumalai and Singara Reserved Forests of southern India, the mean number of species, the total number of man-hours spent and the percentage of identifiable species

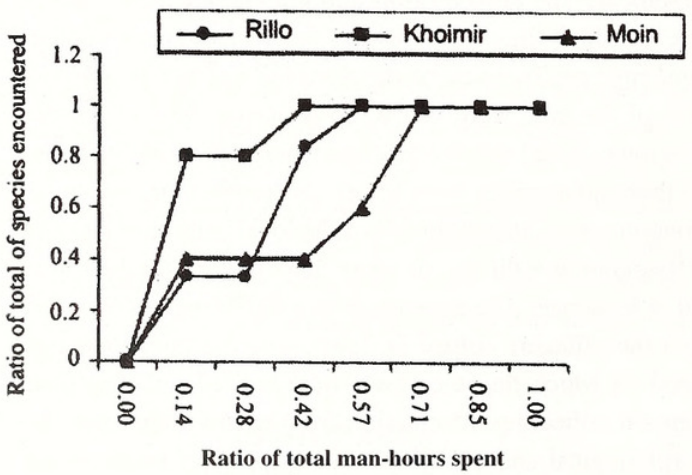

Fig. 2: The species-time curve for the trails close to villages Y-axis: proportion of total number of species whose signs were encountered; X-axis: proportion of total man-hours spent

common to the current survey area for each region were arrived at.

RESULTS

Status of forests

The *Nishi* villages are located in the valley and the adjoining forests were observed to be degraded. The forests were much less disturbed on the other side of the valley. The habitat along the forest trail varied drastically. This variation was found within and across the trails. The microhabitats encountered during the survey were open scrubland, areas under shifting cultivation, bamboo or reed or fern dominated woodlands and riverine habitats. About 58% of the forests surveyed were under open forest and 27% under partially open forest indicating the region has more open forest and only 15% area under closed forest. The status of forests between the covered trails was compared. Rillo trail had no closed forests; Khoimir trail had the highest percentage of open forest (72%), followed by Moin trail (45%).

Encounter rates of wildlife signs

The results show that the encounter rate of wildlife signs/km was highest for Rillo trail (3.50/km) followed by Khoimir (1.26/km) and Moin (1.13/km) trails (Table 1).

Encounter rates of signs in relation to status of forest

The encounter rate/km was high along the trail with less closed forest. The Rillo had only open and partially open forests and more signs were observed in this trail. The Moin, with the least encounter rate/km (1.13) had a high percentage of closed forests. The species encounter rate in relation to the total number of man-hours spent for each trail showed that for the trail close to the Rillo, all the species were encountered in 60% of the time spent. In the Khoimir and Moin trails, 83% of the species were encountered during the survey, and this was achieved through 43% of the man-hours spent in Khoimir trail and after only 85% of the man-hours spent in the Moin trail (Fig. 2).

The mean encounter rate of animal signs for open canopy forest was 1.6 (SE=0.22), for partially open forests it

Table 1: Name of the trails, time spent, distance covered and encounter rate of animal signs/km

S.No	Name of the trail	Time spent rate/km	Distance covered (km)	Encounter (hours)
1	Rillo	6.3	6	3.5
2	Khoimir	8.8	7	1.3
3	Moin	7.5	8	1.1

was 0.8 (SE=0.7) and for closed canopy it was 0, and the difference between the numbers of sightings for open and partially open forests was not statistically significant (Hc=0.39, p=0.73002). Both open and partially open categories were brought under one category of open forest, and the results were tested for the relationship between the openness of the forest cover and encounter rate of animal signs. More animal signs were encountered in open forests, and the difference was statistically significant (χ^2=12.25, df = 2, p<0.0021). Since Shapiro-Wilk's W test for normality suggested that the distribution of encounter rate and canopy cover was not normal (p<0.001), a non-parametric correlation was carried out and it was found that there was no significant correlation between encounter rate and canopy cover (r_s=0.2309, p=0.256, Fig. 3).

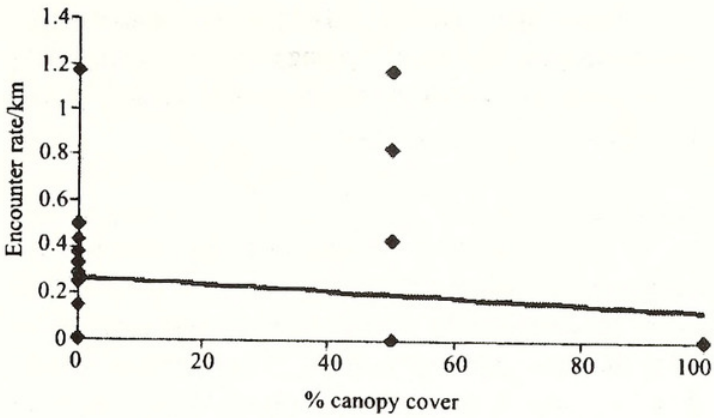

Fig. 3: Canopy cover versus encounter rate
Y-axis: encounter rate/km; X-axis: proportion of canopy cover

Species number reported across the survey methods

The percentage of time spent in collecting information through different approaches showed that 63% of the total time (56 hrs) was spent on village interviews and 37% (33.8 hrs) on trail surveys. With these methods together a total of 23 mammalian species that are key species or easily noticeable were encountered for the region. Out of the 23 species, only 26% (6 species including three unknown species) were encountered in the trail survey. Species detected by the trail survey were, Elephant, Sambar, Barking Deer, Bear (species not known), Canid (Dhole or Jackal) small carnivore (species unknown). The species-time curve for the trail method shows that within 16% of the time spent, all the species (26% of total species) were encountered through this method (Fig. 4) and there were no new species or an increase in the species encounter rate after this time.

Based on the time spent with each villager, a species-time curve was developed for the village interview method, and it was found that there was a gradual increase in the number of species as more and more people were interviewed. Only after spending 95% (54 hrs) of the total time with the villagers, information was obtained on all the species.

Table 2: Number of mammal species reported across different landscapes in Myanmar and India

Region	1	2	3	Altitude (m above msl)	Rainfall (mm)	Terrain	Forest type	Shifting cultivation	Hunting
Itanagar WLS, north-east India	23		0.37	1,000	2,000	Rugged and mountainous	EG, SEG & SF	Yes	Yes
Rakhine Yoma, Myanmar	25	80	33.4	1,200	1,200	Rugged and mountainous	MIXD, SEG & SF	Yes	Yes
Bogo Yoma, Myanmar	22	73	33.4	700	1,600	Rugged and mountainous	MIXD, SEG & SF	Yes	Yes
AKNP, Myanmar	20	80	5.58	1,000	1,500	Rugged and mountainous	MIXD, SEG & SF	Yes	Yes
Mudumalai WLS & Singara Reserved Forest, southern India	36	80	27.1	1,000	1,500	Undulating	DD, MD & SC	No	No

	1	2	3	Altitude (m above msl)	Rainfall (mm)	Number of species reported: Regions only of Myanmar	Number of species reported: Myanmar & Itanagar WLS
Mean	25	78	24	980	1,560	22.3	22.5
SE	3	2	11	89	144	1.4	1
CV %	12	2	47	9	9	6.5	4.44

1 - No. of species encountered; 2 - Percentage of identified species shared with Itanagar WLS; 3 - Percentage of total man hours spent for all the regions;
EG - evergreen; SEG - semi evergreen; SF - secondary forest; MIXD - mixed deciduous; DD - dry deciduous; MD - moist deciduous; SC - scrub forest

It appears that more than 50 man-hours are needed with villagers to get information on all the species encountered and to reach the asymptote in the species-time curve (Fig. 4).

Species number reported across different landscapes

The survey was short-term (a total of 3 weeks, spread across 89.8 hours in March) in nature due to several constrains in data collection; a comparison of the number of mammalian species reported across similar habitats elsewhere was attempted. This was done to estimate an expected number of species that could be a key species or easy to locate or species of conservation interest for the survey area. A comparison of species recorded in some regions of Myanmar was made. Some regions in Myanmar have similar landscape features (altitude and terrain) and some similar wildlife species, along with a low density of human groups. They are also reported to have similar cultural or traditional affinities, food and other resource gathering approaches involving shifting cultivation, hunting of wildlife and a dependency on forest products (Table 2). The regions selected for this comparison were Bogo Yoma (central Myanmar), Rakhine Yoma (western Myanmar) and Alaungdaw Kathapa National Park (AKNP - north Myanmar). The number of mammalian species reported for these regions were 25, 22 and 20 respectively (Varma pers. obs.; Aiyadurai and Varma 2003) translating to an average of 22.3 species (95% CI=18.8 to 25.8) If the current survey results of 23 species was included and the mean number of species was calculated for all these regions, a mean of 22.5 species (95% CI=20.1 to 24.8) would be the result for all these regions. Based on this, an expected number of 24 to 25 species (this assumption is based on the 95% CI of the average number of the species of all these regions) could be computed for the survey area, and the current survey estimated a number of 23 species. If the species number reported for large mammals in mixed deciduous habitat in southern India is also included (Sivaganesan and Desai pers. obs.; Varma pers. obs.), an average of 25.2 mammals (95% CI=19.0 to 31.4) can be estimated.

A comparison across evergreen (south-east Asia) and mixed deciduous (southern India) forests showed that the expected number of species of mammals for the survey area could be 19 to 31. However, when areas with similar affinities are compared, the variance around the mean is narrow (only 7%), but in areas that are dissimilar, and are known to share some percentage of similar species, the variance around the mean is relatively high (13%). The other interesting finding of this comparison is that the relative proportion of the man-hour spent for arriving at these numbers for all these regions varied (mean 24%, SE=11.3, CV=47%) and only 0.37% of man-hours were spent to encounter all the species for the current survey region.

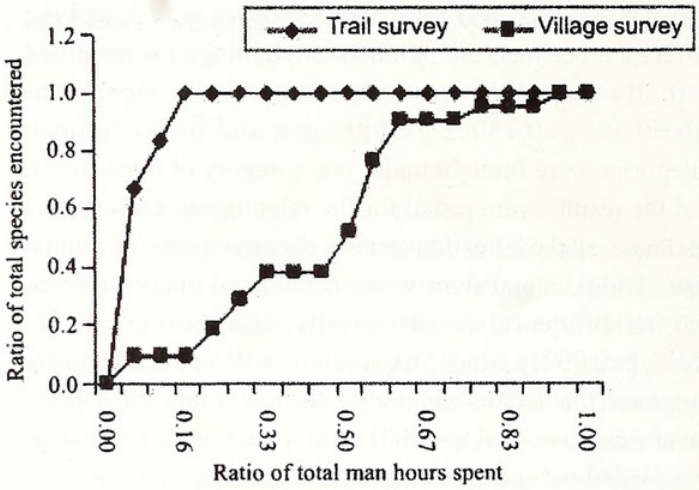

Fig. 4: The species-time curve for the survey methods The proportion of the total number of species encountered is plotted against the proportion of total man-hours spent

Status of species encountered through trail and village survey

No mammalian species was sighted along the trails. However, several signs of animal presence were recorded. These signs could be attributed to seven species or classified into five broad categories such as canids (Dhole and Jackal), cervids (Barking Deer and Sambar), small carnivores (Jungle and other cats), Bear (Himalayan Black Bear) and Elephant. Among them, mean signs of canids dominated followed by elephants, cervids, small carnivores and bear. However, the differences between numbers of signs of all these categories were not statistically significant (Hc=7.44, p=0.140).

Number of species recorded by village survey

Based on the reasons for *Nishis* to visit the forest, time spent, forest products used by the community and the animals that visited human habitations, the presence of 23 species of mammals could be reported for the region, out of which 65% of them were readily identifiable (Table 3). The very important aspect of the results is that the region has seven species of predators (Table 2), of which three (43%) are included in the Vulnerable (facing high risk of extinction) category and one (14%) is within the Endangered (facing very high risk of extinction) category of the IUCN Red List of threatened species. Five out of the seven species are under the Wildlife (Protection) Act of India's Schedule I category, which affords a high level of protection. Including the Asian Elephant, the region has six species of large herbivore mammals.

Out of the 23 species reported by the villagers, they were able to provide information on the frequency of sightings for 20 species (87%), and this indicated that the Barking Deer, Elephant, Jackal, Wild Boar, Capped Langur, Himalayan Black Bear and Dhole were the more commonly found

Table 3: List of mammals reported for the region by the villagers

Species	Scientific Name	Remarks
Leopard	*Panthera pardus*	
Tiger	*Panthera tigris*	
Clouded Leopard	*Neofelis nebulosa*	
Jungle Cat	*Felis chaus*	
Dhole	*Cuon alpinus*	
Jackal	*Canis aureus*	
Mongoose	*Herpestes* spp.	
Himalayan Black Bear	*Selenarctos thibetanus*	
Capped Langur	*Trachypithecus pileatus*	
Elephant	*Elephas maximus*	
Barking Deer	*Muntiacus muntjak*	
Sambar	*Cervus unicolor*	
Gaur	*Bos gaurus gaurus*	
Indian Porcupine	*Hystrix indica*	
Wild Goat		Species not known
Wild Boar	*Sus scrofa*	
Soku*		A small canopy dwelling animal
Taas*		A small canopy dwelling animal
Sukung*		A small canopy dwelling animal
Aama kochchi*		A Squirrel-like brown coloured small animal
Sekke*		A canopy dwelling animal (brown-black in colour, long tail)
Tahi*		A canopy dwelling animal with long tail
Juamola*		A small cat

* - *Nishi* names and the animals described by the local people and their English names could not be identified

species. Rarely seen species included the Sambar, Gaur, Wild Goat, Jungle Cat and Tiger. The elders from the villages also felt that species such as the Sambar, Gaur and Wild Boar used to be sighted more frequently and found in larger numbers, but their frequency of sighting and numbers have been considerably reduced. Another interesting result of the village survey is that, due to Barking Deer's localized distribution, same animals have been encountered frequently giving the impression that there are more Barking Deer in the region.

DISCUSSION

The current survey area in the Itanagar Wildlife Sanctuary and adjoining regions of Arunachal Pradesh was dominated by an open forest indicating large-scale destruction to the forest cover in this region. Studies in north-east India and Laos show that excessive agricultural activity through shifting cultivation not only decreased the forest cover, but also changed the forest into an open secondary woodland shrub (Timminus and Evens 1996; Raman *et al.* 1998). Surveys carried out on large mammals in eastern Cambodia and north-east India identified the practice of shifting cultivation as one of the threats to wildlife habitats (Desai 1996; Hillaludin *et al.* 2005; Mishra *et al.* 2006; Datta *et al.* 2008). On the other hand, in the recent survey, the patterns of high encounter rates of species in less closed trails and the species-time curves for all the trails could support the assumption that open forests attract more large mammals. It could be argued that a greater number of sightings of animal signs in open canopy areas may not have any ecological significance, but could be due to a relatively high visibility of the open canopy sites. However, a closer examination may suggest that the results of encounter rates of animal signs/km may not be related to the percentage of openness of each trail but may be due to the openness (or secondary forests with poor canopy cover) permitting more undergrowth and providing greater forage or forage space availability for herbivores. The region primarily had closed canopy evergreen forests (Kaul and Haridasan 1987), but shifting cultivation practices followed by the local communities had created more secondary forests and may become ideal sites for many species of mammals.

The number of species encountered through the trail survey was very low, and this could reflect the low density of wildlife species. The species (26% (N=6) of the total number) encountered during the trail survey were within 16% of the total and this pattern suggests that more attempts are needed to encounter the remaining 74% of the species. There were a number of constraints in using trail survey methods, as footprints and tracks of animals were not easy to spot or identify because of the heavy litter on the ground. Including livestock, only six categories of animal signs were encountered during the trail survey, of which only the Asian Elephant was possibly identifiable from the signs. Examples of low density or encounter rate of animal signs has been observed in other regions of Southeast Asia and a number of reasons could be speculated on this. Duckworth (1996) attributed these to the shy nature of the species, hunting pressure and fires set by the villagers. However, the relative frequencies of signs and encounter rates do have the advantage of predicting the status of prey and predators in a situation where prey numbers are falling due to heavy hunting and predators are known to prey on domestic animals. Apart from this, trail surveys could be useful for collecting systematic data on the status of forests. In the village interview method, 60% of the time was spent in obtaining the information. As experienced by Duckworth (1996), in Vietnam, villagers gave

convincing reports of several key species of mammals through village surveys, providing vital information of expected species in the survey area. The information on wildlife species was based on the vast and accumulated experience and knowledge of villagers. This survey also illustrated that not only the number of people but also the time spent with each person is a very important factor for obtaining a reasonable level of information about a species. If enough time is not spent, it is likely that different people could refer to a single species as two different ones or two different species could be considered as one. Yet, it is important to know the optimal period one has to spend with a given person for the investigation. Overall, the village survey appears to be a robust method for a basic or advance species list, but it may not be an appropriate method to evaluate the forest status.

Comparison of results from other regions indicates that the survey results match with the expected number of species for regions that have similar settings. Conversely, when observations were compared with the regions with less or no similar affinities, there was a variance in the results. However, these surveys (areas that were compared) resulted in knowing only key species or species that were easy to spot and gave no guarantee for others that are lesser known. It is important to note that there is a difference between the numbers of mammalian species found in a given region and the expected number of species that could be encountered through surveys or the experience of exploring forests. Although the survey was aimed at assessing the status of wildlife, in particular mammals, there was no scope for understanding the status of rodents, bats, elusive lesser-known species and other mammalian species that are not known to Science. Francis *et al.* (1996) reports that bats and small mammals represent a high proportion of the mammalian diversity; however, even to develop a basic checklist of these groups, a great deal of involvement and expertise are needed. Given these constraints we assume that understanding the status of flagship species and conservation of their habitat will eventually help in understanding the status of lesser known, but highly diverse mammalian species. In Nam Phu National biodiversity area of Lao PDR, after 300 man-days of survey, 46 species of non-volant terrestrial mammals were reported (Venkatraman pers. comm.), and Duckworth (1996) reported 30 species for the training and model forest of the Vientiane Forestry College in Laos. Desai (1996) reported 44 species of mammals for Monddulkiri and Rattanakiri provinces of eastern Cambodia, and there was no assurance that all the mammalian species of these regions were found through the surveys. The other important factors are the total area and number of mammalian species reported for a region. Sivaganesan and Desai (pers. obs.) reported 33 species for a 120 sq. km forest and only 31 species for 321 sq. km in southern India. This could indicate that there may be a relationship between the number of species and the quality of the area or microhabitat found in a given area, and the species number may not be related to the size of the area. Apart from these uncertainties, surveys need a lot of time, resources and expertise for all the species present to be encountered in a region.

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