Conservation implications of wild animal biomass extractions in Northeast India

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Abstract

Conservation implications of wild animal biomass extractions in Northeast India.— We investigated the patterns of wild meat extraction and consumption by indigenous communities in Northeast India. Our respondents hunted at least 134 species of wild animals over the previous year in the villages surveyed and continued to harvest and use wild meat as their cash income increased. These indigenous communities of Northeast India showed an average of 32 to 59% dependency on the forestry sector. Wild meat contributed significantly (up to 25%) to their economies, suggesting previous assessments of dependence on the forestry sector should be reviewed. All sections of the society exploited wild meat equally. As education seems to play a role in reducing wild meat extractions, increased awareness in conservation of natural resources should be promoted .

Key words: Wild meat consumption, Wild meat trade, Dependency, Northeast India.

Resumen

Repercusiones en la conservación debidas a las extracciones de biomasa animal salvaje en el nordeste de la India.— Investigamos los patrones de extracción y consumo de carne de caza por parte de las comunidades indígenas del nordeste de la India. En la aldea estudiada, los sujetos interrogados habían cazado al menos 134 especies de animales salvajes durante el año anterior, y continuaron cazando y utilizando la carne de caza cuando sus ingresos aumentaron. Estas comunidades indígenas del nordeste de la India dependían en promedio del 32 al 59% del sector forestal. La carne de caza contribuía significativamente (hasta un 25%) a sus economías, lo que sugiere que deberían revisarse las evaluaciones previas sobre la dependencia del sector forestal. Todas las capas sociales explotaban la carne de caza de igual forma. Dado que parece que la educación juega un papel significativo en la reducción de las extracciones de carne de caza, debería promoverse una mayor concienciación de la conservación de los recursos naturales.

Palabras clave: Consumo de carne de caza, Comercio de carne de caza, Dependencia, Nordeste de la India.

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Introduction

In Northeast India, people hunt wild animals for several reasons and therefore rural people are heavily dependent on wild meat (Hilaluddin, 2005a, 2005b). However, game may often be over–hunted and may have caused local extinctions of several species such as the Green peafowl *Pavo muticus* in Southeast Asia (McGowan et al., 1998). The problem can only be tackled by looking at the wider economic and institutional context within which hunting occurs, from household economies to trade (Abernethy et al., 2003). However, quantitative data on the amount of wild meat harvest, its consumption and trade in Southeast Asia in general and Northeast India in particular, are lacking. Therefore, there is an urgent need to quantify the intensity of wild meat extractions and assess impacts of such extractions on wild animal populations.

There has also been little work to determine the contribution of the forestry sector to the life of local people (Bahuguna, 1993). Economic benefits accruing to local economies from the forests have seldom been estimated (Bahuguna, 2000) and in most cases are incomplete. The economic value of animal biomass may have been significant but it was often ignored in earlier assessments which mainly pertained to timber and non–timber forest products (fuelwood, fodder, fruits, seeds, medicinal derivatives of plants, etc.). People's dependence on wild meat, in particular, remains unknown despite harvesting of roughly 23,500 tonnes annually in Sarawak (Bennett, 2002), 67,000–1,64,000 tonnes in the Brazilian Amazon (Robinson & Redford, 1991; Peres, 2000) and 1 million to 3.4 million tonnes in Central Africa (Wilkie & Carpenter, 1999; Fa et al., 2002).

There is also a need to assess the benefits derived from the wild meat in order to demonstrate the tangible contribution of the forestry in general and wild meat in particular to the society. This is also essential to understand the significance of wild meat in the local economy —both for cash and subsistence needs— and local cultural beliefs (Abernethy et al., 2003).

The economic theory of "Income and Consumption" (Kuznets, 1955), which is now used world–wide in most natural resources conservation action plans, suggests that consumptions of a commodity go up with an increase in household income if it has no substitutes or is considered superior to substitutes. Otherwise, the use of goods falls with rising income, showing inverted "U shape" patterns. Kuznets' model of consumption may not be universally applicable to all goods, however, even if they are inferior, especially in regions of the world where people have developed a taste for a few specific goods for reasons other than economic. His model may thus vary across the nature of goods and areas. Therefore, there is a need to investigate the validity of Kuznets (1955) model in consumption of important forest products such as wild meat before its incorporation into a conservation action plan.

We undertook a survey in Northeast India to assess whether the extraction of wild meat by Angami, Apatani, Mizo and Nishi communities was a conservation problem in the region. Specifically, we sought to determine whether consumption of wild meat was linked to people's income. In order to answer this question we studied the prevalence of wild meat extraction and consumption, the species hunted and differences in hunting patterns of indigenous communities, the linkage between wild animal hunting and trade, the role of wild meat in local economy, and the impact of education, age and profession of a person on wild meat extraction. We also collected information on other forest products harvested by a household in order to calculate income of that household from the forestry. The amounts of all forest products extracted by a household are quantified and their quantities are converted into monetary values based on their prevalent spot prices for estimating a household income from forestry (Malhotra et al., 1991; Hedge et al., 1996). According to Bahuguna (1993, 2000), the income of a household must be calculated by summing incomes of that household from all sources viz. agriculture (labour and crops), forestry (forest products and forest management activities) and other employment opportunities (self and government employment).

Methods

The survey included three methods: A general village level survey, a household level survey, and finally a market survey. Animal extraction data were collected by way of a detailed set of questionnaires and were not independently measured amounts.

The qualitative and quantitative information both at village/hamlet and household level on the animal extraction patterns was gathered following a combination of PRA (Sankaran et al., 2000) and RRA (Sethi & Hilaluddin, 2001) methods. We collected information on the animal species and their number(s) killed by a household during the previous year. The respondents were shown pictures of animal species for the purpose.

A total of 25 villages were surveyed, representing four communities (Angamis 6; Apatanis 5; Nishis 8; Mizos 6). The villages were from the interior and exterior forest blocks among the settlements of the studied communities, thereby covering most of their habitation ranges.

Generally, one interview with a group of villagers was conducted at the village/hamlet level. During this interview we sought wide–ranging information about the resource use patterns (those interested in the questionnaire and the list of species hunted with their numbers will be sent the information upon request to the author) Such interactions were usually a good introduction to the purpose of our surveys, and subsequent data collection at the village level became easier (Hilaluddin et al., in press b).

Fig. 1. Locations of surveyed villlages in Northeast India: 1. Angami; 2. Apatani; 3. Mizo; 4. Nishi.

Fig. 1. Localización de las aldeas del nordeste de la India estudiadas: 1. Angami; 2. Apatani; 3. Mizo; 4. Nishi.

After the village level focal group interviews, we were able to focus on individuals involved in some level of forest produce gathering. A total of 134 household level interviews (Angamis 33; Apatanis 33; Nishis 30; Mizos 38) were conducted in Aizwal, Kohima and Lower Subansiri districts of Northeast India (fig. 1).

Following these interviews, we divided familiy units into hunting or non–hunting households. We further classified them into business, farming and service communities. We selected respondents for household level interviews following random sampling techniques (Sutherland, 1996). Sampling efforts covered at least five percent for each category of households (hunting and non–hunting) in each surveyed village and town for collecting data on range of animals extracted by the household. We also gathered information on agriculture crops and wild plants (timber, firewood, fodder, bamboo, medicinal plants and other NTFPs) products, with their prevailing spot price, gathered by the household during the previous year. In addition, a household's income from other avenues (agriculture labour, forestry labour and other employment opportunities) was also quantified. We also collected data on age, education status and size of the respondent's family. Educational level was assessed from the number of school years (1–15) he/she had passed from a recognized institution.

The respondents in the household level interviews were mainly selected randomly but sometimes on the advice of our guide who hailed from the village. If both a man and a woman from the household were present, we interviewed the man because only male members, within the indigenous communities studied, hunt wild animals.

We also conducted wild meat trade surveys for a period of 15 days each in the local markets of Kohima city (Nagaland) and Hapoli town (Arunachal Pradesh). The main purpose of this survey was to establish whether there was trade of wild meat in urban centers and also whether these markets connected to the remote areas of our survey sites. We recorded species being sold in the markets with their numbers and price.

Data on the intensity of hunting within a village was calculated from the estimated number of animals killed by each household/annum for each species. Crude wildmeat amount extracted by a household for each species was calculated using the average body weight of adult individuals. Mean body masses of animals were taken from the literature (Prater, 1971; Ali & Ripley, 1987) with the exception on fishes. Information on the quantities of extraction of fishes and other forest products by a household were directly gathered in per unit measurement in the field.

We calculated a household's income from forestry by converting quantities of wild animal and plant species extracted by that household into monetary values based on their prevalent spot prices. We also included the income of that household from forest management activities such as forestry labour, nursery, and forest watch and ward activities. The gross annual incomes of households were calculated by summing their incomes from various income sectors viz. agriculture (crops and labour), forestry (plants, animals and employment through forest management activities) and other employment opportunities (self and government employment).

We investigated the relationship between wild meat extraction and consumption rates of Angami, Apatani, Mizo and Nishi communities using Independent sample t test because these communities harvest wild meat both for self–use and for sale. The impact of socio–economic variables, specifically age, educational status, and incomes derived from cash avenues on wildmeat extraction rates, were calculated using Pearson's correlation coefficient. The differences in mean values of wild meat extracted by people in different occupations were investigated using the Kruskal–Wallis test.

The monetary significance of wildmeat extractions to local economies of Angami, Apatani, Mizo and Nishi communities were examined using One Way ANOVA and therefore the null hypothesis "the variations in mean values of dependency sources were statistically non–significant" was tested. This was used to infer whether dependencies of a household on each source contributed significantly to the local economy. We also investigated the impact of cash income from agriculture, forestry (other than wildmeat) and other employment opportunities on wildmeat consumption using Pearson's Product correlation. This was used to examine the impact of cash income on wildmeat use by a household. We compared gross annual incomes and dependencies of surveyed households on various income sources

across their respective villages using Kruskal–Wallis. All the data, wherever appropriate, were normalized and statistical procedures were applied following Sokal & Rohlf (1995).

Results

Socio–economic profile of respondents

Out of 134 respondents, Angami and Apatani indigenous communities each represented 25%, 22% were from the Nishi community and the rest were Mizo. Most of our respondents were literate. Their age, education status and family size are presented in table 1.

Wild meat survey

Our respondents in the villages surveyed extracted at least 137 wild animal species, including 50 mammals and one reptile, during the previous year. Apatani household extracted on average of 282 kg wild meat annually (table 2), mainly from mammals (85%). Birds formed 5.98% of Apatani's extraction. The most relevant group among birds was galliformes. Other animals (mainly fish) represented a significant part of the Apatani diet and constituted 8.4% of the extracted meat by weight. An Angami household extracted about 457 kg of wild meat annually, which was mainly (89%) mammals. Birds too formed a substantial component (9.4%). A Mizo household extracted a mean of approximately 278 kg wild meat annually, of which 89% came from mammals. Birds constituted 3.4% and the majority were galliformes. Other animals formed 7.8% of the Mizos' total wild meat extracted. Amongst Nishis, mammals constituted 69% of the total wild meat extracted (average approximately 545 kg) annually. Other animals formed a substantial component (17.5%) and birds formed about 13.4%.

Wild meat market survey

We observed a total of 773 dead animals (233 mammals and 540 birds) in the markets of Kohima over 15 full days of observation and recorded 53 wild animal species (15 mammals and 38 birds). Similarly, we examined a total of 601 dead wild animals (418 mammals and 183 birds) in the markets of Hapoli, and recorded 19 wild animal species (10 mammals and 9 birds). A total of 118.62 kg of wild meat (80.39% from mammals and the rest from birds) was available at Hapoli and 154.33 kg of wild meat (73.92% from mammals and the rest from birds) at Kohima. All animal meat came from adjoining rural areas.

Wild meat and socio—economic variables

We investigated the relationship between wild meat extraction and socio–economic variables (table 3). A significant relationship emerged only amongst Angami and Mizo communities. Angamis with a higher income from sources other than wild meat tended to harvest more wild meat. The extraction of wild meat amongst Mizos declined the higher the education level. Extraction of wild meat showed no statistically difference in relation to occupation (Kruskal–Wallis, n.s.)

An analysis using Pearson correlation coefficient was performed to determine the effect of income on wild meat consumption. With the exception of Mizo community (fig. 1), significant positive correlations were observed between gross cash income and amount of wild meat consumed by Angami, Apatani and Nishi communities (fig. 2).

Incomes and dependencies

We estimated average annual gross incomes of the indigenous communities included in the study (table 4). Incomes were interpreted as accruals on the basis of cash values of the forest and agriculture–based goods obtained by a household in addition to incomes from other employment opportunities (e.g. self–employment i.e. business, and government employment i.e. state and federal government funded employment in various public departments).

Bulk of average income (approximately 25%) to a Nishi household is derived from wild meat, which is conspicuously higher than their incomes from agriculture and other employment vocations (self and government employment). Similarly, Angami, Apatani and Mizo households derived average 14–16% incomes from wild meat.

Gross annual incomes of the study communities from various income sources (crops, agricultural work, wild plant products, forest management activities, wild meat, self–employment and government employment) and now they state more possibilities) showed significant differences (Angami: $F_{6\ 224} = 6.47$, $P < 0.001$; Apatani: $F_{6\ 224} = 11.6$, $P < 0.001$; Mizo: $F_{6\ 259} = 2.71$, $P < 0.01$; Nishi: $F_{6\ 203} = 3.92$, $P < 0.001$, One way ANOVA).

Similarly, these sources of income varied significantly among the four communities (Angami: $F_{6\ 224} = 16.4$, $P < 0.001$; Apatani $F_{6\ 224} = 18.3$, $P < 0.001$; Mizo $F_{6\ 259} = 7.66$, $P < 0.001$; Nishi $F_{6\ 203} = 15.53$, $P < 0.001$, One way ANOVA). However, incomes and dependencies of these communities on various sources across their respective villages did not show significant variations (Kruskal–Wallis test, n.s.).

Discussion

A large number of mammals and birds are hunted in Northeast India (Hilaluddin, 2005a, 2005b) and many of these are of concern to conservation (Birdlife International, 2000; IUCN, 2003). In the villages surveyed, the hunted animals included 20 species considered as threatened on the Red Data List (IUCN, 2003); four Endangered (*Aceros nipalensis, Bubalus bubalus, Elephas maximus* and

Table 1. Socio–economic profile of the respondents' communities.

Tabla 1. Perfil socioeconómico de los sujetos de las comunidades interrogados.

	Age (years)		Education (class)		Family size		% Literacy rate	
Tribe	Mean	S.E.	Mean	S.E.	Mean	S.E.	Literate	Illiterate
Angami (N = 33)	49	3	7	1	6	1	84.6	15.4
Apatani (N = 33)	45	3	6	1	6	1	57.6	42.4
Nishi (N = 30)	42	3	5	1	8	1	53.3	46.7
Mizo (N = 38)	51	2	7	1	7	1	94.7	5.3

Table 2. Wild meat extraction patterns (in kg/household/annum, mean ± CI) of sampled indigenous communities in Northeast India. (Data at 95% confidence level.)

Tabla 2. Patrones de extracción de carne de caza (en kg/familia/año, media ± CI) de las comunidades indígenas muestreadas del nordeste de la India. (Datos con un nivel de confianza del 95%.)

Mode of Income	Angami (N = 33)	Apatani (N = 33)	Nishi (N = 30)	Mizo (N = 38)
Wildmeat	651.7 ± 349.1 457.5 ± 211.8	282.1 ± 138.4 239.1 ± 92.0	545.9 ± 186.3 496.2 ± 151.5	277.7 ± 140.8 188.8 ± 71.7
Mammals	564.3 ± 291.8 408.2 ± 192.7	241.4 ± 105.5 208.5 ± 84.9	377.3 ± 132.0 346.2 ± 109.6	246.5 ± 132.8 172.0 ± 70.7
Herbivores	9.91 ± 201.98 322.64 ± 147.97	184.2 ± 88.92 164.56 ± 69.65	277.66 ± 117.6 255.76 ± 92.8	206.5 ± 110.11 151.68 ± 66.01
Carnivores	164.42 ± 95.68 85.53 ± 50.53	57.17 ± 23.76 43.93 ± 21.91	99.64 ± 35.9 90.49 ± 31.08	40.02 ± 24.82 20.30 ± 9.15
Birds	51.5 ± 31.1 43.2 ± 22.9	16.9 ± 9.1 16.0 ± 7.8	73.1 ± 48.1 54.5 ± 19.4	9.5 ± 6.0 6.2 ± 2.7
Galliformes	23.38 ± 18.9 15.62 ± 8.14	11.9 ± 8.74 11.19 ± 7.32	29.73 ± 13. 34 26.66 ± 10.43	4.83 ± 4.42 3.00 ± 1.44
Other birds	28.16 ± 14.72 27.60 ± 19.53	4.86 ± 2.43 4.81 ± 2.06	43.35 ± 43.03 27.8 ± 14.51	4.67 ± 2.26 3.17 ± 1.68
Other animals	35.9± 42.7 6.1 ± 5.7	23.8 ± 23.6 14.6 ± 13.3	95.5 ± 74.7 95.5 ± 74.7	21.7 ± 12.3 10.6 ± 3.2

Table 3. Pearson's correlation coefficients between socio–economic factors and wild meat harvest of the sampled indigenous communities of Northeast India: A. Age; E. Education; I. Income; * Denotes level of significance (P < 0.05).

*Tabla 3. Coeficientes de correlación de Pearson entre los factores socioeconómicos y la extracción de carne de caza de las comunidades indígenas muestreadas del nordeste de la India: A. Edad; E. Educación; I. Ingresos; * Indica nivel de significación (P < 0,05).*

	Angami (N = 33)			Apatani (N = 33)			Nishi (N = 30)			Mizo (N = 38)		
Product	A	E	I	A	E	I	A	E	I	A	E	I
Wild meat	–0.29	0.04	0.44*	0.11	–0.27	0.26	–0.23	–0.07	–0.09	0.08	–0.40*	–0.07

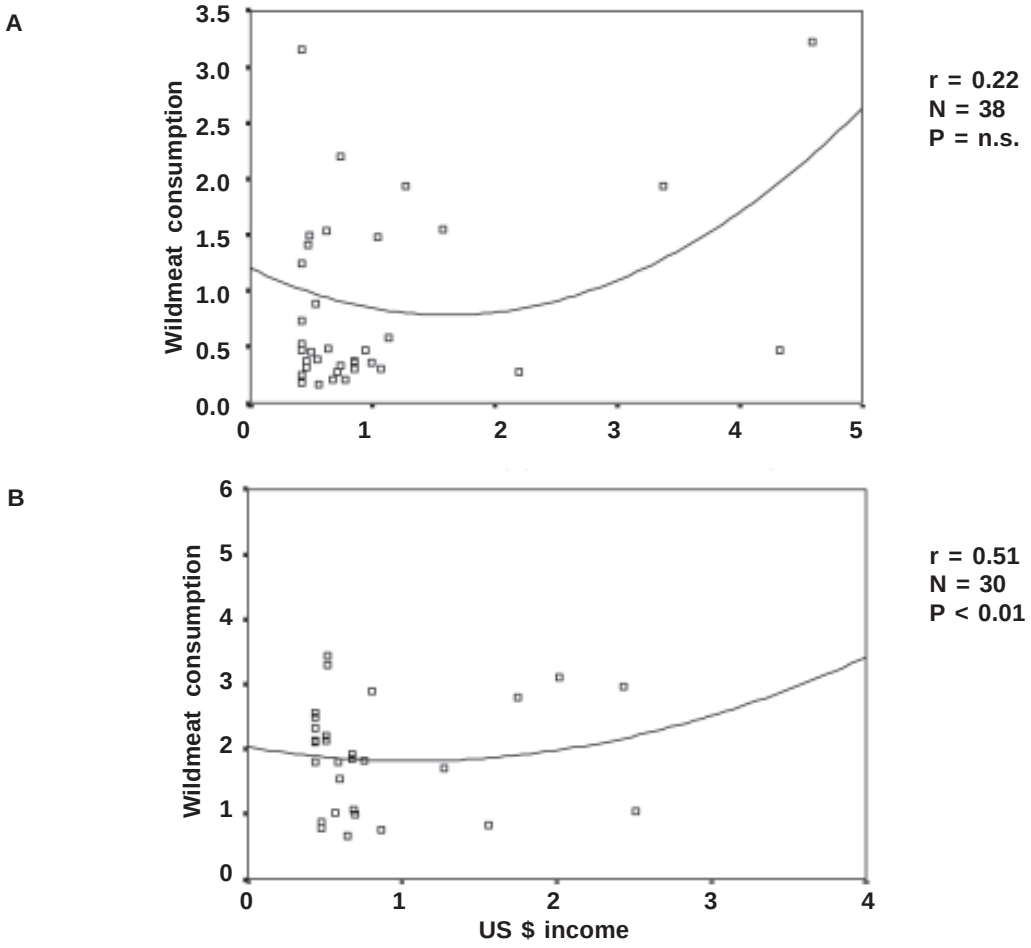

Fig 2. Relationship between wildmeat consumption (kg/year) and incomes: A. Mizo community; B. Nishi community. (All values normalized.)

Fig. 2. Relación entre el consumo de carne de caza (kg/año) y los ingresos: A. Comunidad Mizo; B. Comunidad Nishi. (Valores normalizados.)

Panthera tigris), eight Vulnerable (*Capricornis sumatraensis, Macaca assamensis*, *Manis pantadactyla, Neofelis nebulosa, Panthera pardus*, *Presbytes pileatus, Selenarctos thibetanus* and *Tragopan blythii*) and rest Lower Risk: near threatened (*Columba punicea, Cuon alpinus, Felis bengalensis, F. viverrina, Hylopetes alboniger, Nemorhaedus goral, Nycticebus coucang* and *Prionodon pericolor*).

In India, under the Wild Life Protection Act 1972, it is illegal to kill any wild life (Anon, 2003). Our interactions with respondents revealed that almost half were aware of this law and the penalties for violation . We therefore feel that in some cases our respondents may have revealed lower figures of animals than those actually hunted and the conservation problem may be graver than reported here.

The loss of species to hunting warrants urgent attention in Northeast India because forests here are already much reduced in area and are increasingly fragmented as a result of shifting cultivation (FSI, 2003). This implies that populations of species endemic to this habitat type are not only at risk of loss of habitat and populations becoming isolated from each other, but also from easier access to hunters. The loss of relatively small numbers of individuals, especially species that are included in the Red List, may have a disproportionate impact on small and isolated populations.

Another important issue that warrants attention is the wild meat consumption patterns of the surveyed indigenous communities. Our findings (fig. 2) are contrary to the Kuznets model (1955) of income and consumption of goods. Our models indicate that households in Northeast India continue to use wild

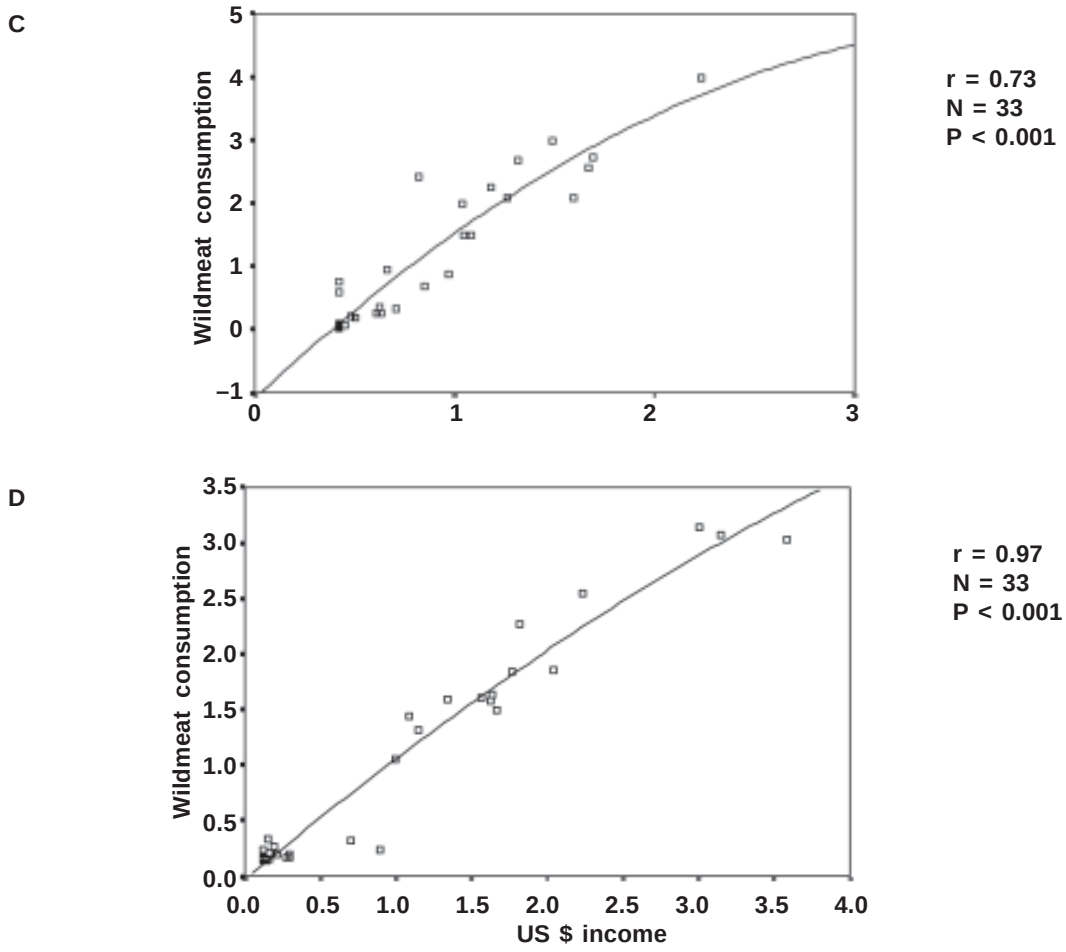

Fig. 2. Relationship between wildmeat consumption (kg/year) and incomes: C. Angami community; D. Apatani community. (All values normalized.)

Fig. 2. Relación entre el consumo de carne de caza (kg/año) y los ingresos: C. Comunidad Angami; B. Comunidad Apatani. (Valores normalizados.)

meat and may even increase their consumption of wild meat as their income increases. The models show that a rise in income may have the unexpected and undesirable side effect of promoting consumption–driven increases in hunting pressure. Given the open access nature of wild meat and its demand in the region, a rise in income levels could easily enhance the demand for wild meat and consequently induce over–harvesting of the species both in the short and the long term. The long term is not relevant for the species that are most threatened by hunting, for which extinction within a decade is a real possibility (Nelleman & Newton, 2002). Therefore, strong intervention is required where there is a need to reduce hunting levels.

It is essential to understand not only the impact of hunting on wild populations but also the reason why certain species are hunted (Kaul et al., 2004). Firstly, hunting has a religious and cultural significance to many communities in Northeast India (Hilaluddin, 2005a). For example, the religious rituals of the Apatani community include generous offerings of smoked *Funambulus palmarus, F. pennanti*, *Hylopetes alboniger* and *Dremomys lokriah*. The Apatani community also sacrifices *Macaca assamensis* to propitiate their deity during their annual spring festival, "Morum". The festival's feasting includes a voluminous amount of *Muntiacus muntjak* and *Sus scrofa* meat.

Barbets, specifically *Megaliama virens,* are often served to entertain special family guests. Nishi priests decorate their headgear with *Selenarctos thibetanus* skins and a pair of hornbill tail feathers. Furthermroe, Nishis prize the skin of *Presbytes pileatus* for making sheaths for their traditional daggers, "Davs". Other community members adorn

Table 4. Gross annual incomes (in US $) of sampled indigenous communities of Northeast India from wild meat and other income avenues. (Data at 95% confidence level.)

Tabla 4. Ingresos anuales brutos (en $ americanos) de las comunidades indígenas muestreadas del nordeste de la India, provinentes de la carne de caza y otras fuentes. (Datos con un nivel de confianza del 95%.)

	Angami (N = 33)		Apatani (N = 33)		Nishi (N = 30)		Mizo (N = 38)	
Mode of Income	Mean	CI	Mean	CI	Mean	CI	Mean	CI
Agriculture	2,164.9	656.6	11,505.7	396.9	853.5	333.9	1,434.8	1,052.7
Agriculture crop	2,105.9	656.8	11,459.7	401.3	754.5	316.3	1,361.4	1,052.6
Agriculture labor	59.0	50.5	445.9	29.7	98.9	73.1	73.4	95.9
Forestry	2,365.6	902.6	11,343.0	300.8	2,149.6	775.4	1,216.8	559.2
Plant	1,088.6	330.7	711.1	172.3	1,241.4	739.3	545.1	463.9
Timber	736.3	319.9	172.1	113.1	194.4	168.2	66.8	*129*.8
Gross NTFPs	352.2	136.1	539.0	91.8	1,047.9	688.2	478.4	452.8
Bamboo	68.4	98.4	176.1	57.8	20.5	9.07	293.4	257.7
Fuelwood	231.9	114.2	324.7	66.7	487.4	161.2	183.9	65.1
Other NTFPs	51.8	30.3	38.1	20.9	539.1	538.4	1.1	0.9
Forest management	0	0	136.5	155.1	91.2	136.4	109.9	109.0
Animal	1,277.1	847.5	495.4	219.8	817.0	275.9	561.7	294.9
Mammals	875.3	539.9	368.7	169.3	517.2	173.5	420.0	245.9
Birds	324.2	249.1	86.9	50.1	156.6	64.6	46.8	30.9
Other animals	77.7	88.6	39.8	45.6	143.2	124.3	94.9	65.5
Other employment opportunity	1,636.7	965.2	1,219.5	472.4	962.4	615.8	2,171.5	1,193.6
Government employment	927.2	388.4	833.8	367.8	538.8	313.2	835.9	357.1
Self employment	709.5	779.5	385.6	366.5	423.6	465.4	1,335.5	1,066.5
Gross Income	6,163.9	1,679.8	4,068.2	679.9	3,965.5	1,230.3	4,823.1	2,016.1

their caps with hornbill beaks, specifically *Aceros nipalensis*, and a pair of *Dicrurus paradiseus* and/or *D. remifer* tail feathers.

Several species are also popular among locals for their role in traditional medicines in local beliefs (Hilaluddin, 2005b). Amongst Mizos, flesh of *Macaca assamensis* is associated with relieving delivery pains and is also believed to aid the development of the infant while inside the mother's womb; bats are supposed to cure asthama; the gall bladder of *Selenarctos thibetanus* heals jaundice; and the liver of *Hylobates hoolock* kills malarial parasites. Angamis consume *Upapa epops* to alleviate male impotency.

Secondly, it appears that the primary objective is to secure an animal for consumption or sale. The opportunity cost for the extraction of a wild animal which is relatively more common than others should be less than that of less common ones. Thus, the most abundant wild animals are expected to be harvested more intensively than the less abundant ones. However, the opportunity cost also depends on body size of the target quarry, and therefore the quantity of meat rather than the quality generally dictates direct preferences. Unfortunately, abundance estimates for most animal species are lacking for Northeast India in general and our study area in particular, making it difficult to determine whether offtake is adversely affecting wild populations (Hilaluddin et al., in press a). This requires investigation.

Thirdly, wild meat in our surveyed areas is also harvested for trade. It appears that families living in comparatively remote areas have poor access to markets and where substitutes are not available, people mainly rely on wild meat for protein. However, those who have migrated to cities and towns for a better living have not lost the "taste" for wild meat. In such areas, wild meat constitutes a "superior good" and people pay 1 to 5 times the domesticated animal meat. The markets in the towns seem to be fed directly from the remote areas where people may kill wild animals mainly to cater for the

Table 5. % Dependencies of sampled indigenous communities of Northeast India on wild meat and other income sources. (Data of 95% confidence level.)

Tabla 5. Dependencias de la carne de caza y de otras fuentes de ingresos de las comunidades indígenas muestreadas del nordeste de la India. (Datos con un nivel de confianza del 95%.)

	Angami (N = 33)		Apatani (N = 33)		Nishi (N = 30)		Mizo (N = 38)	
Mode of Income	Mean	CI	Mean	CI	Mean	CI	Mean	CI
Agriculture	39.4	9.3	37.0	5.8	22.98	5.8	29.8	9.0
Agriculture crop	38.0	9.2	35.2	5.4	20.04	5.6	28.0	8.8
Agriculture labor	1.3	1.3	1.7	1.2	2.94	2.0	1.8	2.2
Forestry	37.7	7.2	37.4	7.1	59.07	7.6	32.4	8.1
Plant	23.5	7.9	19.2	3.5	31.66	5.8	12.4	3.9
Timber	16.9	7.6	3.8	1.9	4.91	2.8	1.3	2.4
Gross NTFPs	6.6	2.5	15.4	2.9	26.74	5.6	11.2	3.5
Bamboo	0.7	0.6	4.7	1.7	0.63	0.2	3.3	2.4
Fuelwood	4.8	2.2	9.5	2.0	16.34	4.4	7.8	2.7
Other NTFPs	1.0	0.6	1.2	0.7	9.78	3.7	0.1	0.1
Forest management	0	0	3.5	3.6	2.21	3.7	3.5	4.5
Animal	14.1	5.8	14.7	5.8	25.2	7.4	16.4	6.4
Mammals	10.3	4.4	10.7	4.5	15.79	4.6	11.9	5.5
Birds	3.1	1.4	2.9	1.6	5.81	2.7	1.1	0.5
Other animals	0.7	0.6	1.1	1.1	3.6	2.8	3.4	2.4
Other employment opportunity	23.1	8.5	25.6	8.7	17.95	7.2	37.8	9.6
Government employment	16.4	7.9	18.4	7.7	12.43	5.3	21.0	9.3
Self employment	6.7	4.9	7.2	5.8	5.52	6.1	16.8	6.6

demand of urban areas and thereby ensuring a supply of wild meat even if city dwellers do not have the time or opportunity to hunt regularly.

Therefore, wild animal hunting in our study area clearly demonstrates a direct link between level of harvest and economic growth of those involved in wildlife trade. Thus, there is likely to be an increase in the wild meat extraction intensities of commercial hunters with an increase in urban populations. This increased appetite for goods should further stress the need to exploit animal resources in remote forest areas. One such example is found in the link between demand for tropical hard timber in the international market and over–exploitation of forests in Southeast Asia and the Amazon basin (Kolk, 1996; Dauvergne, 1997; Barker, 1998).

The majority of our respondents belonged to an economic stratum well above the poverty line (annual income above Indian Rupees 11,000/household or 244.44 US $). Taking the other income sources into account (fodder and shifting cultivation), these figures would further add up to a significant annual income.

Amongst Nishis, a large proportion of rural income is derived from the forestry. Amongst Mizos, the bulk of income is derived from other employment opportunities (self and government employment) and the agriculture sectors followed by the forestry. Such patterns are contrary to the general economy and employment of rural India which is largely agriculture based (Sethi & Hilaluddin, 2001). However, the rural economy of Angamis seems to conform the general agriculture based economic pattern of rural India. The rural economy of the Apatanis shows equal dependence on agriculture and forestry sectors. Amongst the Nishis, wild meat occupies an important place in village economy. Such an economic pattern is similar to the rural economy of Ghana where wild meat makes a significant contribution to both the household food supply and as cash income (Dei, 1989). Our respondents seemed to be highly dependent upon wild meat for both their kind and cash values.

Our estimated annual incomes and dependencies of Angami, Apatani, Mizo and Nishi communities on the forestry are not directly comparable with

income levels and dependencies on the forestry sector reported earlier in India or elsewhere in the world. This is because in their estimates, previous workers (e.g. Malhotra et al., 1991; Bahuguna, 1993, 2000; Hedge et al., 1996; Sethi & Hilaluddin, 2001) have overlooked incomes derived from wild meat contributing significantly to local economies. We thus feel previous estimates are incomplete and that previous appraisals should be revised

Our analysis on occupation status vis–à–vis wildmeat extraction suggests that all sections of the society: be they custodian of the law or farmer or businessman, remove animal biomass equally. It also seems that an increase in education among the Mizo decreased the amount of wild meat extraction. With a higher level of education, people have access to better jobs, and this in turn presumably leaves them with little time to hunt. However, in certain communities such as the Angami, increased cash incomes from vocations other than wild meat resulted in higher extraction of wild meat. It is likely that an improvement in financial status of a household also increases the desire to consume more. Therefore, policies linking poverty alleviation programs with the conservation of natural resources should be drafted with utmost care. Policies linking extraction of wild meat to alleviate poverty with conservation of natural resources require major review.

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