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Conserving wildlife wealth of Patharia Hills Reserve Forest, Assam, India: A critical analysis

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ABSTRACT

Wildlife plays an important role in maintaining the balance of various natural processes of the earth. It contributes to food security, economical growth, pollination, seed dispersal for forest regeneration. The present study was carried out at Patharia Hills Reserve Forest (RF) of southern Assam (India) with the aim to study the wildlife distribution, species trend over time and various threats to them. Semi-structure interview and secondary literature were used during the study; 83 species of mammals were found to inhabit RF. Unfortunately, the wildlife of the RF are facing numerous threats, largely due to clearing of forest, encroachment, collection of timber and non-timber forest products, habitat loss and fragmentation. People are of the opinion that the RF is their common property which they can exploit as their wish. The study revealed the wildlife distribution and the various threats, which is the basic challenge for the conservation. Multi-action approaches for the benefit of villagers as well as wildlife are suggested. Elevating the status of the RF may be a vital solution to protect the RF in a better way.

1. Introduction

North East (NE) India is the eastern-most parts of India with geographical area of 2,62,230 square kilometers, comprising the contiguous seven states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura) and the Himalayan state of Sikkim. Two-third of the area is hilly terrain interspersed with valleys and plains. Besides the west coast of India, north east India is the other important place of Indian sub-continent's remaining rain forests that harbor a great biodiversity. At the convergence of two global biodiversity hotspots: the Indo-Burma and the Himalayan, the NE India is unique in providing various habitat, which supports diverse biota with a high level of endemism (Myers et al., 2000; Mittermeier et al., 2004). Geographically NE India is having the size of United Kingdom and harbors biodiversity equal to all European countries (Choudhury, 2013). The area of North east India is 8% of the country supports more than half of the biodiversity of the country (Proctor, 1998; Hedge, 2000; FSI, 2003). The rich biodiversity is due to favorable topographic conditions, vegetation types, soils varieties and enormous rainfall. The rainfall in North East India is mainly due to monsoonal wind. The region is abode to approximately 135 tribes, 23% of India's total tribal community (Census of India, 2011). The culture and customs of them are important for the conservation of biodiversity. Already overburdened population of north-eastern India increases by more than half a million per year, leading to reduce the extent of forest cover for human settlement.

Assam is the second largest state of North East India after Arunachal Pradesh. The state harbors greatest biodiversity than any other North East Indian States. Assam is also a diversified area which is geographically divided into three parts,

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viz., Brahmaputra Valley, Barak Valley and Hills of North Cachar and Karbi Anglong. The Plains of Barak valley supports agricultural activities and thereby provides major food requirements of the valley. The forests in the valley are tropical evergreen and semi-evergreen, tropical deciduous forests, secondary forests, and tea plantation areas endowed with a large diversity of flora and fauna (Choudhury, 2013; Talukdar and De, 2016). Because of adequate temperature, high rainfall, the valley supports many globally important species. Two famous National Parks Kaziranga and Manas are situated in Assam.

In the early decades of the 20th century, tea plantations exacerbated the deforestation and fragmentation of the habitats of many animal species (Choudhury, 1988a, 1995, 1996). Additionally, poaching, slash and burn shifting type of practice (*jhum*), increase in developmental activities, construction, etc., have pushed many of the animals to the brink of local extinction (Mazumder, 2014).

The present study was carried out in Patharia Hills Reserve Forest (RF) that lies within the Indo-Burma hotspot. Although many studies have been carried out on the wildlife in various types of protected areas of NE India (Choudhury, 1988b, 1989a, b, 1990a, 1992, 1997a, 2013; Gupta and Kumar, 1994; Hazarika et al., 2008; Mazumdar et al., 2011; Mazumder, 2014), but this RF has always been ignored due to trans-border location (with Bangladesh) which is largely inaccessible. Importantly, the RF is one of the last abodes of many of the endangered and threatened animals including the Asiatic elephant. Since, very little work has been done on distribution of wildlife within the RF entailing for conservation, the present study was done to develop a clear understanding of the abundance of mammals, threats to their survival and conflict with coexisting human beings. The study has immense significant for conservation as the RF and wildlife that inhabit the area are highly threatened by habitat loss, fragmentation and various developmental activities.

2. Methodology

2.1. Study area

The present study has been done in the Patharia Hills Reserve Forest (RF), covering an area of 76.4730 square kilometers. The Patharia Hills (24°38′0″N, 92°15′0″E) is declared as a Reserve Forest by the Government of Assam under the Indian Forest Act, 1927. Running from south to the north, its length is about 45 kilometers and breadth about 11–13 kilometers (Dey et al., 2015). The highest point of the RF is 243.84 meter above MSL.

The RF has diverse topographic features from hilly area to grassland where Asiatic elephants and other grazers sustain. The RF is a part of a continuous forest that runs into Bangladesh (see Fig. 1). Thus, initiating any conservation actions is rather a difficult venture as this involves joint efforts for the two neighboring countries. This is especially true for the species which have a long migratory route. Climate wise the district is having moderate temperature and is high humidity.

The area receives tropical monsoon with a hot and wet summer and a cool and usually dry winter. Annual average rainfall is more than 3068 mm. The warm humid climate of the area is characterized by a dry winter from November to February, hot dry summer from March to May, and a long rainy season from June to September. Temperature varies from 20 °C to 33 °C, but in winter it sometimes decreases to 11 °C. Average temperature is 24° 8C. Relative humidity ranges from 89% to 90% in the morning and 40% to 81% in the afternoon (Climate Data.org, 2016).

2.2. Data collection

The study was carried out from December 2015 to November 2016 in and around the Patharia Hills Reserve Forest (RF). Multi-stage collection sampling technique (De Vaus, 1996), using structured interviews based on a questionnaire (open and close ended), was used to collect information from the fringe areas experiencing wildlife and threats on them. Pilot testing was performed on a sample of 30 respondents including forest staffs and various sections of respondent to prepare questionnaire. A list of species was made from the pilot study and the available literatures. A pre-test was conducted to a few respondents to ensure that the questionnaire was fully understood by the respondents. For interviewing the respondents, samples were objectively selected among the fringe villages of the RF. The sample size was estimated from the total number of households and aimed to cover approximately 40% of the population (Karanth, 2007). This sample size was realistic as the population is relatively homogeneous and gave similar response; 300 respondents were selected for questionnaire among the selected villages. These include both individuals and groups. People interacted were of different age groups, village headmen, experienced people, members of community institutions, teachers, forest staffs, people dependent directly on forest produce like bamboo, and poachers. Amongst others, the poachers were found to have a very high level of knowledge on the presence and abundance of species.

The questionnaire was divided into three sections as per (Kellert and Berry, 1987; Calvet-Mir et al., 2012). In the first section, a field guide book was used and asked the respondents to identify the species that they have seen during the last 5 years. Photographs of the species were arranged serially according to animal order. The animal orders were arrange according to Ellerman and Morrison-Scott (1951) and Choudhury (2013). The species identified by respondent were noted as their serial numbers. We also documented the species which were not directly seen by the respondents but claimed for their existence on the basis of previous knowledge and experiences on the species and their activities.

Secondly, the respondents were asked to name the species which they assumed as increasing or decreasing and probable reasons for that. The rise and decline of species were marked by writing symbol at superscript of the serial number of species. For example, if the species 1 is rising and 2 is declining in the recent time, it was written as 1^{r} and 2^{d}.

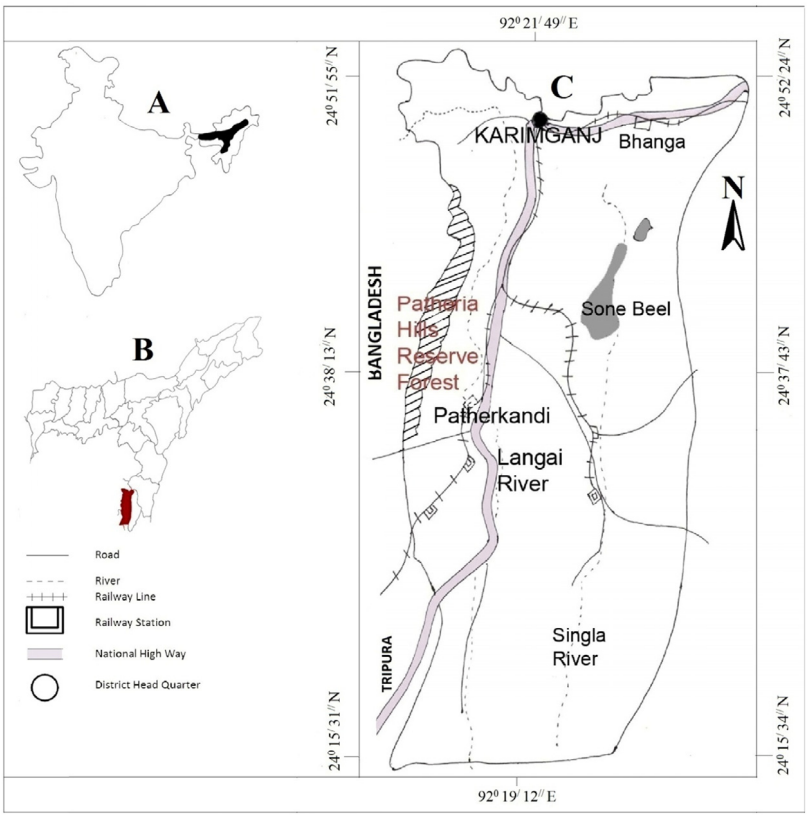

Fig. 1. Map of the study area: A: Map of India highlighting the state of Assam. B: Map of Assam highlighting Karimganj district. C: Map of Karimganj District highlighting the Patharia Hill Reserve Foresst.

In the third section, the respondents were asked the threats faced by wildlife species in Patharia Hills RF, problems caused by the species and the community responses towards them. The probable reasons for assessing the trend of individual species over time and threats were noted in field note book in short forms, for example, Hunting and Teasing 'HT', Developmental activities 'DA', Farmland Encroachment 'FE' etc. Perceptions of majority (>50%) of respondents have been used for population trend analysis. Collected data were then combined as per the objectives.

3. Results

3.1. Species abundance

It has been found that the Reserve Forest (RF) is home to 83 species of mammals. Most of the species belongs to order Chiroptera (26), Carnivora (22), Rodentia (16), and Primate (8) (Fig. 2). On the contrary, the orders Lagomorpha, Proboscidea and Pholidota are represented by only one species each (Appendix). Out of 83 species documented from the available literatures and pilot survey, only 48 species were identified by the respondents. The respondents identified only those species which had closely seen. The literatures suggest that more than 26 species of Chiroptera are available in the areas and or likely to occur as of same habitats (Choudhury, 2013). However, people identified only three species of Chiroptera, namely *Pteropus giganteus*, *Rousettus leschenaultii* and *Pipistrellus tenuis*. These three species are commonly seen in human habitation also, so easy for the respondents to distinguish them.

On an average the respondents confirmed sighting of 24 species out of 48 identified species. Maximum and minimum numbers of species sighted by respondents were 33 and 10 respectively. Out of 300 respondents, 179 could instantly identify 25%–50% of the species looking at the photographs (from 48 identified species), and 119 respondents confirmed 50%–75% species, while the remaining 2 respondents had seen less than 25% species (Fig. 3). The lists of species are shown in Appendix.

3.2. Species populations –trends over time

Respondents recognized the species which they perceived to have increased or decreased in numbers during the last five years. Data from the study showed that out of 83 species, six species are increasing in numbers while remaining species are

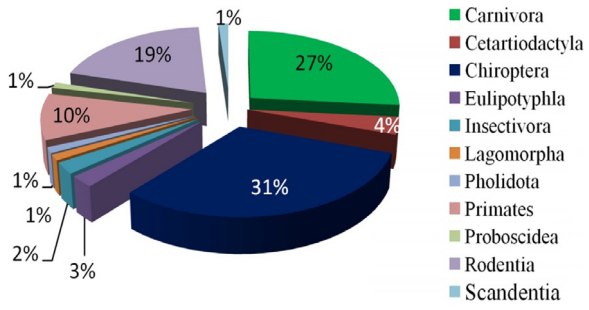

Fig. 2. Diagram showing percentage of animals in different orders.

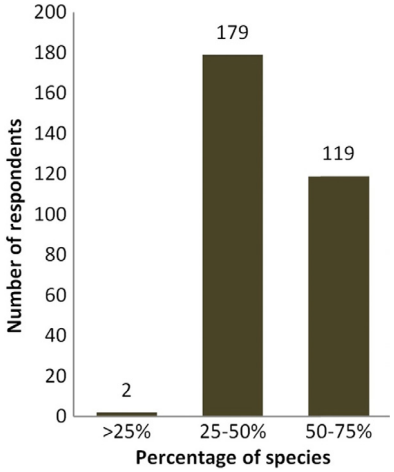

Fig. 3. Percentage of species sighted by respondents.

Table 1
Population trend of the species.

Sl. No.	Species increase in numbers	IUCN	CITES	WPA
1	Rhesus Macaque (*Macaca mulatta* Zimmermann, 1780)	LC (IUCN 3.1)	–	Sch II (Part I)
2	Irrawaddy Squirrel (*Callosciurus pygerythrus* Geoffroy St. Hillaire, I., 1832)	LC (IUCN 3.1)	–	–
3	Wild Pig, Wild Boar (*Sus scrofa* Linnaeus, 1758)	LC (IUCN 3.1)	–	Sch III
4	Jungle Cat (*Felis chaus* Schreber, 1777)	LC (IUCN 3.1)	–	Sch II (Part I)
5	Indian Flying Fox (*Pteropus giganteus* Brunnich, 1782)	LC (IUCN 3.1)	II	Sch IV
6	Chinese Porcupine (*Hystrix brachyura* Linnaeus, 1758)	LC (IUCN 3.1)	–	Sch II (Part I)
	Species decline in numbers			
1	Asian Wild dog, Indian Wild Dog (*Cuon alpinus* Pallas, 1811)	EN (IUCN 3.1)	II	Sch II (Part I)
2	Bengal Slow Loris (*Nycticebus bengalensis* Lacepede, 1800)	VU (IUCN 3.1)	I	Sch I (Part I)
3	Indian Muntjac (*Muntiacus muntjak* Zimmermann, 1780)	LC (IUCN 3.1)	–	Sch III
4	Clouded Leopard (*Neofelis nebulosa* Griffith, 1821)	VU (IUCN 3.1)	I	Sch I (Part I)
5	Common Palm Civet (*Paradoxurus hermaphroditus* Pallas, 1777)	LC (IUCN 3.1)	III	Sch II (Part I)
6	Stump-tailed Macaque (*Macaca arctoides* Geoffroy I., 1831)	VU (IUCN 3.1)	–	Sch II (Part I)
7	Chinese Pangolin (*Manis pentadactyla* Linnaeus, 1758)	CR (IUCN 3.1)	II	Sch I (Part I)

either declining or they are in balance as respondents had no idea on it. Only those species are increasing which are getting their food due to declining of predatory and competitive species. However, if the continuous threats go on, these increasing species also will lose their habitats and will be declined. Table 1 show that population trends of the species over time.

3.3. Threats on wildlife

Most of the respondents were found well aware about the threats on wildlife (Fig. 4). A large part of respondents (53%) informed that habitat loss and fragmentation is the main threats on wildlife and of declining the numbers. Human population

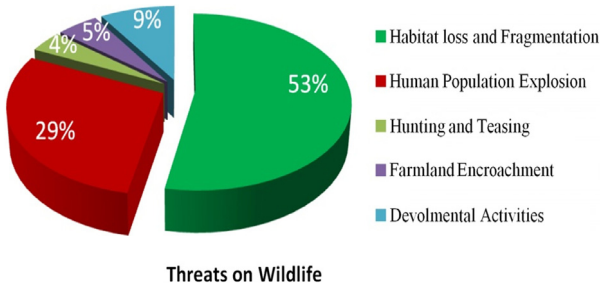

Fig. 4. Reasons for decline of Wildlife.

explosion (29%) is the second most important factor which also affecting the habitat loss and fragmentation. People shared that with the population explosion the demand for the firewood and other necessities increases. Another section of people (9%) indicated that developmental activities in and around the RF threaten the wildlife of the RF as construction of roads, electricity etc. causes destruction of habitat of the species. While a few respondents (5%) claimed that with the increase of population, conversion of forest land into farmland is on increase. The remaining respondents (4%) stated that hunting, teasing and driving of animals affects survival of animals, especially small sized animals and hence decreasing wildlife within the RF.

4. Discussion

Population estimation of the available species of the Reserve Forest (RF) was not performed previously and thus concrete data on the population trend is lacking. Since, the interviewees include people, some of whom were previously hunters, elderly persons and in addition to some of forest officials who keep constant vigil of the forest, the data obtained from them remains the only clue for assessing the population trend. Hence, respondents view (>50%) on population trend have been used for population trend analysis.

Data revealed that the wild pig *Sus scrofa*, Rhesus macaque *Macaca mulatta,* Irrawaddy squirrel *Callosciurus pygerythrus*, Indian flying fox *Pteropus giganteus* etc. are increasing in numbers (Table 1) and it has negative impacts on people. These species are increasing in numbers and thus their utilization as well as damage to cash crops also increasing. The Indian muntjac *Muntiacus muntjak,* once common in the RF is very rarely found in recent years; however, its existence within the RF was strongly supported by respondents. Chinese porcupine was also informed to increase and they often came to human habitation adjoining to RF and destroy the vegetation /crops.

The species which were reported as being sighted most are also reported to have increased. Similarly, less sighted species were perceived as declined. Therefore, the rising and declining species may not be same as practical. However, it can be assumed that the rise in some species is a positive phenomenon in the RF. As, it implies those species have significant numbers in the RF. Similarly, species which are less sighted species can be predicted to have reduced as habitats are not being restored. Sun bear/Malayan bear (*Helarctos malayanus*) and Royal Bengal tiger (*Panthera tigris*) were not sighted by any respondents within the last five years. However, older people shared that these species were no longer seen from the last two decades. The sun bear was last seen in the RF approximately eight-nine years ago.

The Barak Valley, Assam (India) is known as the paradise of primate species (Choudhury, 1990a,b, 1999; Mazumder, 2014). The Patharia Hills RF is home to a large number of primate species due to its congenial habitats. Eight types of primates, viz., Bengal slow loris (*Nycticebus bengalensis*), Rhesus macaque (*Macaca mulatta*), Assamese macaque (*Macaca assamensis*) Pig-tailed macaque (*Macaca nemestrina*), Stump-tailed macaque (*Macaca arctoides*), Phayre's leaf monkey or spectacled monkey (*Trachypithecus phayrei*), Capped langur (*Trachypithecus pileatus*) Hoolock gibbon (*Hoolock hoolock*) were listed during the survey. Among them, Assamese macaque (*Macaca assamensis*), Pig-tailed macaques (*Macaca nemestrina*), Stump-tailed macaque (*Macaca arctoides*) are rare, Phayre's leaf monkey (*Trachypithecus phayrei*), Capped langur (*Trachypithecus pileatus*) are common and Rhesus macaque (*Macaca mulatta*) are abundantly found. Bengal slow loris (*Nycticebus bengalensis*) has been reported by the respondents to be very rare. However, other study in this region (Choudhury, 2013), found it is common in the RF but rare to see. The reason may be due to its nocturnal nature and slow movement of the species, it is not visible to respondents

In 2015, India and Bangladesh signed a treaty to conserve the important primates (especially, spectacled monkey *Trachypithecus phayrei*) residing on both side of the international border of the RF. However, it was found that these primate species are being highly threatened by various anthropogenic activities in and around the RF. Fragmentations of forest, habitat loss not only reduce their foodstuffs but also have exposed them to predators.

Asiatic elephant (*Elephas maximus*) has a good habitat in the RF. Sizeable numbers of elephants are known to exist within the RF (Choudhury, 1999). A migratory corridor exists from Bangladesh side of the RF to Mizoram and Tripura transversing the RF. They migrate to Madhabkunda RF of Bangladesh and its adjoining areas especially in summer season. From the last two decades various developmental activities are going in and around the RF. The railway track connecting Tripura with

Fig. 5. Suitable habitat for wildliife (left); *Areca catechu* cultivation (right) (top). Rubber plantation (left); Interaction of author with ONGC officer (right) (bottom).

the rest of India is running near to the RF. Elephants often come out from the RF and cross the railway track. A female elephant was hit by train and consequently injured in 2014 while crossing the railway track. The construction of roads in and around the RF appears as a serious threat, increasing road kill mortality, creating barrier for migration of animals, and also helps in trade of timber and non-timber forest products illegally. All the human populations around the RF (especially tea laborers) collect firewood from the forest. Grazing is also an important factor threatening the habitats within the RF. Common perception of the people is that the RF belongs to government; so they think there is no harm to graze domestic animals in the RF.

Oil and Natural Gas Corporation (ONGC) centre is situated at Sonakira, near the RF. The workers are indulged in various types of activities in and around the RF. They access into the RF with the permission from forest authority. Their activities directly and indirectly affected the survival of animals in the RF; to carry their machinery and vehicles to inaccessible forest patches, few roads/tracks have been constructed that making forest accessible to common people too. The fence between the trans-boundary is not creating a major problem in the migration of Asian elephant as few areas have been kept open for migration. However, it might be problematic for other animals due to regular patrolling by Border Security Forces (BSF).

4.1. Threats to wildlife

Wildlife in the RF is facing following threats identified on interview based discussions with the fringe villagers, and likely to have broad range impact on the forest species.

(a) **Habitat Loss and Fragmentation:** Clearing the forest for developmental activities (e.g. road construction), collecting timber and non timber forest products reduce the primary forest and therefore shrinking the habitats. Though *jhum* practice was not seen in the study area which is the major threats in other RF of the region (Choudhury, 1988a, 1995, 1996; Johnsingh, 1985; Katti, 1992; Mazumder, 2014) but local people use to deforest the forest area for monocultural activities like bettlenut and rubber plantation (Fig. 5). Cash crop plantation areas in the home gardens in the settlement areas are increasing replacing original forest. The forest staffs are not too active in the area which indirectly supported the people for encroachment.

Habitat Loss and fragmentation are the two major threats for the survival of wildlife (Groombridge, 1992; Fahrig, 1997; Choudhury, 1997a, 2006; Srivastava, 2006; Mazumdar et al., 2011). Loss of habitats results in reduction of

population size in particular areas of the forest leading to increase the chances of local extinction (Burkey, 1995). On the other hand, loss of habitat and fragmentation leads to increasing the troop size of many animals especially primates (Mazumder, 2014) as the reduction of forest compels them in the same forest patch. It was found that local people depended on the Patharia Hills RF for timber and non-timber products. They are clearing the forest for the settlements as well as illegal trading of timber plants.

Climate change is another reason for habitat loss as the rainfall and temperature are unevenly distributed throughout the year (Baker, 1995; Turner, 1998). Scarcity of food increases due to delay or early rainfall. Climate data shows the duration and timing of rainfall in and around the RF is changing from the last few decade (KNMI Climate Explorer, 2016). This compels wild animals to search food in human habitation and consequently increases seasonal Human–Wildlife Conflict (HWC).

(b) **Human Population Explosion**: Population explosion is the main threats of wildlife, which is directly related to increasing population (Ehrlich and Anne, 1970; Cincotta and Engelman, 2000). Increasing population forcing local people to encroach the RF for their settlement and livelihood. Over population implies over consumption of food, water and fuel. This not only reduces the habitat of wildlife but also increases the conflict.

(c) **Developmental Activities:** The ongoing developmental activities, human settlements etc. around the study area acting as barrier for migration of animals. Limiting migration entangle more species within small area and consequently scarcity of food for wildlife. National highway and railway line connected to Tripura are adjoining the RF besides the other roads connected to fringe villages. Fringe villages are also getting electrified. BSF camp was established near the India–Bangladesh border which is affecting the wildlife through direct and indirect way. The developmental activities not only threatening habitat and wildlife but also aids illegal trade of forest products.

(d) **Hunting, Teasing and Driving Animals:** It is also a major factor declining the wildlife in the RF. Illegal hunting and poaching of animals for food and trade declining the number of species. People around the RF were found to use various hand guns to kill wild animals. When a wild animal come to adjoining human settlement, people use to kill them. Besides these, mismanagement of forest department and forest guards triggers these problems.

Teasing is the disturbance of wildlife by noise or other instruments (Wildlife Protection Act of India, 1972). The villagers often snare and tease the primates and other small mammals. Since, many animals follow their specific route for searching food; the snaring and teasing make them to change their feeding sides. It is common for people to react when the Wildlife damages the crop and human settlement area, but it has negative impact on the wild animals. This also impel to Human–Wildlife conflict.

(e) **Lack of Awareness:** People around the RF were found to over-utilize the forest resources, which have been exaggerated by population explosion. They think these are the government properties so consume as much as possible. The Governmental and Non Governmental Organization (NGO) should come forward to educate the local people about the values of forest and wildlife wealth to reduce the dependency on forest.

4.2. Human–Elephant Conflict

Through interviewing with the local people it was gathered that Human–Elephant Conflict (HEC) is a regular phenomenon in the area since last 2–3 decades. However, this HEC occur mainly during paddy cropping season. Large areas around the RF were being facing threats by HEC. This HEC may be due unavailability of food in that season. As elephants are mega-herbivore, they damage houses, commonly raid crops and even death and injuries have reported by the local villagers and these have been increasing with the passage of time (Fig. 6). Damaging house is though common but death caused by elephant attack in the area is very rare. Respondents informed a local villager from Medli was killed by elephants in 2010. No incidents were reported after that as people have become alert during conflict season

Elephants generally raid crops during night time and return before sunset. The local people were found to use various sound crackers and fire to kept away Asiatic elephants from the crops. As a result, the historical respect and reverence for elephants to villagers and local societies are rapidly eroding. It is the need of the hour to find out the distribution and current status of the Asian elephant with accurate mapping of its current movements and conservation of migratory corridor.

These public conflicts threatening the survival of wildlife even to the extinction level. Table 2 shows the list of species which are already extinct from the RF.

Only the forest department cannot solve these problems. Cruelty to the wildlife can be minimized only by community awareness and participatory wildlife management programme (Zinn et al., 1998). Hence, cooperation of all stakeholders (i.e., community, conservationists, government, national and international funding agencies) is crucial for long-term successful in survival of wildlife. This initiative will need the adoption of conservation strategies that are pro-active, mutually beneficial and sustainable. This should include extension of benefits to residents, protection of residents from wildlife, involvement of residents in the management of the resource, setting-up of a fund to assist or compensate victims of wildlife injuries or deaths, aware residents on how to coexist and keep the corridors for wildlife movement. This may help to foster and create more positive attitudes towards wildlife conservation. Since the RF harbors a large number of wild animals, government should come forward to improve the status of the RF which will help to protect in a greater way.

Fig. 6. Elephant herd returning from the paddy field to reach forest through Medli tea garden, Karimganj.

Table 2
List of extinct species from the study area.

Sl. No.	Scientific Name	Common English Name	IUCN	CITES	WPA
1	*Vulpes bengalensis* Shaw, 1800	Bengal Fox	LC (IUCN 3.1)	III	Sch II (Part I)
2	*Helarctos malayanus* Raffles, 1821	Malayan Sun Bear	VU (IUCN 3.1)	I	Sch I (Part I)
3	*Melursus ursinus* Shaw, 1791	Sloth Bear	VU (IUCN 3.1)	I	Sch I (Part I)
4	*Panthera tigris* Linnaeus, 1758	Bengal Tiger, Royal Bengal Tiger	EN (IUCN 3.1)	I	Sch I (Part I)
5	*Cervus unicolor* Kerr, 1792	Samber	VU (IUCN 3.1)	–	Sch III
6	*Axis porcinus* Zimmermann, 1780	Hog Deer	EN (IUCN 3.1)	III	Sch III
7	*Bos gaurus* Smith, 1827	Gaur, Indian Bison	VU (IUCN 3.1)	I	Sch I (Part I)
8	*Pardofelis marmorata* Martin, 1837	Marbled Cat	NT (IUCN 3.1)	I	Sch I (Part I)

4.3. Recommended conservation measures

- Along with the control of forest fragmentation, encroachment should be strictly controlled.
- Commercial felling in the forest should be completely ban to maintain tree cover and ecology of forest.
- Any developmental activities within the Reserve Forest should be ceased.
- ONGC activity should be stopped inside the forest boundary.
- Electric fence should be installed throughout the Patharia Hills Reserve Forest to reduce Human–Elephant Conflict.
- Expeditious payment for loss of life and property by Wildlife, Especially by Asiatic elephant.
- Aware to the local people by both Governmental and Non Governmental Organisations (NGO) to conserve wildlife and minimize the dependency on the Reserve Forest.
- Long term assessment of forest habitats and Human–Wildlife Conflict Impact Assessment should be done to see correlation between these two variables to mitigate the current scenario.
- The last but not the least recommendation is to improve the status of Patharia Hills Reserve Forest and declare the same as 'Patharia Hills Wildlife Sanctuary' which would ensure more protection of wildlife within the area.

5. Conclusion

Patharia Hills Reserve Forest of southern Assam (India) has good diversity of vegetation and habitat which made sure to sustain a large number of species. The present study identified 83 species of mammals in the Reserve Forest, belonging to 11 Orders. Out of which, the population of eight species have declined in the recent past and six species have increased (Table 1). Human activities, viz., illegal logging, encroachment, collection of firewood, plantation of cash crop and transformation of wildlife habitat as agricultural land making the Reserve Forest vulnerable. Large number of globally important species such as *Rhinoceros unicornis, Rhinoceros sondaicus, Dicerorhinus sumatrensis and Panthera pardus* already vanished from the Reserve Forest (Wood, 1930; Rookmaaker, 1980; Choudhury, 1997b, 2013) and those are available now in the Reserve Forest are in a critical situation. Increasing Human–Wildlife Conflict throughout the fringe areas are the consequences. Though Human–Carnivore Conflict (HCC) has not been found in the area but crop raiding and other negative impacts has been increasing with

Table A.1
List of animals were sighted by respondents and authors within the last five years as well as available literatures.

Sl No.	Order	Scientific name	Family	Common name	Local name	IUCN status	CITES	WPA
1	Pholidota	*Manis pentadactyla*[a] Linnaeus, 1758	Manidae	Chinese Pangolin	Bonrou	CR (IUCN 3.1)	II	Sch I (Part I)
2	Insectivora	*Talpa micrura*[a] Hodgson, 1841	Talpidae	Himalayan Mole, Indian Short-Tailed Mole	Cheeka	LC (IUCN 3.1)	–	–
3		*Talpa leucura*[a] Blyth, 1850	Talpidae	White Tailed Mole	Cheeka	LC (IUCN 3.1)	–	-
4	Eulipotyphla	*Suncus murinus*[a] Linnaeus, 1766	Soricidae	House Shrew, Grey Musk Shrew	Cheeka	LC (IUCN 3.1)	–	–
5		*Crocidura attenuata*[a] Milne-Edwards, 1872	Soricidae	Grey Shrew, Indo-Chinese Shrew	–	LC (IUCN 3.1)	–	–
6	Scandentia	*Tupaia belangeri*[a] Wagner, 1841	Tupaiidae	Northern Tree Shrew	kota	LC (IUCN 3.1)	–	–
7	Chiroptera	*Pteropus giganteus*[a] Brunnich, 1782	Pteropodidae	Indian Flying Fox	Badur	LC (IUCN 3.1)	II	Sch IV
8		*Rousettus leschenaultii*[a] Desmarest, 1820	Pteropodidae	Leschenault's Rousette, Fulvous Fruit Bat	Badur	LC (IUCN 3.1)	–	Sch IV
9		*Cynopterus sphinx*[c] Vahl, 1797	Pteropodidae	Short-nosed Fruit Bat	Badur	LC (IUCN 3.1)	–	Sch IV
10		*Megaerops niphanae*[c] Yenbutra & Felton, 1983	Pteropodidae	Northern Tailless Fruit Bat	Badur	LC (IUCN 3.1)	–	Sch IV
11		*Eonycteris spelaea*[c] Dobson, 1871	Pteropodidae	Common Dawn Bat	Badur	LC (IUCN 3.1)	–	Sch IV
12		*Macroglossus sobrinus*[c] Anderson, 1911	Pteropodidae	Hill Long-tongued Fruit Bat		LC (IUCN 3.1)	–	Sch IV
13		*Taphozous longimanus*[c] Hardwicke, 1825	Emballonuridae	Long-winged Tomb Bat		LC (IUCN 3.1)	–	–
14		*Megaderma spasma*[c] Linnaeus, 1758	Megadermatidae	Lesser False Vampire Bat		LC (IUCN 3.1)	–	–
15		*Megaderma lyra*[c] Geoffroy, 1820	Megadermatidae	Greater False Vampire, Indian False Vampire		LC (IUCN 3.1)	–	–
16		*Rhinolophus luctus*[c] Temminck, 1834	Rhinolophidae	Wooly Horseshoe Bat		LC (IUCN 3.1)	–	–
17		*Rhinolophus macrotis*[c] Blyth, 1844	Rhinolophidae	Big-eared Horseshoe Bat		LC (IUCN 3.1)	–	–
18		*Rhinolophus pearsonii*[c] Horsfield, 1851	Rhinolophidae	Pearson's Horseshoe Bat		LC (IUCN 3.1)	–	–
19		*Rhinolophus lepidus*[c] Blyth, 1844	Rhinolophidae	Blyth's Horseshoe Bat		LC (IUCN 2.3)	–	–
20		*Hipposideros pomona*[c] Anderson, 1918	Hipposideridae	Andersen's Leaf-nosed Bat		LC (IUCN 3.1)	–	–
21		*Hipposideros cineraceus*[c] Blyth, 1853	Hipposideridae	Least Leaf-nosed Bat		LC (IUCN 3.1)	–	–
22		*Hipposideros larvatus*[c] Horsfield, 1823	Hipposideridae	Horsfield's Leaf-nosed Bat		LC (IUCN 3.1)	–	–
23		*Hipposideros lankadiva*[c] Kelaart, 1850	Hipposideridae	Indian Leaf-nosed Bat		LC (IUCN 3.1)	–	–
24		*Myotis formosus*[c] Hodgson, 1835	Vespertilionidae	Hodgson's Bat, Hodgson's Myotis		LC (IUCN 3.1)	–	–
25		*Myotis muricola*[c] Gray, 1864	Vespertilionidae	Nepalese Whiskered Bat		LC (IUCN 3.1)	–	–
26		*Scotophilus kuhlii*[c] Leach, 1821	Vespertilionidae	Asiatic Lesser Yellow House Bat		LC (IUCN 3.1)	–	–
27		*Scotophilus heathii*[c] Horsfield, 1831	Vespertilionidae	Asiatic Greater Yellow House Bat		LC (IUCN 3.1)	–	–
28		*Tylonycteris pachypus*[c] Temminck, 1840	Vespertilionidae	Lesser Bamboo Bat, Club-footed Bat		LC (IUCN 3.1)	–	–
29		*Pipistrellus javanicus*[a] Gray, 1838	Vespertilionidae	Javan Piperstrelle		LC (IUCN 3.1)	–	–
30		*Pipistrellus coromandra*[c] Gray, 1838	Vespertilionidae	Indian Pipistrelle		LC (IUCN 2.3)	–	–
31		*Pipistrellus tenuis*[a] Temminck, 1840	Vespertilionidae	Least Pipistrelle	Salchora	LC (IUCN 2.3)	–	–
32		*Scotozous dormeri*[c] Dobson, 1875	Vespertilionidae	Dormer's Bat		LC (IUCN 3.1)	–	–
33	Primates	*Nycticebus bengalensis*[b] Lacepede, 1800	Lorisidae	Slow Loris, Bengal Slow Loris	Lojjaboti bandor, shormila bilai	VU (IUCN 3.1)	I	Sch I (Part I)
34		*Macaca nemestrina*[a] Linnaeus, 1766	Cercopithecidae	Pig-tailed Macaque	Bandor	VU (IUCN 3.1)	–	–
35		*Macaca assamensis*[a] McClelland, 1840	Cercopithecidae	Assamese Macaque	Bandor	NT (IUCN 3.1)	–	Sch II (Part I)
36		*Macaca mulatta*[a] Zimmermann, 1780	Cercopithecidae	Rhesus Macaque, Rhesus Monkey	Bandor	LC (IUCN 3.1)	–	Sch II (Part I)
37		*Macaca arctoides*[a] Geoffroy St. Hillarie, 1831	Cercopithecidae	(Stump-tailed Macaque)	Bandor	VU (IUCN 3.1)	–	Sch II (Part I)
38		*Trachypithecus phayrei*[a] Blyth, 1847	Cercopithecidae	Phyare's Leaf Monkey, Spectacled Monkey, Phyare's Langur	Chosma Bandor, Kaala Bandor	EN (IUCN 3.1)	–	Sch I (Part I)
39		*Trachypithecus pileatus*[a] Blyth, 1843	Cercopithecidae	(Capped Langur, Capped Leaf Monkey	Honuman, Uluman	VU (IUCN 3.1)	I	Sch I (Part I)

(*continued on next page*)

Table A.1 (*continued*)

Sl No.	Order	Scientific name	Family	Common name	Local name	IUCN status	CITES	WPA
40		*Hoolock hoolock*[a] Harlan, 1834	Hylobatidae	Hoolock Gibbon, Hoolock, White-Browned Gibbon	Ulluk, Uluman	EN (IUCN 3.1)	I	Sch I (Part I)
41	Carnivora	*Canis aureus*[a] Linnaeus, 1758	Canidae	Golden Jackal, Asiatic Jackal	Hiyal, Srigal	LC (IUCN 3.1)	III	Sch II (Part I)
42		*Cuon alpinus*[b] Pallas, 1811	Canidae	Dhole, Asiatic Wild Dog, Indian Wild Dog.	Ram bingul, Ram kutta	EN (IUCN 3.1)	II	Sch II (Part I)
43		*Ursus thibetanus*[b] Cuvier, 1823	Ursidae	Asiatic Black Bear, Himalayan Black Bear.		VU (IUCN 3.1)	I	Sch II (Part I)
44		*Arctonyx collaris*[b] Cuvier, 1825	Mustelidae	Hog Badger	Baliya sour	VU (IUCN 3.1)	–	Sch I (Part I)
45		*Melogale personata*[a] Geoffroy, St-Hilaire, 1831	Mustelidae	Burmese Ferret Badger, Large-toothed Ferret-Badger	–	LC (IUCN 3.1)	–	Sch II (Part I)
46		*Melogale moschata*[a] Gray, 1831	Mustelidae	Chinese Ferret Badger, Small-toothed Ferret-Badger	–	LC (IUCN 3.1)	–	Sch II (Part I)
47		*Lutra lutra*[a] Linnaeus, 1758	Mustelidae	Common Otter, Eurasian Otter	Uud	NT (IUCN 3.1)	I	Sch II (Part I)
48		*Lutrogale perspicillata*[c] Geoffroy, St-Hilaire, 1826	Mustelidae	Smooth-coated Otter		VU (IUCN 3.1)	–	Sch II (Part I)
49		*Aonyx cinereus*[c] Illiger, 1815	Mustelidae	Oriental Small-clawed Otter		VU (IUCN 3.1)	–	–
50		*Viverra zibetha*[a] Linnaeus, 1758	Viverridae	Large Indian Civet	Hupi bagh	LC (IUCN 3.1)	III	Sch II (Part I)
51		*Viverricula indica*[a] Geoffroy Saint-Hilaire, 1803	Viverridae	Small Indian Civet	Gondhagokul	LC (IUCN 3.1)	III	Sch II (Part I)
52		*Paradoxurus hermaphroditus*[a] Pallas, 1777	Viverridae	CommonPalm Civet	Bozro-batul	LC (IUCN 3.1)	III	Sch II (Part I)
53		*Paguma larvata*[c] Smith, 1827	Viverridae	Masked Palm Civet	–	LC (IUCN 3.1)	III	Sch II (Part I)
54		*Arctictis binturong*[a] Raffles, 1821	Viverridae	Binturong, Bearcat		VU (IUCN 3.1)	III	Sch I (Part I)
55		*Herpestes javanicus*[a] Geoffroy St. Hillaire, 1818	Herpestidae	Javan Mongoose	Neuul	LC (IUCN 3.1)	III	Sch II (Part I)
56		*Herpestes urva*[c] Hodgson, 1836	Herpestidae	Crab-eating Mongoose		LC (IUCN 3.1)	III	Sch II (Part I)
57		*Felis chaus*[a] Schreber, 1777	Felidae	Jungle Cat	Patbiral, Bonbiral	LC (IUCN 3.1)	–	Sch II (Part I)
58		*Prionailurus bengalensis*[a] Kerr, 1792	Felidae	Leopard Cat	Jongli mekur, Bonbiral	LC (IUCN 3.1)	I	Sch I (Part I)
59		*Prionailurus viverrinus*[b] Bennet, 1833	Felidae	Fishing Cat	Mecho-biral	VU (IUCN 3.1)	–	Sch I (Part I)
60		*Catopuma temminckii*[a] Vigors & Horsefield, 1827	Felidae	Asian Golden Cat, Temminck's Golden Cat	Lal bagh	NT (IUCN 3.1)	I	Sch I (Part I)
61		*Neofelis nebulosa*[a] Griffith, 1821	Felidae	Clouded Leopard	Kupia, Betangi bagh	VU (IUCN 3.1)	I	Sch I (Part I)
62		*Panthera pardus*[b] Linnaeus, 1758	Felidae	Leopard, Panther	Cheetah bagh	VU (IUCN 3.1)	I	Sch I (Part I)
63	Proboscidea	*Elephas maximus*[a] Linnaeus, 1758	Elephantiadae	Asian Elephant	Haathi	EN (IUCN 3.1)	I	Sch I (Part I)
64	Cetartiodactyla	*Sus scrofa*[a] Linnaeus, 1758	Suidae	Wild Boar, Wild Pig	Jongli suor, Chera	LC (IUCN 3.1)	–	Sch III
65		*Muntiacus muntjak*[a] Zimmermann, 1780	Cervidae	Indian Muntjac, Barking Deer, Red Muntjac	Khatia, horin, Orin	LC (IUCN 3.1)	–	Sch III
66		*Capricornis rubidus*[b] Blyth, 1863	Bovidae	Red Serow, Burmese Serow	Ram sagol, Jangli sagol	NT (IUCN 3.1)	I	–
67	Rodentia	*Ratufa bicolor*[a] Sparrrman, 1778	Sciuridae	Malayan Giant Squirrel, Black Giant Squirrel	Ram kota	NT (IUCN 3.1)	II	Sch II (Part I)
68		*Callosciurus erythraeus*[c] Pallas, 1779	Sciuridae	Pallas's Squirrel	–	–	–	–
69		*Callosciurus pygerythrus*[a] Geoffroy St. Hillaire, 1832	Sciuridae	Hoary-bellied Squirrel, Irrawaddy Squirrel	–	LC (IUCN 3.1)	–	–
70		*Tamiops macclellandii*[b] Horsfield, 1840	Sciuridae	Himalayan Striped Squirrel	–	LC (IUCN 3.1)	–	–
71		*Hylopetes alboniger*[b] Hodgson, 1836	Sciuridae	Particolored Flying Squirrel	–	LC (IUCN 3.1)	–	Sch II (Part I)
72		*Mus musculus*[a] Linnaeus, 1758	Muridae	House Mouse	Undur, eedur	LC (IUCN 3.1)	–	Sch IV
73		*Mus booduga*[a] Gray, 1837	Muridae	Little Indian Field Mouse	–	LC (IUCN 3.1)	–	Sch IV
74		*Rattus rattus*[a] Linnaeus, 1758	Muridae	House Rat, Black Rat, Roof Rat	Gatua, Gatua undur	LC (IUCN 3.1)	–	Sch IV

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Table A.1 (*continued*)

Sl No.	Order	Scientific name	Family	Common name	Local name	IUCN status	CITES	WPA
75		*Rattus tanezumi*[a] Temmink, 1844	Muridae	Oriental House Rat	Undur	LC (IUCN 3.1)	–	–
76		*Rattus norvegicus*[c] Berkenhout, 1769	Muridae	Norway Rat, Brown Rat		LC (IUCN 3.1)	–	Sch IV
77		*Bandicota indica*[c] Bechstein, 1800	Muridae	Large Bandicoot Rat		LC (IUCN 3.1)	–	Sch IV
78		*Bandicota bengalensis*[c] Gray, 1835	Muridae	Lesser Bandicoot Rat, Indian Mole Rat		LC (IUCN 3.1)	–	Sch IV
79		*Rhizomys pruinosus*[c] Blyth, 1851	Spalacidae	Hoary Bamboo Rat	–	LC (IUCN 3.1)	–	–
80		*Cannomys badius*[b] Hodgson, 1841	Spalacidae	Bay Bamboo Rat, Lesser Bamboo Rat	–	LC (IUCN 3.1)	–	–
81		*Hystrix brachyura*[a] Linnaeus, 1758	Hystricidae	Crestless Himalayan Porcupine, Chinese Porcupine, Malayan Porcupine	Seda, Shojaru	LC (IUCN 3.1)	–	Sch II (Part I)
82		*Atherurus macrourus*[c] Linnaeus, 1758	Hystricidae	Asiatic Brush-tailed Porcupine	Sojaru	LC (IUCN 3.1)	–	Sch II (Part I)
83	Lagomorpha	*Lepus nigricollis*[b] Cuvier, 1823	Leporidae	Indian Hare	Khorgus	LC (IUCN 3.1)	–	Sch IV

Note: IUCN: International Union for Conservation of Nature and Natural Resource. CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora. WPA: Wildlife Protection Act of India (1972).

[a] Represents the common species.

[b] Represents the species rarely seen.

[c] Represents the species likely to occur as supported by habitat and also seen in nearby areas.

time, changing the people attitude on conservation of wildlife in general. Therefore, there is an urgent need to protect the Reserve Forest for sustainable habitat for wildlife. It is proposed that a multi-action approach should be used to ameliorate the threat on wildlife in Patharia Hills Reserve Forest. Otherwise, human hostility will continue to pose a danger to animals and Reserve Forest will lose its uniqueness. A detailed work on Human–Elephant Conflict is necessary for mitigating Human–Elephant Conflict and conservation of wildlife in the Reserve Forest.

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Appendix

See Table A.1.

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