FIELD FORESTER

VOICES FROM THE FIELD

VOLUME 1 • ISSUE 5 MARCH 2016

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From the Chief Editor's Desk

India has shown its sincere commitment towards addressing the emerging issues from global warming and changing climate. The National Action Plan on Climate Change (NAPCC), 2008 envisages, among eight different missions, a National Mission for Sustaining the Himalayan Ecosystem. The Mission is aimed at evolving management measures for sustaining and safeguarding the Himalayan glaciers and the mountain ecosystem. The Mission also envisages documentation of good practices in natural resource management in the Himalayan Ecosystem including North East India in the form of 'Governance for sustaining Himalayan Ecosystem (G-SHE): Guidelines and best Practices', which puts together guidelines and best practices related to governance and management of Himalayan Ecosystem.

North East India which forms the richest biodiversity regions in the Himalayan and the sub Himalayan region exhibits not only uniqueness and richness of biodiversity but also, intricate linkages of human and natural resources, highlighting the sensitivity of biodiversity elements of the region for human and climate induced changes. Realizing that the North East region is highly vulnerable due to natural and demographic reasons such as increased pressure of population, exploitation of natural resources and other related challenges, including climate change, it needs special attention.

Forest management thus is important from the regional perspective due to the extreme sensitivity and fragility of the ecosystem. There are resource management practices which are special to this region such as Traditional Ecological Knowledge, Community Conserved Areas (CCAs), 'natural cultural landscapes', Jhum practices, traditional dependence of people on wild edibles, rich tradition of using fermented foods and beverages using local bio-resources and potential of certain plant groups such as Orchids and Rhododendrons. Forest Management through the larger ecosystem approach can benefit a lot if it can be flexible enough to rein in cultural and ecological linkages from the community in the region. Multiple functions of forestry can be well appreciated when one tries to understand the traditional forest management practices in the region.

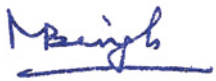
The present issue of Field Forester thus attempts to bring together some of the good stories in resource management from North Eastern region of India including North Bengal. The collection of articles emerge from travels to different places such as Tinsukia, Kamrup, Digboi, Kaziranga, West Jaintia Hills, Shillong, Majuli, Nameri, West Kameng, Orang, Darjeeling etc. and subsequent studies and documentation by the State Forest Service Officer Trainees from Central Academy for State Forest Service, Dehradun.

It is important to remember that Northeast India has approximately 65 percent of its total geographic area under forest cover and it is often said that it continues to be a forest surplus region. However, the picture is not without threats and challenges. The forest cover is rapidly disappearing. The quality of the forest is deteriorating, with the dense forests becoming degraded into open forest or scrub. A vast area of land is transforming into barren and unproductive wasteland, be it the hills of Assam or the mountainous slopes in Arunachal Pradesh and Meghalaya.

The challenges need to be understood in the context of its location in the eastern Himalayan periphery, fragile geo-environmental setting and economic-underdevelopment. The fact that forestry in North East has stood the test of time through numerous decades, despite all the extreme testing challenges go on to prove the resilience of the local management practices.

Traditional beliefs have been a cause of maintenance of forests in Arunachal Pradesh and Sikkim, be it the umang lais of Manipur, and numerous sacred forests in Meghalaya. Community Reserves are good examples of traditional governance structures in communities. The states of Meghalaya and Manipur, are known for its sacred groves and forests. A success story of Mawphlang sacred grove in Meghalaya finds a deserving place in this issue.

Case studies on NTFPs, Wildlife management, mining, community based projects, man animal conflict and species such as red panda and the rhinoceros are documented in the present issue. While trying to understand conservation and climate change adaptation imperatives in the north eastern region, the key challenge would be to effectively use development in the service of conservation. There is also an analysis of the development versus conservation debate in the context of a wildlife sanctuary, which is presented in this issue. Considering the fast evolving environmental changes, especially the weather and climate related changes in the North East, a more inclusive notion of conservation and sustainable use, in the form of sustainable forest management and strengthening existing forms of community participation and local governance of natural resources would emerge as a key challenge.



M.P. Singh

TINSUKHIA / ASSAM

Digboi Arboretum – A Sanctuary for Indigenous Trees

The arboretum offers an insight into the diversity of species found in the forests of Assam and attracts not just forest administrators but also researchers, students and locals

Promothesh Deb Roy

The term 'arboretum' has been derived from the Latin word "arbor" which means trees. Thus an arboretum is "a place where trees are grown for scientific and educational purposes". It is an area set aside for growing and effective display of different plant species that can be grown over an area for their maintenance, proper labelling and study. Although, it is not necessary to include all the plants growing in a region to grow in an arboretum.

The Digboi Arboretum is located in Lakhipather Forest Range, under Digboi Forest Division, in Tinsukia District of Assam. Established in the year 2010, by P. Sivakumar, IFS (DFO, Digboi Division) the arboretum is the largest arboretum in Assam and in the north-east and second largest arboretum in India – area wise – spread over 50 hectares.

Developed at a cost of Rs. 1.2 crore, the arboretum was funded by District Rural Development Agency (DRDA), Tinsukia. The aim behind the setting up of the arboretum was to plant 200 trees species, of which 167 species have been planted. In the first phase, an area of 30 hectares was covered and 117 plant species of 41 families had been planted of which more than 50 species have medicinal value. In the second phase 10 ha area has been taken up under the project, where 50 more species have been planted. Of the species planted, preference has been given to indigenous and RET (Rare, Endangered and Threatened) species. A small nursery of poly-potted seedlings too has been created from where seedlings are distributed to the public free of cost.

The main reason for establishment of the arboretum was to offset the huge pressure of human interference due to NTFP collection, encroachments and illegal felling. These had led to the extinction of some species and a large number of species had become endangered. The arboretum helps to conserve those rare and endangered species and propagate them in their natural habitat. The arboretum offers an insight into the diversity of trees found in the forests of Assam and attracts not just forest administrators but also researchers, scholars, students and local

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people. The arboretum will directly and indirectly also have an impact on the microclimate of the region and enriches the carbon pool.

Apart from the objective of encountering encroachments and illegal falling in forest lands, the other objectives behind the creation of the arboretum was to engage with the local people for protection and conservation of indigenous species and to impart training to local people by organising awareness and motivation programmes.

The arboretum also provides training to students of schools, colleges, universities, Government organisations, public bodies and people on identification, protection, conservation and propagation of rare, endangered and threatened species. The arboretum also has a facility for raising plantations of indigenous species and propagation/multiplication of rare and endangered species.

There are, however, issues of management of the arboretum. Out of 167 species, only 19 plant species are in good condition. The condition of other species is not too good; a number of species have died. The main reason seems to be negligence and lack of proper care. The other reasons include lack of staff – there is only one forest guard – in the arboretum and lack of proper management and guidance. The nursery management too was not up to the mark.

The arboretum also faces problems of grazing and damage to trees and seedlings due to attacks by elephants, monkeys and wild boar. There are also inadequacies in the scientific management of the arboretum; spacing in the plantation and lack of adequate sign boards. Timely weeding often suffers due to inadequate funding and lack of labour. In a number of cases, the choice of species was not according to climatic conditions. Some of the other issues included lack of permanent fencing; facility for irrigation; the interpretation centre was not operational; and encroachment too has started on one side of the arboretum.

To improve the prevalent situation in the arboretum, the following measures should be taken:

- proper coordination between Forest Department and DRDA for timely funding
- recruitment of trained staff

This will help in the delivery of the outreach programmes undertaken by the arboretum as will the association with good NGOs. The infrastructure needs that need to be addressed include proper signboards, signages, fencing to check illegal grazing, making the interpretation centre functional, construction of elephant trenches, good irrigation facilities, a check on encroachment and involvement of local people for their protection of the arboretum.

UPPER ASSAM / ASSAM

Marketing barriers of Agarwood industry

Important social benefits of agar plantation are employment generation and improved economic opportunities for rural people of Assam

Champak Deka

Agarwood is a resinous, fragrant and highly valuable heartwood. This valuable and highly fragrant wood has been used in many ways for over two thousand years, especially as incense in Buddhist, Hindu, and Islamic traditional ceremonies, and is a significant component of traditional Ayurvedic, Tibetan and Far Eastern medicine and Middle Eastern perfumes. The scientific name is *Aquilaria.* The genus *Aquilaria* has 15 species, of which eight species are known to produce agarwood. Most common species in north-east India are – *A. malaccensis* and *A. khasiana.*

How the agarwood resin is produced

It has known since long that the production of the resin is associated with wounding and associated fungal invasion, possibly assisted by insects. As a response to the fungal infection, the tree produces a resin high in volatile organic compounds that aids in suppressing or retarding the growth of the fungus. Various fungi are associated with agarwood formation although it is still not completely clear which ones make the plant generate the resin. However, the insect that bores into the tree is found only in the Upper Assam districts of Golaghat, Jorhat, Sivasagar, Dibrugarh and Tinsukia up to Sadiya and in Lakhimpur district. It has been reported by the Rain Forest Research Institute, Jorhat, that bulk of the resin production and eventually the production of oil is from the Upper Assam districts. In natural forests, only an estimated 7-10% of the trees are infected by the fungus. The major constituents of agarwood oil are sesquiterpenes, which are difficult to synthesize artificially, and therefore there are currently no good substitutes for high quality agarwood.

Agarwood Trade

Agarwood has become a precious commodity and is often compared to gold. The international trade in agarwood involves wood, wood chips, powder, oil and products such as perfumes, incense and medicines. The cost of agarwood is extremely high depending on the oleoresin content of

Roll No-05, Officer Trainee, 2015-17 Batch

Keys for Identification of the Infected Agar Trees

Natural closing of borer's hole

Cracking System

Sickly appearance of agar tree is a sign of agarwood formation

the wood. Prices range from US$ 10,000 to 30,000 per litre of agar oil. Indonesia and Malaysia are the main traders of agarwood. Today, the demand for agarwood far exceeds supply. A recent study revealed that supply rates are only 40 per cent of the demand and a litre of agarwood oil can be sold for around US$ 10,000 - 14,000 in the market. Indeed agarwood is reputed to be the most expensive wood in the world and it is estimated that specialized buyers are prepared to pay as much as ten times more for this product.

The origin of agarwood business in Assam dates back to the 1930s when a few enterprising families from the then Sylhet district (now in

Bangladesh) adjoining the Golaghat district (Nahoroni area) of Assam (Padma Konwar, pers. comm. March 2008) started its trade. The business then slowly shifted to Golaghat, parts of Jorhat and Hojai in Nagaon district (Assam), and presently these districts are important loci for small-scale agarwood chip preparation and oil extraction. The business is most popular among the Muslim community and has become a major source of income in Naharani, Kabarugaon (Golaghat), Kakojan (Jorhat), and Hojai (Nagaon). Growers generally sell standing trees to the local traders, who in turn, sell the wood and wood-chips to the agar oil extraction industries. These local and small-scale traders generally sell agar oil or perfume either in the local markets or to the Ajmal Group of Companies, the largest exporter of agarwood oil to the Middle East.

However, there are no obvious external signs that a tree may contain agarwood and if it does, the quantity can only be fully determined after the tree has been felled and cut open. The search for the product therefore results in indiscriminate felling of trees and degradation of habitats, causing a loss of the ecological niche for agarwood producing species and a dramatic decline in wild *Aquilaria* species in the last few decades. Due to indiscriminate felling of agar trees, there are no *Aquilaria* species found in wild. In order to safeguard agar trees from extinction export of agarwood has been prohibited since 1991, this included the export of all wood products (including log, timber; chip; powder, flake, dust, etc.) of all species was banned through the Export and Import (EXIM) policy in force at that time. In the EXIM policy (2009-2014) published by the Directorate General of Foreign Trade, Government of India, import of agarwood is restricted and this is subject to the provisions of Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES). However due to high demand of agarwood oil in the international market and for easy export of agarwood oil from the agarwood planters, the Govt. of India formulated the agarwood policy in January 2014, thereby legalizing the export of agarwood oil.

As per the EXIM policy (2009-2015) published by the Directorate General of Foreign Trade, Government of India, export of plants, plant portions of wild or cultivation origin specified under Appendix II or III of CITES is now permitted. This is subject to obtaining a certificate of legal possession in favour of the exporter, issued by the Divisional Forest Officer having jurisdiction where the exporter is situated and also as per the provisions of CITES.

It is however unfortunate that the Government of Assam has banned the export of agarwood parts and derivatives till date. As a result of this, agarwood entrepreneurs of Assam are facing a lot of difficulties to raise agarwood plants on their farmlands. The biggest obstacle is the acquisition of a certificate of origin from the forest department after which trees on homestead land or in plantations can be felled and sold. It takes more than three months for such a certificate to

be issued with the farmer having to spend money to bring the department and district administration personnel for a joint verification to the cultivation site in order to get the document, and the process is not incorruptible. Thus the farmers are forced to sell their plants as well as plant parts illegally to some middle men and this ultimately leads to an illegal trade of agarwood throughout Assam.

Overcoming obstacles

1. Forest department of Assam should take initiative by involving all stakeholders by making a policy on agarwood as early as possible so that entrepreneurs related to agarwood based industries benefit from it.
2. Government of Assam should take initiative by establishing agarwood distillation units in Upper Assam districts (mainly Sibsagar, Golaghat and Nagaon) as micro, small and medium enterprise (MSME) under the Khadi and Village Industries Commission and also curb illegal distillation plants situated at Hojai in Nagaon district.
3. Research on artificial agarwood production is ongoing in Rain Forest Research Institute, Jorhat. The government should frame policies so that results from research reach the agarwood plantation sites of farmers.
4. Assam Forest Department should take steps to lift the ban on export of agarwood and also promote agarwood plantation through JFMCs in degraded forest lands.

Conclusion

Important social benefits of agar plantation are employment generation and improved economic opportunities for rural people of Assam. Cultivation of agar in the Upper Assam district is beneficial; owners get an additional income from agar without much extra efforts. Furthermore, low input management, lack of site specificity, and intercropping opportunities are predisposing factors for agar cropping. In this context if Government of Assam formulates a policy then this **"liquid Gold of Assam"** can be a major industry of the State Assam in the near future.

Acknowledgement

I owe my sincere thanks to Dr KS Jayachandran, IFS, Course Director, SFS 2015-17 Batch, for providing all the facilities for undertaking the Case Study tour to Rain Forest Research Institute, Jorhat. My sincere thanks goes to Dr RSC Jayaraj, IFS, Director, RFRI, Jorhat, RK Kalita, Training Coordinator and all other scientists of the institute for helping our group in all aspects to make our case study a successful one.

WEST KAMENG / ARUNACHAL PRADESH

A haven for wildlife

The Eaglenest Wildlife Sanctuary is home to a number of rare and endangered species, some of which are found nowhere else in the world.

Chinpilhing Kipgen

Arunachal Pradesh with its rich biodiversity of wildlife species forms part of the Eastern Himalaya biodiversity hotspots. It has the second largest area under forest cover which stands at 67,248 sq. km with a little over 80 per cent of its geographical area under forest cover (FSI report, 2015). The Eaglenest Wildlife Sanctuary located in West Kameng district of Arunachal Pradesh was declared a sanctuary in 1989 with an area of 218 sq. km. Drained by the Kameng River, the sanctuary area is traditionally the community land of Sherdukpen tribe. However, there are no settlements inside the protected area. The adjacent Sessa Orchid Sanctuary is the community land of the Bugun tribe. The Eaglenest sanctuary forms a part of the Kameng Protected Area complex which is the largest contiguous forest tract in the Eastern Himalayas spread over an area of 3500 sq. km in two states – Arunachal Pradesh and Assam. The Kameng Protected Area comprises of the Eaglenest Wildlife Sanctuary (218 sq. km), Sessa Orchid Wildlife Sanctuary (100 sq. km) in the West Kameng district, Pakke Tiger Reserve (861 sq. km) in East Kameng district as well as the reserved forest of Doimara,

Bugun liocichla (*Liocichla bugunorum*): discovered in 2006, found only in Eaglenest and nowhere else in the world

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Bird's eye view from Lama Camp (Photograph by Chinpilhing Kipgen)

Amortala, Papum and Shergaon of Arunachal Pradesh extending over to Nameri Tiger Reserve and Sonai Rupai Wildlife Sanctuary in Assam.

The sanctuary is named after a regiment of the Indian Army – the Mountain Eagles – which was stationed in the area in the 1950s. Located in broad elevation zone – 200 m to 3,200 m – the sanctuary has a wide range of forest types varying from tropical evergreen forest in the lower elevation to temperate broad leaved forest in the mid altitude to conifers and

Species discovered or rediscovered	Characteristics
1. Arunachal Macaque (*Macaca munzala*)	It is an endangered primate species discovered in 2003, numbering 250-540.
2. Bugun Liocichla (*Liocichla bugunorum*)	It is a critically endangered bird species discovered in 2006, found only in Eaglenest and nowhere else in the world.
3. Bongpu Litter Frog (*Leptobrachium bompu)*	It was discovered in 2011 at Bongpu and has been seen only at Bongpu.
4. Dafla Hill Agama (*Mictopholis austeniana*)	This rare lizard was rediscovered in Eaglenest after 100 years and had been seen last in Darjeeling.
5. Tibetan Brimstone (*Gonepteryx aminthat hibetana)*	This butterfly was found in Tibet and is a new discovery in India.
6. Bhutan Glory (*Bhutanitis lidderdalei)*	It is the national butterfly of Bhutan, seen for the first time in Eaglenest.
7. Chestnut Breasted Hill Partridge (*Arborophila mandellii)*	It is a vulnerable species, and has been photographed in wild only in Eaglenest

Tibetan Brimstone (*Gonepteryx amintha thibetana*): found in Tibet, new discovery to India

Bhutan Glory (*Bhutanitis lidderdalei*): national butterfly of Bhutan, first seen in Eaglenest in India

rhododendrons at the highest elevation. Most part of the sanctuary area has extensive bamboo cover.

Biodiversity value

The protected area is rich in floral and faunal diversity which may be partly due to the fact that the road passing through the sanctuary was not used anymore after the Indian Army abandoned it, which ultimately led to the regeneration of the forest area. The sanctuary is home to a number of rare and endangered species. A new bird species Bugun Liocichla (*Liocichla bugunorum)* was discovered near the sanctuary in 2006 and is found only in Eaglenest and nowhere else in the world. A survey recorded three threatened species of birds – Blyth's Dragoman (*Dragoman blythii)*, Rufous-necked Hornbill (*Aceros nipalensis)* and Rusty-bellied Shortwing (*Brachypteryx hyperythra*) – and five near threatened species – Satyr Tragopan (*Tragopan satyra)*, Great Hornbill (*Buceros bicornis*), Ward's Trogon (*Harpactes wardi*), Lesser Rufous-headed Parrotbill (*Paradoxornis*

Camera trap image of Arunachal Macaque (*Macaca munzala*) which was discovered in 2003

Bongpu Litter Frog *(Leptobrachium bompu)* discovered in 2011 at Bongpu

atrosuperciliaris) and Greater Rufous-headed Parrotbill (*Paradoxornis ruficeps*). It is an important birding area with over 700 species of birds known from a 100 sq. km region, globally second only to the eastern slope of the Andes in South America. The sanctuary is internationally recognised and frequented by bird watchers.

The protected area is a haven for butterfly and moth watchers as over 189 species of butterflies have been recorded here and of these 39 species have been provided legal protection under Schedule I, II and IV of the Wildlife (Protection) Act, 1972. Around 1,300 distinct moth species have been recorded of which 600 species have been identified to the species level and it is likely that the number of the species recorded will go up as the survey continues. On a good night, mercury vapour bulbs attract up to 2,000 moths on a single moth screen.

Many of the mammal species found in the wildlife sanctuary are protected

under the Wildlife (Protection) Act, 1972. Some of the important mammals found there are Red panda (*Ailurus fulgens*), Yellow throated marten (*Martes flavigula*), Golden cat, Dhole or the Indian wild dog and the Asian elephant (*Elephas maximus*). Inside the sanctuary, the elephants migrate from the plains of Assam up to 3,200 m elevation every year during the summer months. This is probably the highest altitude that elephants are found in India. The Kameng Protected Area complex provides the mammal, a vast tract of forest area for their movement and is an important habitat. Keeping this in mind the government of Arunachal Pradesh declared this area as an Elephant Reserve in 2002.

"The voyage of discovery is not in seeking new landscapes but in having new eyes," said Marcel Proust. This is indeed an apt explanation for the field research which is carried out here. A number of researchers and wildlife enthusiasts are engaged in research work in the sanctuary studying and documenting wildlife. A number of new species have also been discovered in the sanctuary. Among the discovery and rediscovery of wildlife species observed, the table mentions a few of the notable discoveries and rediscoveries.

Dafla Hill Agama (*Leptobrachium bompu*) rediscovered in Eaglenest after 100 years, last seen in Darjeeling

Conservation and Management

The nature interpretation centre at Eaglenest inaugurated on September 23, 2015, provides information about the sanctuary, its flora and fauna which serve as a part of conservation education. It has been designed creatively in collaboration with experts. In my interactions with the DFO, Mr. Millo Tasser and forest staff of Shergaon Forest Division, I was told that since there are no villages inside the sanctuary there are no encroachment related issues. There is a little threat from hunting and poaching since the community residing in the area is aware of their environment and its importance, they practice community based conservation through ecotourism initiatives. Ecotourism at Eaglenest does not impose to many demands, visitors use the existing single lane road to visit the sanctuary.

Largescale felling is absent in the protected area however, there are cases of occasional felling. In the reserved forest and unclassed areas, felling has been stopped since 1996-97. Prior to that, largescale logging took place on

the slopes facing Rupa, Jigaon and Chillipam (south-west of Rupa) and other forest areas. Since protection and law enforcement are the key measures in conservation efforts, the staff of the forest department needs to be strengthened and well equipped with resources to carry out regular patrolling, protection and strict enforcement of wildlife laws inside the sanctuary.

The two main positives of ecotourism are economic betterment of the local community and conservation of the area. "People will conserve what they know of and appreciate," says astronomer and ornithologist Ramana Athreya. Ultimately for long term prospects, the fate of the Eaglenest Sanctuary lies in the hand of the people residing in and around the sanctuary.

Acknowledgement

I would like to thank the Shri Millo Tasser, DFO Shergoan Forest Division for his hospitality and great help in providing me the necessary information and valuable photograph which have been used in writing this article. I thank Shri Kushal Hazarika (RFO), Shri Thongchi (Dy.RFO) and Mr Indi Glow (President, Bugun welfare Society) for their assistance in the field and making our stay comfortable during the case study. I also give my thanks to the Authority of Central Academy for State Forest Services, Dehradun for giving me the opportunity to carrying out the case study. My sincere gratitude goes to the Government of Manipur for their financial support throughout the Study period.

RANI RANGE / ASSAM

Anti-depredation activities for wild elephants

The Forest Department has taken a number of steps to reduce incidences of man-elephant conflict and have involved the villagers too in the endeavour

Mito Rumi

It was around 9:15 pm on November 25, 2015, when Rani Range RFO received the news of death of a villager in Jobe Patgaon village, 25 kms from Guwahati, Assam, at the back of region`s famous water theme-park, *Accoland*. Then the solo elephant bull disappeared in the forest, only to reappear in the village at around 10 pm in front of a massive gathering of angry villagers. It took several gunshots in air and bursting of firecrackers to guide the bull back to the forest. Forest Department staff, alongwith police personnel from the nearest police station at Azara outpost, kept patrolling till 3 am to prevent any more human-wildlife conflicts in the village. Angry villagers demanded killing of the elephant and raised slogans against the Forest Department, holding them responsible for the villager`s death. "Your elephant killed him," was the sentiment heard amidst the enraged crowd. It is a different matter that investigation later revealed that the victim was intoxicated that night and had continuously teased the wild elephant before he was trampled by it. Our team of four SFS Officer Trainees from CASFOS, Dehradun, alongwith RFO Rani Range, visited this site and adjoining forest areas on December 7, 2015, to study the human-elephant conflict in the range.

Rani Range comes under the Kamrup East Division, at a distance of about 25 kms from Guwahati city. It borders Zirang Reserved Forest of Meghalaya in the east. Its management faces the problem of timber smuggling across the Meghalaya border. About 40 human deaths caused by wild elephants have been reported in Rani Range in the last two decades. The primary reason for human-elephant conflict in the region is damage of paddy field crops by herds of elephants. Though elephants are reported in paddy fields during the entire season – from June to December – there is a higher rate of incidence in November when crops are ready for harvesting.

The Asian Elephant, *Elephas maximus*, is the largest terrestrial mammal on planet. It is found in 16 States of India. There are 28 demarcated Elephant Reserves in India which

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Site of the incident in Jobe Patgaon village, Rani Range

have a sizable population. As per the latest Elephant Census in 2012 of the Ministry of Environment & Forests, total population of elephants in India is estimated at 29,000. Assam has about 5,620 elephants. Elephants have a wide range and can travel for hundreds of kilometres on a determined path, called the Elephant Corridor. These corridors have been used for by generations of herds of wild elephants centuries before human settlements grew in or around these corridors. Rani Range is an example of human-elephant conflict caused due to fragmentation of the elephant corridor due to human development activities like settlement, agriculture, rail-roadways, etc. This phenomenon is seen across the entire country in the 28 Elephant Reserves and the elephant corridors connecting them.

So what is *'depredation'* of wild elephants? It can be defined as damages caused by wild elephants – like, crop damages, human settlement damages and human-wildlife conflicts incidents. Anti-depredation measures are therefore implemented to prevent human-elephant conflicts. Common measures taken up by the State Forest Departments across India include solar-powered electric fencing near rail lines and human settlements, building watch towers, forming anti-depredation squads at the village level and also providing firecrackers and rifle guns to the frontline staff. Since 1992, State governments are funded by centrally-sponsored scheme, Project Elephant, along with technical assistance on ecological restoration of existing natural habitats and migratory routes of elephants, development of scientific and planned management for conservation of elephant habitats and viable population of wild Asiatic elephants in India, promotion of measures for mitigation of man-

elephant conflict in crucial habitats and moderating pressures of human and domestic stock activities in crucial elephant habitats, strengthening of measures for protection of wild elephants form poachers and unnatural causes of death, research on elephant management related issues, public education and awareness programmes, veterinary care and elephant rehabilitation/rescue centres. But, with the growth of elephant population and shrinking of their habitat, the human-elephant conflicts have increased. Anti-depredation measures implemented today thus, need critical analysis for its effectiveness in both the short- and long-term basis.

The primary causes for venturing of wild elephants into human habitat in the Rani Range have been identified as: a) Disturbance in the elephant corridor and fragmentation of their natural habitat due to rail and road constructed across Deepor Beel water body and expansion of villages. b) Scarcity of food and water in natural habitat caused by degradation of water bodies in the habitat due to deforestation and noise and disturbance in the corridor on the Meghalaya side where 7 stone quarries and 22 stone crushers are currently reported to be running. c) Change of food habits of elephants: smell of locally available rice beer '*Mod*' attracts elephants to village households. Taste of salt and sweet paddy crops have also affected their food preferences.

Rani Range Forest Officials have taken several anti-depredation measures. There are two night patrol duty teams with 5-6 personnel of the Forest Department and the Assam Forest Protection Battalion. Tree houses – *Tongchi* – deep inside the forests have been built with natural forest produce to avoid their detection and uprooting by wild elephants. Each tower is manned by two watchers on daily rotation basis, who report on the sighting of wild elephants and detection of illegal timber felling. The Department has also done plantation of banana and jackfruit inside the forest, away from the village borders. Torches and crackers have been provided to villagers under the monitoring of the nearest beat office. Anti-depredation squads of unemployed village youths have been formed for quick information and response on sighting of wild elephants in villages. Good coordination mechanisms have been set up on information sharing and duties in response among the Forest Department, Police, Administration and villagers. Meetings have been conducted in villages where they have been urged and trained to restrict liquor and salts away from easy reach of stray wild elephants.

A meeting of our team with villagers of Jaipur village gave an insight into the problems faced by villagers due to wild elephants. They complained of quantity of torches and firecrackers provided by the department to be insufficient for a village of 102 households. They further demanded building of more trenches around the village borders and agriculture fields. The department constructed about 2 km of 5-feet deep trenches in 2015. These are effective to stall advances of herds. But they face

siltation and erosion in the rainy season and are costly to maintain. It also raises the question that if we have the right to deprive wild animals of their right of way which they have been ranging for centuries. Forest officials also need to be vigilant and blindly agreeing to the demands of villagers to construct structures and trenches inside or near reserve forests boundaries as they may further encourage encroachments by villagers.

The Rani Range has eight Beat Offices. But they face challenges of power supply, drinking water and communication. Only vehicle patrol to mobile network zones is the fastest mode of transmitting information on any poachers or illegal felling to RFO office, or nearest police outposts. Wireless communication facilities may be provided on the lines of the police outposts. But it was encouraging to find solar-powered units functioning at various BOs during the night patrol. Sukurberia Beat Office needs special mention here for good maintenance of the solar-powered unit. The Forest Department, in general, also faces problems of human resource management (HRM) where transfer and posting durations are not uniform throughout the entire frontline staff with respect to tough outposts. State government departments urgently need to revamp HRM, which may be on the lines of major PSUs like SBI, ONGC, SAIL, BHEL, etc., which have online computer database-based HRM System (HRMS). Postings, work assignments and number of staff can all be put into electronic form that can be openly accessed in the closed network of Forest Department to decrease red-tapism, favouritism and nepotism in the department. Several State government departments have tried to implement e-Gov models in the State machinery, but in patches only. A complete revamp is the need of the hour, which can be done with the already tested HRMS models and expertise of major government-owned PSUs.

The discussion on Wild Elephant Management will be incomplete without the analysis of Annual Operation Plan of the State Forest Department with respect to Project Elephant. In 2014-15, Rs 236.6 lakh were granted to Assam out of a total India allocation of Rs 34.58 crore under CSS Project Elephant. The Kamrup East Division was granted Rs 29 lakh from CSS Elephant Project and Rs 6 lakh from the State Fund. On critical analysis, it can be found that this fund is utilised only for maintaining the existing anti-depredation measures in place on a short-term basis. The expenditure outlay under CSS for every year remains almost the same i.e. maintaining trenches, solar fencing, squads, watch towers, patrol, hiring of kinkis, etc. Ex-gratia and crop damage compensation uses up the major chunk of State Fund. There is no holistic mitigation plan for human-elephant conflict at regional level across elephant reserves and States on a long-term basis. The story of Elephant Project needs several elephant heroes to transform it into another Project Tiger in terms of funding, urgency and highlighting its importance at the national level of policy making and planning. Various

scientists, researchers, forest officials, public and State machinery as a whole must come together to take the much-needed bold steps to critically analyse the problem of human-elephant conflict in India and execute mitigation plan at new heightened significance and urgency at national level.

Acknowledgement

I am grateful to Mr MP Singh, Director of Forest Education, Ms Meera Iyer, Principal, CASFOS, and tour incharge, Mr KS Jayachandran, and faculty CASFOS for arranging this new module in the East India Tour. I extend my gratitude to Mr Chandan Bora, DFO Kamrup East Division, Mr Bhaskar Deka ACF, for valuable information, support and guidance to impart knowledge and letting us experience the onfield anti-depredation activities carried out. I would also like to thank Mr Kalita, RFO Rani Range, for carrying out night patrol operation across the stretch of Rani Range. Last but not the least, my humble regards to my fellow officer trainees for their cooperation and support to make it a successful and memorable tour.

WEST JAINTIA HILLS / MEGHALAYA

Community Reserves: Better protection for natural forests

Augmenting the level of protection to Sacred Groves and community forests by converting them to Community Reserve will surely help in better conservation of natural forests

Waikhom Romabai

A ray of hope arises with the introduction of Community Reserve, a Protected Area (PA) category in the Wildlife (Protection) Amendment Act of 2002, for legalisation and rendering a more degree of protection to the already conserved and preserved forest patches under the name of community forests and sacred groves. This category was added because of the reduced protection in and around existing or proposed PAs due to private ownership of land and land use. With the consent of the individual or the community, any private or community land which is not comprised within a National Park, Sanctuary or a Conservation Reserve, is declared as a Community Reserve for protecting fauna, flora and traditional or cultural conservation values and practices as stated in WL(P)A, 1972.

The concept of Community Reserve was absorbed in a big way in Meghalaya, as compared to many states of India. As many as 39 community forests were converted into Community Reserves, of which 5 are in the Jaintia Hills. The year 2013-14 was marked as a development in the area of environment protection in Jaintia Hills for the recognition of various community forests as Community Reserves.

This approach was regarded as a big achievement as only 12.3 per cent of the total forest land (2,516 sq. km) is owned by the State government and remaining 87.6 per cent (2,204.55 sq. km) in Jaintia Hills comes under different categories of privately owned forests, namely Law Ri Kynti (recognised private land), Law Ri Sumar (village common land), Law Lyngdoh and Law Niam (sacred groves), Law Adong and Law Shnong (village forest reserved by villagers to conserve water) and Raid forest (looked after by the head of the raid and managed by the local administrative head).

The only difficulty faced by the Forest Department in the process of converting privately owned community forests into Community Reserve (CR) was to convince the local communities as they are reluctant to give away their forest and also fear losing their rights which they have been facilitating since time immemorial.

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These communities were convinced through constant consultation with the Forest Department officials and Kur, Raid and Dorbar Shnong, as they are addressed by different title for different clans. Till now, Forest Department, West Jaintia Hills, has notified five community reserves, namely Sein Raid Tuber (89.43 ha), Khloo Blai Kongwasan Khloo Blai Chyrmang (7 ha), Ka Khloo Thangbru Umsymphu (19.6 ha), Khloo Pohblai Mooshutia (33.5 ha) and Ka Khloo Langdoh Kur Pyrtuh (15.4 ha). After recognising these community forests into CR, the success story spread like a wildfire and now people are starting to show interest and have been approaching the Forest Department for converting their forests to CR. So, two more – Raid Buam Thangbuli (128.8 ha) and Khloo Blai Ka Raij longlang (15.12 ha) – previously a community forest for the purpose of conserving water and a sacred grove, respectively, are on the way to be notified as CR. The most fascinating thing about Raid Buam Thangbuli community forest is that it is recorded to be conserved since 1913 for the purpose of water conservation. On the contrary, even today people find it hard to understand the relation between maintaining forest cover to augment water conservation as they act as a source of many rivers.

Prior to the notification, many rounds of meeting were held and an agreement was signed between the Forest Department and the headman of the clan/village or the owner of the community forests. Some of the important clauses included in the agreement can be listed as: ownership of the land shall be solely with the community; no inference from the Forest Department on the activities related to conservation which has been practiced by the community from time immemorial; provision of the Section 18(2), Section 27(2,3,4), Section 30, Section 32 and Section 33 (clause b & c) of WL(P)A, 1972, shall as far as may be applied in a CR as they are applied in relation to a Sanctuary, etc. After the recognition of community forests as CR, a Community Reserve Management Committee is formed, comprising six members. The Chairman is usually the headman of the community, who shall also be the honorary Wildlife Warden of the CR. The Member Secretary is DFO, Wildlife Division, West Jaintia Hills. The Committee is responsible for the preparation and implementation of the management plan for the CR and also the works related to conservation, preservation, protection and development of the CR.

Initiatives taken up by the Forest Department after the notification consist of: boundary demarcation with proper mapping of the area using GPS; construction of boundary pillars; creation of fire lines and supplying fire-fighting equipment; hoarding of Forest Department board and signage at regular interval; and, most importantly, timely monitoring of the area. Some of the issues addressed by adapting the concept of CR can be listed as encroachment, forest fire, illegal hunting and felling, etc.

Apart from these, the establishment of CRs empower the community to take up various projects like tree

plantations, construction of community halls and eco-friendly crematorium, leading to creation of employment opportunities from time to time. In some of the CRs, especially those formed from Sacred Groves like Sein Raid Tuber and Khloo Blai Chyrmang, nothing from inside can be extracted and nothing from outside should be brought inside the forest, except for some particular days in a year. Thus, for plantation purposes, seedlings grown naturally in the forest are to be used, which is a well-known silviculture operation called Wilding. Community hall and eco-friendly crematorium are being constructed under the Centrally Sponsored Scheme, which will help in reducing the consumption of felled trees; in tribal communities, cutting down of trees for making camps for every ritual is a common practice. The Forest Department also helped in the construction of eco-friendly crematorium model developed by Kambel Chulai with the objective of minimising the consumption of wood as compared to the traditional way of cremation.

Many indirect benefits which we seldom perceive are also achieved. These include: moderation of climate; regulation of the local hydrology; maintenance of nutrient cycles and soil fertility; rendering aesthetic scenic beauty to the landscape; regeneration of tree species; conservation of native and endemic species; and, conservation of traditional and cultural values related to forests, rituals and taboos.

The next question is, why the need to conserve the already preserved forest assets? The only explanation to this is that the biodiversity-rich Sacred Groves and community forests protected by the people as a result of religious and cultural beliefs is given legal protection through CR. The need of legal protection crops up in today's scenario as dilution of religious and cultural beliefs are frequent in society and many a times, illegal activities are done by individuals of different clan or village and by the relatives of the headman of the community, leading to bias in decision making. Thus, better protection will be assured with the intervention of the government.

The applicability of this approach is immense for a country like India for conserving its natural forests where many community-owned forest patches are facing multiple threats. These threats include: dilution in our traditional beliefs; urbanisation; over-exploitation of resources; partially cleared forest area for construction of shrine or temple; invasion by alien species, etc. Particularly for the north-eastern part of India, Sacred Groves and community forests may be regarded as forest patches which are often spared from the most primitive form of agriculture – shifting cultivation due to traditional beliefs and taboos associated with it. So, augmenting the level of protection to such forests by converting to CR will surely help in better conservation of our pristine natural forest.

Acknowledgement

I would like to thank Mr MP Singh, IFS, Director, Directorate of Forest Education, Ms Meera Iyer, IFS,

Principal CASFOS, Dehradun, and Dr KS Jayachandran, IFS, tour-in-charge, and C.D. 2015-17 Batch CASFOS for giving me the opportunity to explore such a beautiful place through this case study tour. I am also grateful to MS H Lato, MFS, DFO, Wildlife Division, West Jaintia Hills, and her staff for their guidance and constant support during the tour.

DIGBOI / ASSAM

Issues plaguing mining of minor minerals

Mining of sand and stone needs to be regulated strictly as otherwise it has the potential of not only harming the wildlife of the area but also negatively impacting the local people

Khanindra Kalita

If we can reduce the width of Eco-Sensitive Zone (ESZ), illegal mining of sand and stone can be decreased to some extent," the Divisional Forest Officer of Digboi Forest Division said. Can it really be a solution for illegal mining in Digboi?

The Government of Assam is earning revenue of about Rs 1 crore annually from the sand and stone mines under Digboi Forest Division in Digboi. But the value of the loss to the resources that may occur in near future due to its effect might prove to be much more than this if proper steps are not taken in time for regulation of unscientific and illegal mining of minor minerals in Digboi. Digboi is a town in the Tinsukia district of Assam and the region has loads of natural resources like oil, coal, flora and fauna, etc. Asia's first oil well was drilled here. The Dihing Patkai Wildlife Sanctuary in Digboi is one of the last remaining lowland tropical wet evergreen forests of Assam.

Extraction of minor minerals is permitted with a view to earn revenue, to meet the ever-increasing demand for sand, stone etc., and to stop and discourage illegal mining and pilferage. Like other States, mining of sand and stone has been done since long in Assam. Mining in Digboi is on rivers that flow down the hills of Arunachal Pradesh and deposit minerals downstream. Mining of minor minerals in Assam is governed by the Assam Minor Mineral Concession Rules, 2013. Schedule Y of this Rule defines the minor minerals that can be extracted. Sand having less percentage of silica and stones are permitted for mining.

Illegal mining of sand and stone, pilferage from authorised mining and cross-border issues are the main problems facing Digboi Forest Division, as far as mining of minor minerals in Digboi is concerned. At present, there are nine mines in operation, out of the 17 mines under this division. Some are yet to be sold and five mines fall under ESZ, for which permission cannot be granted.

Scientific mining, or the legally permitted mines, have the approved Mining Plan/Scheme of mining and Environmental Clearance granted by the authority for sustainable extraction

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Excavators are mercilessly mining sand in Digboi

or mining of sand or stone. But illegal mines are causing environmental damage as well as a loss to the State exchequer and posing threat to the life and property of the people living near the mines.

Some forest officials feel that by decreasing the width of the ESZ – at present, 10 km around the Protected Area– more mines can be permitted, which might be helpful in curbing illegal mining and pilferage. But, will it be able to address the negative effects of unregulated mining.

Negative effects under the Digboi Forest Division include riverbank erosion in Tirap and Dihing rivers; destruction of riparian and aquatic flora and fauna; damage to roads in the mining area; pollution created by extra vehicular traffic, etc. These can lead to a change in the river course, depletion of water level which will affect the local people. Cross-border mining is another issue for Digboi Forest Division. Dihing and Tirap rivers traverse the State boundary between Assam and Arunachal Pradesh. Illegal and unregulated mining can at any time cause damage in either side. For example, mining of boulders in the private forests in Tirap district of Arunachal Pradesh is appealing the traders from Assam, which is causing extra traffic inside the Dihing Patkai Wildlife Sanctuary. These vehicles use the shortest route – sometime through the forest, sometimes by the periphery – causing disturbance to the wildlife in the sanctuary.

The limitations of Digboi Forest Division include lack of manpower and vehicle which is affecting the monitoring and proper follow up processes.

What can be done? It is high time the matter is taken seriously. Awareness of people can be very helpful. Local people should be made aware about the mining activities in their area, the provisions of mining, about the negative impact of illegal mining, etc. Voluntary organisations like Mahila

Samities and Gaon Panchayats can play a great role in this with guidance from the Forest Department. For example, the mining areas should have a signboard, displaying the name of the promoter/contractor, his contact details the area of mining and some 'dos' and 'don'ts, so as to make the people more responsible. People will come forward to inform about any illegal mining activity only if they find it comfortable to interact with the field forest staff. So, good relations between the locals and the field staff of the Forest Department are very important.

Without adequate field staff and vehicles, it is very difficult to keep a strict vigil on the mining activities in Digboi. Sudden visits by officers and strict implementation of law is very important to deal with illegal mining.

Maximum permitted quantity of mineral to transport should be adhered to, not only to check pilferage but also to curb road accidents. For this, a Transit Pass should be issued after due diligence and it should be checked at regular intervals. Corruption is an open secret in the trade of transit of mined minerals. Monthly meeting of field staff should be organised; frequent transfer/ rotation of these staff is also an option. Good work of staff members should be recognised to increase motivation and provide encouragement. Also, latest tools of information and technology and remote sensing can be used for permitting, prohibiting and regulating these mines.

A meeting of Divisional Forest Officers should be organised to discuss various issues regarding mining in different divisions. Solution for lots of problems would come out with experience sharing. A State-level monitoring committee should be formed to review the overall scenario of mining in the State and to take it to the government.

For minimising adverse effects of illegal mining, conditions laid down in the Environmental Clearance Certificate, Mining Plan, Special conditions for riverbed – area (within the central 3/4th width of the river/ rivulet), limit (maximum depth of 3 metres from the river bed level/water level, whichever is less), way of mining (manually) – should be strictly followed by the miner or contractor. Use of excavators or suction pumps should be banned.

Mining in a specific area should not be allotted more than once. Generally, mining is allowed for 5-7 years in a term. So, continuous mining in an area for a long time may prove to be harmful. Large rivers and streams, whose periodic sediment replenishment capacity is larger, may be preferred than smaller rivers. The aim should be to mine out material only to the extent that is deposited annually. Mining at the concave side of the river channel should be avoided to prevent bank erosion and mining should not be allowed before sunrise, after sunset and in rainy season.

The vehicles used for transportation should follow a predetermined route, observe the speed limit and must possess proper fitness certificate. It should comply with the emission norms along with valid 'Pollution

Under Control' certificate. Also, there should be a government policy for regulation of cross-border trading of mined minerals.

In a developing country like India, the need and demand for sand and stone is going up. So, it is up to the government and government officials to take care of the issues related to development. We need development, but not at the cost of wildlife and environment. We have to strictly follow the terms and conditions so that sustainable development can be achieved, minimising the negative impacts of mining.

Acknowledgement

My sincere thanks to Mr Ranjan Kumar Das, IFS, Divisional Forest Officer, Digboi Division, Mr Arun Hazarika, Range Forest Officer, Digboi Range, and Mr B B Das, Range Forest Officer, Jagun Range, for their support and cooperation.

KAZIRANGA NATIONAL PARK / ASSAM

Diminution of natural abode

The application of a landscape approach for Kaziranga will require evaluation of current and future pressures, development of different options, agreement on the optimal way forward and a series of strategic interventions

Sayambrita Dutta

If Brahma is known as the creator of the universe, then his son, Brahmaputra, the mighty river that criss-crosses through Assam, can rightly be called the creator of Kaziranga. What Kaziranga is today was perhaps once the main channel of the red river which habitually changed its course over the century due to earthquakes at various points of time. Kaziranga National Park (KNP), located in the heart of Assam, is one of the last areas in Eastern India undisturbed by human presence. Spread over an area of 430 sq. km, and a further addition of 400 sq. km, it is known worldwide for its success in the conservation history of One Horned Indian Rhinoceros, the pride of Assam, from more than a century. The management history dates back to June 1, 1908, when it was first declared as a Reserve Forest and then a National Park in 1974.

Kaziranga National Park

The park is the natural habitat for *in-situ* conservation of biological diversity, including rare, endangered and threatened species with Rhino as the flagship species. These unique values and criteria got it declared as a World Heritage Site in 1985, it being the largest undivided Brahmaputra Valley floodplain, grassland and forest with associated large herbivores, avifauna and wetland values, home to the Bengal Florican (*Houbaropsis bengalensis*), significant population of Asian Elephant (*Elephas maximus*) and the junction of the Australasia flyway and Indo-Asian flyway.

The past 100 years have seen major conservation successes in Kaziranga National Park, with populations of many endangered species, notably Rhino, Elephant and Tiger rising and the ecological integrity of the area being maintained, despite high biotic pressures. These successes, and the expectations that they will continue, bring about several management challenges. Since it provides an entire range of habitat – from the floodplains to grasslands to hill evergreen forest communities – it also faces certain threats which, if not adequately mitigated today, would become the cause of extinction of the Rhinoceros in times to come. The habitat of the Kaziranga National Park is undergoing

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a slow degradation process under the influence of various biotic and abiotic pressures, some of which are discussed herein.

Invasive weeds

The *Mimosa invisa* species was grown by tea gardens on the periphery of the Kaziranga National Park to suppress the *Imperata cylindrica* in the prospective tea garden areas meant for expansion and also to supplement nitrogen fixation in the degraded soils. As all the water channels in the surrounding gardens run into the Park, the seeds of *Mimosa* spp entered the Park, and invaded the grasslands. So far, about 170 hectares of tall grassland is affected by the invasive weed, destroying the prime habitat of the Rhinoceros. Due to its thick and thorny growth, animals cannot move through the *Mimosa* vegetation, blocking animal movements inside the Park. As no chemicals can be applied inside the Park, only manual methods of physical uprooting are resorted to. It is not only costly, but also time consuming. Next to *Mimosa invisa*, a wild *Rosa* is one of the most trouble giving weeds – more particularly in the moist grazing lands –damaging the swamplands, reducing drastically the diversity of other plant species, destroying habitats and grazing areas of animals and several birds.

Siltation of water bodies

Kaziranga is very rich in water bodies, which form about 5.96 per cent of the total Park area. There are 92 perennial water bodies and more than 250 seasonal water bodies. These water bodies play important ecological roles such as being important breeding ground and nurseries for numerous fish population, prime habitat for Rhinos, harbours Swamp Deer, Asiatic Wild Buffalo, Elephants, etc., and act as roosting and nesting ground for migratory and indigenous water birds.

This unique wetland ecosystem is confronted with numerous problems, such as shrinkage in size and depth of water bodies due to deposition of heavy silt carried in by the Brahmaputra and its tributaries and choking by water hyacinth. Almost all water bodies are connected through channels/*nullahs*. These may be described as arteries and veins of Kaziranga. Desiltation / clearance of water channels is of paramount importance to maintain and restore ecological systems.

Shrinking of grasslands

In several parts of the Park, there has been mass regeneration of Simul (*Bombax ceiba*), which is encroaching upon the grasslands and destroying the habitat. Manually cutting down Simul trees was done by engaging labour. It has been observed that Simul is coming back prolifically through natural regeneration of seeds scattered all across the grassland, as well as coppice from the cut trees.

Overgrazing

Kaziranga National Park has only 3 per cent of area covered with palatable short grasses. Out of this, 1,440 ha area is clearly in disturbed state due to overgrazing by wild buffalo/feral buffalo livestock as well as wild herbivores. This poses

manifold problems for management, like competition for palatable grasses and spread of diseases from livestock to wild animals. During February-March, when fodder becomes scarce for the livestock because of prevailing dry weather, villagers often push their livestock into the Park area for grazing. Annual burning during the period also results in growth of new shoots and the livestock relish such vegetation. Besides, competing for fodder with wildlife, such intrusion increases the risk of spread of epidemic as the livestock are not always properly immunised.

Water scarcity

Water scarcity is an issue which may come up in a big way in the times to come. In March-April, 2014, drought-like conditions prevailed in the Park. Currently, there is no mechanism to hold water inside the Park after the floods recede. For future, the planning is to experiment with causeways with good foundation which can withstand the force of incoming floodwaters, that may be in a position to retain some water in the Park for longer periods.

Migration of wild animals

Kaziranga is biologically a very productive habitat and acts as source for the surrounding landscape. Despite fragmented corridors, considerable migration still occurs due to the islands of the Brahmaputra River. Given the high risks of poaching, efforts are made by the Park authorities to drive back the Rhino if it crosses the boundaries of the Park and information is received. Once the corridors are secured, it is made safe for the Rhinos and there may not be any need of any translocation of these animals.

The way forward

Based on the above facts, the conclusions are being drawn that Kaziranga National Park has already lost a net land area of 83.385 sq. km to erosion by the Brahmaputra river, with the bank line shifting westward and southward. The habitat in KNP is getting fragmented – especially the corridors connecting to the Karbi Anglong hills – and may be permanently lost if steps for restoration are not taken now. A Rhino lost is a Rhino lost forever, whether due to poaching or habitat loss or degradation. KNP is reaching its ECC (Effective Carrying Capacity) limits in a short span of time which calls for need to translocate Rhinos out of the Park to other safe areas, or expand the area of the Park to increase the ECC limit. If none of the two are done, Rhinos run the risk of being lost.

Some of the multi-pronged and multi-disciplinary measures, as reported by the Director of Kaziranga National Park, to mitigate threats and long-time survival may include erosion control, habitat improvement, extension of habitat, corridors retrofitting, upscaling of anti-poaching infrastructure, security and surveillance in and around the Park, adopting a landscape-based approach and constitution of a landscape authority for conservation and development of the areas and, above all, creating secure habitats outside Kaziranga for rhinos.

The park authorities have been carrying out certain habitat improvement programmes from time to time, subject to quantum of funds available, providing temporary reprieve, but the issues continue. A long-term consistent programme of habitat improvement in terms of Invasive Weed Control, encroachment of grassland by Simul and other woody growth, desiltation of water bodies, highland creation and maintenance, biotic interference control, grazing and fishing, water harvesting and forest fire control is required.

For invasive weed control, manual methods like resorting to ploughing before flowering along with tested safe herbicides may be tried. For weeds coming from agricultural crops and human habitation nearby, a 'No Activity Buffer Zone' of 500 metres at certain select places just next to the Park boundary may be maintained. A special provision in the wildlife regulation for conflicting punishment of those found responsible for invasive weed injection in conservation areas, as in Kenya, should be incorporated. It would also not be out of place to mention here that the problem of invasive weeds is so extreme in US forests that the US Fish and Wildlife Service maintains special station on the border of the conservation areas, where the vehicles entering and leaving are sanitised for invasive weeds.

Simul encroachment upon the grasslands can be managed only by mechanical removal, using logging equipment after the grasses have been burnt during late January to March, to make the operation less costly and sustainable. The other option could be, for the areas which are already covered by Simul regeneration, to cut down the trees below the soil surface in the month of September-October and burn the area during January-February.

Desiltation and highland creation could go hand-in-hand. Highlands to be raised must be planned and mapped beforehand. Similarly, water bodies and parts thereof should be identified well in advance based on ecological and water flow dynamics of the area and thereby making an annual plan in advance. This will also improve the water scarcity during drought considerably. Small causeways with strong foundation should be made so that some water in the upstream level is retained in different stages in cascading manner.

Grazing of domestic livestock should be prevented by effective enforcement by the staff and through EDC activities. The other associated problem is of stray dogs from villages entering the Park. It is possible that these dogs may be attacking the newly born fawns and babies of other animals. Further, such attacks would be adversely affecting the growth of the populations concerned, especially endangered animals such as swamp deer. Electric fencing around the Park also didn't work as it hindered the easy movement of wild animals to and fro in their corridors. Moreover, stall feeding and rearing hybrid cows are not in the traditional habit of the communities in the fringe villages.

Although Kaziranga has seen major conservation success, there are still

many endangered species within, or passing though, the Park. The continued survival of species within KNP over the next century will depend to a large extent on what happens beyond the Park's boundaries and will rely on ensuring that management options elsewhere, in the river and in the surrounding landscape, do not undermine the ecology of the Protected Area.

Developing a mutually acceptable management mosaic will be difficult and implies hard negotiation and some trade-offs. The application of a landscape approach for Kaziranga will require evaluation of current and future pressures, development of different options, agreement on the optimal way forward and a series of strategic interventions, carefully monitored so that adaptive management can be applied as necessary.

Acknowledgements

I wish to convey my heartfelt gratitude to Mr MK Yadava, IFS, Director, Kaziranga National Park, Mr SK Seal Sarma, DFO, EAWL and Mr S Choudhary, IFS, ACF, Kaziranga National Park, Assam, for planning and executing our case study at Kaziranga and in providing official records in compiling the case study.

HILL AREAS / MEGHALAYA

Hazard of traditional lime kilns

A number of steps could be taken to curb the practice as it affects the environment and results in increasing instances of landslides and loss of forest cover

Hibu Tana

Meghalaya is a mineral rich State which has 559 million tonnes of coal reserves and around 2462.5 million tonnes of limestone reserves. The maximum reserve of limestone is in Jantia Hills (55 per cent), followed by Khasi Hills (38 per cent) and Garo Hills (7 per cent). In villages of Meghalaya, lime is usually used for whitewashing the tree stem due to its insecticidal properties and because it acts as a physical barrier against stem borers. A little amount is taken along with betel leaf and betel nut, locally called '*kwai*', as it is believed that it helps in digestion and kill worms in the digestive system. Currently, limestone is mined extensively for cement manufacturing.

In Meghalaya, most of the minerals are located in southern part of the State which is under thick forest viz. Cherrapunjee and Shella-Bholaganj of Khasi Hills, Nonkhlieh and Lumshong in Jantia Hills and Darrangiri-Era and Anig-Siju in Garo Hills. Extraction of lime using lime kilns has been done here traditionally.

Limestone mining in general and traditional lime kilns in particular could be a potential hazard to the environment as they are owned by relatively poor sections of the society and most of them use wood – as they can't afford coal – as fuel in lime preparation. Traditional lime kilns are also unorganised and go unchecked from the government's watchful eyes. There is very few legislations to regulate such kilns, except for 'Meghalaya Industrial and Investment Promotion Policy (MIIPP)-2012', which discourages use of wood-fuelled lime kilns.

Problems

In the Forest Survey of India 2013, despite inclusion of non-forest areas under dense and mid-dense forests, the net loss of forests worked out to be 1376 sq. km. Losses were mostly observed from States of Jammu and Kashmir, Uttarakhand, Meghalaya, Kerala, Arunachal Pradesh, Karnataka, Uttar Pradesh, Telengana, Manipur and Andaman and Nicobar.

According to the paper, 'Environment concerns in Meghalaya', the quality of forest has deteriorated and dense forest with canopy closer of 40 per cent or more has been degraded into open or scrub forest. There could be various possibilities

CASFOS, Dehradun, Batch: 2015-17

An abandoned lime kiln site

that cause degradation of quality forest in Meghalaya like sand mining from hills, coal mining, excavation of rocks from hills and limestone mining. An expert from the North Eastern Space Application Centre, Umiam, focused on the loss of forest cover and came up with the results (Table 1).

There was a total loss of 1265.35 ha from classified forest, highest being in medium-dense forest from the year 2005 to 2011. A study was carried out by Kasturi Chakrabortry and S Sudhakar, using satellite images in ERDAS imagine software in Lumshnong, Jantia Hills, to see the change in forest cover around cement factories for the period 2005 to 2011. Although, it was carried out in a small area –5 km to 10 km from the centre of mining area and cement manufacturing units – it was found that the expansion of the non-forest area attributed to the cement manufacturing units amounted to 554.69 ha during 2005-2009 and 291.86 ha during 2009-2011. Thus, lime kilns possess a threat to the forest and environment.

Environmental impact

The assessment of abandoned site revealed that soil contained very less organic matter (C, N, P&K). The heavy metal concentration was in order of Ca > Fe > Mg > Se > As > Na > Mn > Zn > Pb > Cu > Cr > Ni > Co. It increased the pH of water bodies due to dissolved

Table 1

LOSS OF EXISTING FOREST AREA (HA) FROM 2005 TO 2011			
Classified forest	**Total forest area**	**Remaining forest after establishment of units**	**Loss of forest**
Less dense forest	**5,111.37**	**4,859.72**	**-251.65**
Medium dense forest	**13,295.9**	**12,528.9**	**-767.70**
Very dense forest	**9,145.32**	**8,898.62**	**-246.70**
Total	—	—	**-1,265.35**

calcium carbonate. It also increased electric conductivity of water bodies due to dissolved ions (chlorine) in water. Total Dissolved Solid (TDS) in water bodies was high due to the addition of organic and inorganic ions from contaminated water to these water bodies. Hardness of water was observed due to an increase in dissolved Calcium Carbonate (>300mg/L). Some of the ill-effects of traditional lime kilns are clearance of forest cover for extraction of limestone, felling of trees for fuel wood and pollution due to smog. Unplanned extraction of lime in patches caused soil erosion and landslides in these areas. Largescale extractions may also lower the water table.

Analysis of the problem

Most of the mineral-rich areas are under the forest cover. If we see the holding pattern of the forest, out of total recorded forest area of 9,496.4 sq. km, only 1,172 sq km (12.35 per cent) is under the control and management of the State Forest Department, about 7,914.5 sq. km (83.34 per cent) is under three different Autonomous District Councils and the rest, 25 sq. km, is under village forest that form around 5 per cent of the total forest cover.

As the largest chunk of forest in the State is under the control of Autonomous District Councils, it has to be stringent in implementing guidelines according to its law. However, the councils were not in condition to implement the law as they were under-staffed and sometimes senior officers from the State Forest Department were deputed under such Distinct Councils.

Forest Class.	Area (sq km)
1. Reserve Forest (Govt. forest, Parks & Sanctuary)	993.0
2. Unclassed forest	7146.5
3. Private forest	384.0
4. Protected forest	179.0
5. Village forest	25.9
6. Raid forest	786.0
Total	**9496.4**

Forest classification in Meghalaya

In the case of the village forest, there is a strong sense of community feeling and land ownership. It is also found that there are many different types of local forest management systems, like Sacred Grooves, Lao Adong and Clan Forest, and they are very successful in the management of the village forest area. Another case is that of successful implementation of REDD+ project in Meghalaya, which in itself is an example of capability or willingness of community in sustaining forest in the State, given that they are provided with alternate or better livelihood options.

Possible solution

The solution to the given problem broadly could come through community participation in Joint Forest Management, by finding out alternative means of livelihood for villagers and proper monitoring of forest using modern tools like GIS technology.

The State Forest Department, through legislations and court interventions, made some progress in curbing lime kilns:

- Under the Meghalaya Industrial

A traditional lime kiln

and investment Promotion Policy (MIIPP), 2012, wood-fuelled lime kiln was put under the negative list. Thus, the industries were no more eligible for 30 per cent subsidy under the State Capital Investment Subsidy as well as subsidy on the interest on term loan by specified banks.

- Cessation on issue of NOC for establishment of lime kiln by the State Forest Department after EIA notification 2006.
- Creating awareness on discouraging traditional lime kilns.
- Ban on mining of minor minerals by the Meghalaya High Court.
- Ban on rat hole mining of coal by National Green Tribunal (NGT).

All these measures effectively curbed the number of traditional lime kilns. At present, there are around 23 traditional lime kilns operating in Shella and Maulong and few in Sohra (Cherapunjee) area.

However, for management of the forest under the Autonomous District Councils (ADC), there's a need to come up with a new legislation that will be suitable for controlling traditional lime kilns in forests under ADC. To implement such a legislation, it requires staff. So, there should be a regular recruitment of personnel as it would smoothen the process of administration of the area.

Further, efforts should be made to convince villagers in remote areas to agree with these rules and guidelines because their perception of private land is at odds with others as perceived in the mainland. They have a strong sense of belonging and feel complete authority over the resources.

At the same time, there should be a simplification of procedure, using single window system to provide subsidy under MIIPP, 2012, by making arrangement for meeting all the stakeholders viz. bank, forest department, administration, department industries and the kiln owners under the general administration.

Briefing of procedure and documents required for kiln owners, fixing of date for collection of documents, distribution of documents to relevant department, including banks, by general administration and release of funds by the bank with subsidy are some of the steps that could curb the traditional kiln practice.

The limestone areas are also famous for production of quality oranges. Some of the varieties are *Khasi Mandarin, Citrus Indica* and *Citrus Medica*. Orange growers can be organised into Self Help Groups (SHG) and orange pulp and juice extraction units may be established, on similar lines with custard apple processing unit at Deola in Udaipur district, Rajasthan. The management could be looked after by the SHG with the Forest Department providing machinery and training to the employee. The benefit sharing mechanism could be on 80:20 ratio.

JFM works, like plantation of fast growing species like eucalyptus, may be done with the community for paper and pulp industries. Bamboo is another option as it has a ready market in Hindustan Paper Corporation Limited, Jagi Road, Naogaon, Assam, Nagaland Pulp and Paper Company Limited, Tuli, Mokochung, Nagaland, and Kachar Paper Mill, Assam.

The State Directorate of Handloom and Handicraft could be approached for financial assistance and consultancy services like training, marketing, etc. Some individual could also start units with financial aid from NABARD. They may increase their contacts for marketing by participation in national, regional and state-level expos like North-East Expo, State expo during Statehood Day, etc.

Fresh cut flowers, like Anthurium and Rose, can be grown and exported to Bangkok on similar lines with florists in Mizoram.

Acknowledgement

I would like to thank Mr Bijoy Lyndoh, ACF, Territorial, and Mr S M Lyngdoh, Forester, Beat Officer, Southern Range, Shillong, and the staff for giving their valuable inputs in successful completion of this case study.

JAINTIA HILLS / MEGHALAYA

India's only pitcher plant in peril

Forest fires, deforestation, mining and overexploitation of N. khasiana are some of the main reasons for the decreasing number in the pitcher plant unique to Meghalaya

D John Sha

A case study on pitcher plant, *Nepenthes khasiana*, Hook. f., was conducted in Jaintia Hills of Meghalaya. Said to be endemic to Meghalaya, *Nepenthes khasiana* is a dioecious and scandent insectivorous shrub of the tropical and subtropical climatic regions, belonging to the family Nepenthaceae. It is distributed throughout the State, from the West Khasi Hills to East Khasi Hills, Jaintia Hills and East, West to South Garo Hills from 1,000 to 1,500 m above MSL. But in 2006, a similar plant was reported in Buning area of Tamenglong district, Manipur, by the Manipur Forest Department. Pitcher plant is a flagship species of Meghalaya. This plant grows in association with *Licuala peltata*, *Calamus erectus*, *Lithocarpus dealbata* and fern species like *Alsophila gigentea*, *Dicranopteris lanigera*, *D. splendens*, *Thelypteris lakhimpurensis* and other species. It is known that Sir J D Hooker, an eminent botanist, discovered the species of *Nepenthes khasiana* Hook.f.,

Figure 1: ***Nepenthes khasiana Hook. f.,*** **Pitcher plant**

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commonly known as pitcher plant, in 1873. In Jaintia Hills, pitcher plant is known as '*kset phare*', which means, "caging the fly or flies". Pitcher plant is basically an insectivorous shrub and is adapted to grow in places where the soil is thin or poor in nutrients, especially nitrogen.

They developed a unique way to get the nutrients they need from source other than soil. These insectivorous plants derive their nutrients from trapping and consuming insects and other arthropods. Insectivorous plants are the only plant group in the entire plant kingdom that lives by hunting tiny insects.

Study site

A study was conducted on the pitcher plant in the Jaintia Hills of Meghalaya, North-East, India about their distribution and habitat.

Status

Pitcher plant is a protected species, classified as 'Endangered' and is included in the Appendix-I of CITES. It is an endangered medicinal plant of eastern India. Pitcher plant is included in the Botanical Garden List of Rare and Threatened Species of India compiled by the International Union for Conservation of Nature and Natural Resources (IUCN). It is under Schedule VI of WLP Act and is an indicator of nitrogen-deficient soil.

Uses

Pitcher plant is known for ethno-medicinal uses by different communities in Meghalaya. The Khasi-Jaintias look at it as a source of herbal medicinal value. In Khasi and Jaintia Hills, about 1,878 kg of pitcher is used annually in traditional healing systems. The juice extracted from the leaves is said to be helpful for diabetic patients and also for those who suffer from difficulties in passing urine. Garos use to crush the plant until it reduces to powder form and then they apply it to those parts which are affected by leprosy. The fluid of unopened pitcher is used as an eye

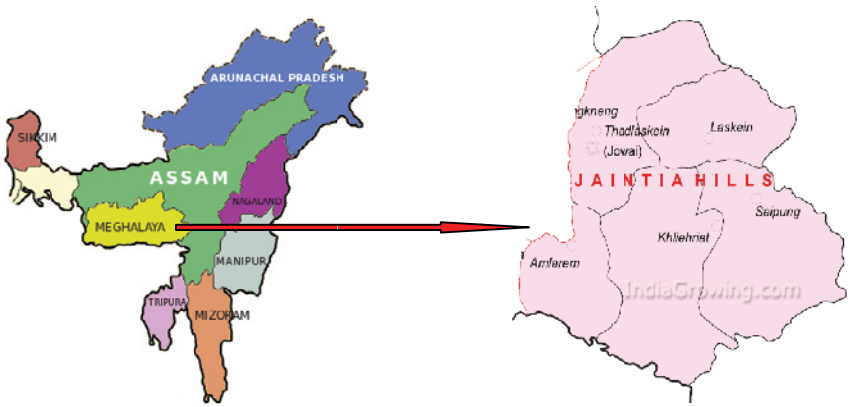

Figure 2: **Map Showing North-East India and Jaintia Hills.**

Figure 3: **Cutting of fire lines in Khliehriat, East Jaintia Hills.**

drop for cataract and night blindness. Recently, some herbalists used pitcher water as an eye-wash or in curing the inflamed skin.

Management practices

The management practices of pitcher plant adopted presently in Jaintia Hills is cutting of fire lines during the dry season, replanting in the month of May-June through Stump pit planting technique and fencing construction in some forest patches. Control burning is also carried out.

Causes for population decline

a. Forest fire

Forest fire is one of the major causes for destroying the forest growth and regeneration in the Jaintia Hills. The regeneration of pitcher plants and their habitat is greatly impacted due to rampant burning of forest in these areas.

b. Coal and limestone mining

The activity of coal mining and limestone mining is mostly seen as we move towards the East Jaintia Hills, particularly in the Khliehriat area. There is extensive and unscientific way of mining activities which leads to the pockets of coal-spoiled degraded forest, thus destroying surrounding vegetations which ultimately destroy the habitat of *Nepenthes khasiana.*

c. Deforestation

There is excessive felling of trees and removal of vegetation in unregulated forest areas, mostly community and village forests. For a favourable habitat, pitcher plant needs some other plant species as well to exist together. Large amount of trees are removed every year by the neighbouring villagers for their domestic uses.

d. Urban development

Development activities like construction of roads and buildings, establishment of industries, urbanisation, etc. have a great detrimental impact on the habitat of pitcher plant in these areas. These activities result in the removal of entire vegetation without much rehabilitation programme.

e. Overexploitation of N. khasiana

Most of the farmers collect the pitcher plants from the wild and are unaware of the population of the plant and its declining population. Therefore, they sometimes uproot or remove the

Figure 4: **Habitat destruction due to mining activities.**

whole plant, which is a faulty method of collection, thereby slowly removing the population. Uprooting of the whole plant for sale domestically is usually done by the community (seedlings collected from forests are sold in the market for Rs 20–30 per seedling).

Conservation strategies

- Mining of coal and limestone should be stopped. If allowed in private lands, it should be done in proper scientific ways so as to put less pressure on the forest areas where wild *N. khasiana* is growing.
- The Jaintias' villages committee and other panchayat committees should implement some common rules in collaboration with the Forest Department and NGOs for the protection and amelioration of the *N. khasiana* patches.
- The best method of conservation would be to protect the plant permanently in wild by creating public awareness and involving local people in the process of conservation.
- The government can allot demarcated forests areas to the villagers as village forest, thus motivating the Jaintias to take special care for its protection and rehabilitation thereof and for sustainable resources.
- The Forest Department should help the tribal communities in preserving ancient forest patches like Sacred Groves, so as to conserve pitcher plants existing there.
- Sustainable harvesting method for *Nepenthes khasiana* should be adopted and followed.

Acknowledgements

I would like to thank the Principal and Course Director, CASFOS, Dehradun for giving me support

and encouragements. My heartfelt thanks to the Department of Forest and Environment, Meghalaya for allowing me to carry out my case studies. In particular, I would like to thank the Jaintia Hills Forest Division for helping me and guiding me throughout my studies. The DFOs, ACFs, RFOs and staffs of Jaintia Hills Forest Division were a great help by guiding me and accompanying me to visit different places and giving necessary information. I also would like to thank the village elders of Khlieriat, Mukhaialong, Thangbuli, Umladkhur and Sohminting of Jowai district for cooperating, giving me information and suggestions.

MAWPHLANG / MEGHALAYA

Mawphlang Sacred Grove: A lesson to be learnt

The Sacred Grove at Mawphlang village is a biodiversity rich forest and has thrived due to the efforts of the local community

H.Moda

A Sacred Grove is any grove of trees which is of religious importance to a particular culture. IUCN treats Sacred Groves under the Sacred Natural Sites (SNS), which is defined as "natural areas of special spiritual significance to peoples and communities". They include natural areas recognised as sacred by indigenous and traditional people as well as natural areas recognised by institutionalised religions and faiths as places for worship and remembrance. Sacred forests may be seen as a traditional means of biodiversity conservation and natural resource management through self-imposed community fencing.

The sacred forest at Mawphlang village in East Khasi Hills district of Meghalaya, is about 25 km from the State capital, Shillong. It is at an altitude of 1842 metres MSL and well-connected by road. The maximum and minimum mean temperature here is 25°C and 5°C, respectively. With temperate climate and high annual rainfall of 2,200 mm, the forest is of sub-tropical wet hill evergreen type. The local community is mainly Khasi tribe and their main occupations are agriculture and trading. As it stands out stark in a low-lying area surrounded by sloping grassland, one can easily have an unobstructed view of the grove from the point of approach. Covering an area of around 75 ha, this natural forest stands quite in contrast to the surrounding area and even from the areas one drives through for reaching the grove.

Known throughout the world, this patch of pristine forests, about 500 years old, is well protected by the local community from a long time ago. Uniformly high density of trees with abundant humus cover is a testimony to the non-interference of human beings. Stones, tree trunks and branches may be seen covered with epiphytes like lichens, mosses and orchids, as an adaptation to low penetration of sunlight owing to the closed canopy. The periphery of the grove is marked with monoliths erected in memory of the departed souls. A narrow path leads into the most sacred site where rituals and sacrifices are made. Stone altars of different shapes and sizes are erected along the path and at the sacred site for

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different reasons. The local community believes in the presence of deity in the grove and their socio-cultural life is associated with this grove. Reverence for the deity and fear of punishment by him form the basis of social fencing. According to local beliefs, the forest deity resides in the forest as guardian and protector of the local people. The forest deity appears in the form of leopard (which is a good sign) or a snake (bad sign). They say that the deity protects them from natural calamities, diseases and enemies and also gives punishment to those breaking the rules by inflicting sickness and death. Within the grove area activities like cutting of trees and branches, plucking of leaves and flowers, hunting, immoral acts, using bad words and making nuisance are all forbidden. Products like fruits, nuts, medicines, honey, etc., can only be used while in the grove and may not be taken outside.

The Sacred Grove is controlled and managed by the Chief (*Lyngdoh*) of Hima Mawphlang (Council of constituent villages). The traditional village institution, Hima Mawphlang consists of the Chief (*Lyngdon*) assisted by Council of ministers (*Myntri*) and Council of *Hima* (formed by heads and adult representatives of constituent villages). As per the 'The United Khasi & Kaintia Hills Autonomous District (Management and Control of Forests) Act 1958', sacred groves are to be managed and controlled by the *Lyngdoh* in accordance with the customary practices and rules framed by the executive committee of the concerned Autonomous District Council. Controlling forest fires and grazing of cattle, prohibiting mining in nearby areas and regulating entry of visitors by levying entry fees, prohibiting vehicle entry, requiring prior permission from chief for entry and engaging guides are some of the activities carried out by the Hima Mawphlang. The Mawphlang Sacred Grove today remains well protected in its pristine form as a result of the efforts

of Hima Mawphlang in protecting the forest and strong social fencing.

As there is least human interference, generally Sacred Groves are rich in biodiversity and are home to endangered, rare and endemic animals, birds, trees and medicinal plants. They are also the habitat of many insects and act as seed bank for threatened species of plants, besides providing ecosystem services like water catchment, soil and moisture conservation, nutrient recycling, carbon sequestration, moderating harsh local climate, pollution control, protection from floods, socio-cultural linkage for local people and so on. Mawphlang Sacred Grove is one such biodiversity-rich forest with varieties of medicinal plants, orchids, mammals, birds, amphibians, reptiles, fishes and insects, some of which are rare and some endangered.

Mawphlang Sacred Grove is the most famous and well protected one in Meghalaya where human pressure is still very less. It exists intact today not just because of the control exercised by the Hima Mawphlang, but also because there is a cultural tie between the forest and the local community. Cultural change owing to adoption of other faiths, migration and modern education may dilute the beliefs on which the social fencing is based and may result in indifferent attitude towards the Sacred Grove. Keeping in view the human pressure in future, regulation and control measures has to be made stronger and stricter without compromising the participation of local people in management and control of the sacred forests and local community should be provided access to some form of incentive from the government.

Acknowledgement

My sincere gratitude to Mr W S Manner (IFS), DFO, Khasi Hills WL Division, Shillong; Mr Vijay Lyngdoh (ACF), Khasi Hills WL Division; Mr Tambor Lyngdoh (CCF and PD) Umaim-Mawphlang Welfare Society and Dr K S Jayachandran (IFS), CD, CASFOS, Dehradun.

JAINTIA HILLS / MEGHALAYA

The menace of illegal mining

There were and still are many challenges to total cessation the mining activity as there are many misconceptions and legal ambiguity exists due to Meghalaya being a Sixth Schedule State

S.L. Niangthianhoi

Mining and its environmental consequences is an issue which is not new to anyone. It is considered a "necessary evil" as it cannot be stopped even though we are all aware that we are mining minerals at the cost of the health of the ecosystem. Our natural environment, more often than not, bears the brunt of the ever-present tug-of-war between the need for economic stability and ecological health of the country. This article is based on a week-long visit (from December 3-9, 2015) to Jaintia Hills District of Meghalaya. The cases of mining in Meghalaya have been highlighted in various scientific papers and newspapers for many years now.

Extensive mining of coal have been done in the district for a long time. Jaintia Hills District has been a major producer of coal in the State. Coal mining has been done using a primitive method called 'rat-hole' mining. In this method, the land to be mined is cleared of all vegetation. Then pits of size ranging from 5 to 100 sq. m are dug vertically into the ground to reach the coal seam (Swer and Singh, 2004) leading to deforestation. The legality of these mines is a big question and challenge, as most of the mining activities in Meghalaya, especially in the Jaintia Hills District, are small-scale ventures controlled by individuals who own the land (Swer and Singh, 2004). Even communities with small landholdings with coal deposits started digging for coal without getting proper clearance from concerned departments. They do so without following any environmental and health safety measures. So, the illegal private mining in Meghalaya is in violation of the Forest Conservation Act, 1980, and the Environmental Protection Act, 1986, as no clearances have been applied for or granted (Medhi, 2010). About 4,03,690 metric tonnes of coal deposits are found in Jaintia Hills (only 7 per cent of the State), but 64 per cent production is from the district (Challam, Samrakshan). It is mined exclusively by people in the State and supplied in national and international market (Bangadesh).

Extensive limestone mining, on the other hand, began about a decade ago. Meghalaya has about 9 per cent of the country's total limestone deposit and

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An abandoned limestone mine in Jaintia Hills District. No policy or plan exists to reclaim or restore this scarred landscape.

Jaintia Hills District has the largest (Lamare and Singh, 2014). The increase in quantum of limestone mining has led to deforestation, degradation of land and pollution of water, causing severe socio-environmental problems. Limestone extraction was done through open cast mining and it disturbs or changes the landscape and vegetation in the area. Heavy machineries were used for extraction as well as transportation by road to many depots in the State, leading to different kinds of pollution. Limestone is considered a forest produce as per Section 2 (3) (a) (iv) of the Indian Forest Act, 1927. So, the Forest Department was collecting royalty and passes were issued in lieu of TP.

Many socio-environmental problems were reported as consequences to these extensive mining of coal and limestone in the district. Some of these include subsidence of land in areas where 'rat-hole' mining was prevalent. There were also records of loss of tree cover and subsequent drinking water scarcity due to removal of vegetation cover. On interacting with villagers, it was clear that they now have to buy or draw water for drinking from far off places where the water catchment areas have been protected traditionally as Sacred Groves or village forests. The water bodies, including streams and rivers in nearby areas, were reported to have high levels of pollution due to these

mining activities (Swer and Singh, 2004; Lamare and Singh, 2014). The coal mine itself is a health hazard in absence of approved safety measures. More than 70,000 children were also reported to be engaged in about 5,000 coal mines in the year 2001 alone (Challam Samrakshan).

Taking cognisance of all these issues, the National Green Tribunal (NGT) put a ban on coal mining on April 17, 2014. The tribunal directed the Chief Secretary, Government of Meghalaya, and the Director-General of Police, State of Meghalaya, to ensure that rat-hole mining/illegal mining is stopped forthwith throughout the State and any illegal transport of coal shall not take place until further orders passed by the Tribunal. As there were still reports of the activities still continuing, the NGT then passed a blanket ban on mining and transportation of coal on May 9, 2014. Subsequently, the Meghalaya High Court put a ban on limestone mining, which came into effect from June 30, 2015.

There were and still are many challenges to total cessation the activity as there are many misconceptions and legal ambiguity exists due to Meghalaya being a Sixth Schedule State. Coal mining on a small scale is also considered a customary practice as it was introduced during the British period (Challam, Sarakshan). The mining mafia is still strong and threatens the smooth functioning of concerned departments as evident from the fact that we had to travel with armed guards while passing through mined areas. As most of these mines were illegal, no plan exists for restoration of these mined out areas or the overburdens. Insufficient staffing in the Forest Department is also a common problem in India that restricts the monitoring activity that could have reduced the illegal mining. Moreover, the Meghalaya Mines and Minerals Policy was formulated only on November 5, 2012, which means that all mines were not bound by any stringent mining rules or policy.

Having listed the challenges in the field my objective is in trying to figure out the role of the Forest Department in reducing and controlling such mining activities. Sometimes in cases like this our priority as a Department is compromised by either indifference or societal pressure, which prevents us from taking note of an issue or prevent us from taking timely action. When this happens, NGOs come into play. So, as a Department entrusted with the natural heritage of the country, it is important that we maintain a good relation with these organisations and the people. It is also important that forest officers keep themselves updated about the issues in their territories and the forestry sector so that we can at least maintain the forest area if not increase it. We need to document any factor that has the potential to threaten the natural wealth of our country. One way to do it is to write to journals and publish articles in local dailies.

The involvement of the Department had been minimal in case of Jaintia Hills District, but such activities are in violation of our forest laws

as already mentioned. According to the Godavarman Case 1996, these areas will come under the forest area irrespective of the ownership and certain forest laws will apply. So, the way forward is to recognise and understand that all these activities affect the forests – provisioning and regulating ecosystem services of the forest. This means that we need to be vigilant and proactive with regular monitoring of our territories. We also need to know our laws and legal powers so that we can nip potential disasters in the bud.

Acknowledgements

I am extremely thankful to Ms Meera Iyer, IFS, Principal CASFoS, Dehradun, and to Dr K S Jayachandran, IFS, Course Director, for giving me an opportunity for this case study. I am also very grateful to Ms H Lato, DFO (WL) Jaintia Hills Forest Division, Dr George H Chyrmang, ACF (Protection), Jaintia Hills Forest Division, and their staff for their cooperation, guidance and assistance during this study. This study would not be possible without their help. I also thank my colleagues Romabai, Jeeceelee and John for being helpful and wonderful teammates.

MAJULI / ASSAM

Erosion in Majuli Island: Role of Forest Department in mitigation

The Forest Department has taken a number of steps to check the incidence of surface erosion in this riverine island

Laishram Gitla

Majuli is a river island in Brahmaputra. It is the seat of Assam's Vaishnavite culture and a symbol of Assamese identity. Situated in the midstream of Brahmaputra river, the island is a unique fluvial landform. It was formed as a result of the dynamic river system i.e the southward journey of Brahmaputra. It is about 80 km long, 10-15 km wide along the north-south direction and at an elevation of 85-90 m above the mean sea level. Once a 1,226 sq. km island, Majuli has reduced to a mere 523.88 sq. km in a little under 30 years due to massive erosion by the Brahmaputra. It is bound by River Brahmaputra in the South and River Subansiri in the north-west and the Kherkutia Suti in the North East. The tributaries of these rivers cause flash floods with deposition of high amount of silt and clay. As a result of the braiding river, islets locally known as '*Chaporis*' (islets) are formed around the island.

Ferry service in the Brahmaputra is the only mode of transportation to the island. Most widely used routes are Nematighat-Kamalabari and Dakhinapat-Nematighat. The island is an administrative sub-division under the Jorhat District. The island has rich cultural heritage with 70 per cent of its population belonging to tribal communities such as Mishing, Deori, Kachari and Koch Rajbongshi. It has a population of 1.68 lakh as per 2011census.

Problem statement

The main reason for which Majuli has become the centre of attraction is flood and bank erosion. Furthermore, another problem which the island faces is surface erosion. In this article, only surface erosion will be dealt with since it is in the area where the Forest Department could intervene and do something.

Circumstances which lead to the problem

The main factors contributing to surface erosion are:

1. The continuously changing land use/ land cover (LULC) of the area
2. Reduction in area previously covered by vegetation

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Table 1: Effect of 'Change in vegetated area' on erosion (Burman *et al*., 2013)

Class	Area in 1975 (sq. km)	% of total area	Area in 1998 (sq. km)	% of total area	Area in 2008 (sq. km)	% of total area
Vegetation (Grassland+ Plantation)	237.69	33.67	151.16	26.13	86.21	17.8
Annual soil loss (Kg/sq. m)	7.53		7.65		8.39	

3. Heavy rainfall in the area (average annual rainfall: 2,818 mm)

Due to surface soil erosion, cultivable lands are degraded which, in turn, affect sustainability of regional development. Barman *et al*., 2013, while analysing the LULC changes from 1975 to 2008, observed that there was significant decrease in the area covered by grass in the island. Furthermore, an increase in the area covered by human settlement was also observed. They attributed the growth in population as one of the major factors for the decrease in grassland and plantation area in that span of 33 years.

The study found that change in vegetation alone leads to an average soil erosion of 7.53 kg/sq. m, 7.65 kg/sq. m and 8.39 kg/sq. m in 1975, 1998 and 2008, respectively. Though the main concern for Majuli island is the bank erosion by rivers Subhansiri and Brahmaputra on its north and south sides, respectively, surface soil erosion should also be taken as a serious hazard as these cultivable lands can lead to the agricultural and economic development of the local people.

Role of Brahmaputra Board

Due to the public outcry in the 1990s, the Brahmaputra Board, an autonomous statutory body set up under an Act of Parliament in 1980, was assigned the responsibility of protecting Majuli from flood and erosion. It is reported that in the year 2004, total area of landmass of Majuli island (assessed as per satellite imagery) was 502.21 sq. km, but it increased to 523.88 sq. km in February, 2014, with regular implementation of anti-erosion/bank protection measures by the Board (*Source: Ministry of Water Resources and Planning Commission*). However, not many are satisfied with the Board.

Role of Forest Department

According to the Office of the Divisional Forest Officer, Jorhat Division, during 2004-05, a 200 ha Compensatory Afforestation was raised at the eastern side of the island, at Salmora Grazing Chapori. The site was chosen in the interest of the local people of Salmora Grazing Village, Bongaon, Meragarh, Kolonibari and also different organisations including NGOs and student community. Plant species, such as *Bombax ceiba, Gmelina arborea,*

Lagerstroemia spp., Morus laevigata, Albizia lucida, Dalbergia sissoo, Dillenia indica, were used for the plantation. Since it is a non-forest land, proposal for mutation of non-forest land to Reserved Forest has been initiated and is under correspondence since September 27, 2013. At present, the plantation has not only uplifted the environment, but also brought permanency to the pioneer soil of Majuli island. It has also checked the *chapori* from erosion. The plantation is now home to various species of birds, including migratory birds, which will make it a paradise for bird watchers. Wild elephants, stray rhinos and other animals, which come out of Kaziranga National Park in search of food, also take shelter in this plantation for maximum time.

In 2011, the department also started a plantation of trees that are favourite of elephants on a plot of 10 ha at Kartik *chapori,* in the southwest of the island. The plantation consists of bamboo, banana, jackfruit and other trees whose fruits elephants love. The main reason for selecting this site is that the area is frequented by the herd of elephants which is a manace for the people residing there. Once the plantation grows and develops into a tiny forest, the elephants can feed and stay there, thereby reducing the depredation of agricultural crops.

However, massive erosion is still witnessed at Bonoria Chapori and Kumalia Chapori, which are adjoining areas to the 200 ha plantation forest. If erosion is not checked by the departments concerned and agencies at the *chaporis*, then it will be not only a case of losing land mass, but a waste of an effort initiated by the forest department for setting up a full-fledged reserve forest on the island.

Choices offered for mitigation of the problem

Plantation is one of the solutions to the problem. Secondly, management of human-elephant conflict is a must. The local people of Majuli do not want a forest because they strongly believe that forest gives refuge to the elephants and these jumbos raid their agricultural fields, causing largescale destruction of paddy, vegetables and fruits. Without the cooperation of the local people, a successful plantation is a big challenge. Therefore, man-elephant conflict mitigation should be a priority. With very less number of staff and infrastructure, the Forest Department in Majuli is having a tough time in tackling depredation by the herd of elephants. The Department has also constructed a solar fence at Dhanoi Sapori to minimise elephant depredation on the island. Unlike electric fencing, there is no chance of electrocution if they come in contact with the solar fence. Solar fencing keeps the intruders away by giving a short but safe shock. Unhappy with the damage of their crops by the herd, the villagers still blame the Forest Department despite the efforts made by the forest staff to chase the herd away each day, from dusk till dawn.

One of the most sustainable solutions, therefore, is in developing strategies which take into account empowering the local community to take responsibility for the problem. A community-centred

approach will help in improving the attitudes of communities towards the elephants and the Forest Department as well. To develop and direct effective community-led mitigation strategies, it is vital to make the local people aware about the potential of long-term conservation strategies, such as habitat protection and plantation.

At the same time, sustainable ecotourism activities, which will generate income for the local people, could also be introduced. Some of the proposed activities are:

- Eco resorts/ huts built in local indigenous style using locally available materials for tourists
- Ethnic and local cuisines served at the eateries/resorts /huts
- With the cooperation of the local community, creation of artificial water holes/food points for better bird sighting/bird watching by tourists
- Creation of medicinal gardens to showcase the rich traditional healthcare system of the Mishing Tribe
- Promotion of local handicrafts. Training facilities could be given to the local people in handicraft. This could be done based on the need and capacity of people and after assessing the marketability of the products
- Arrangements of nature camps/ programmes for school children

All these activities should be led by a Society, formed with the participation of local villagers. The Tourism Department and Forest Department could also guide the Society in initiating Self Help Groups, wherein unemployed youth could provide services as nature guides, sell handicraft items and earn their living. These groups can be organised at the village level by collaborating with the panchayats and local NGOs. Also, local people should be made aware about the ecological and economic benefits of conservation of rare and endangered species of ecologically and economically important plant and animal species.

Acknowledgement

I would like to thank Mr MP Singh, IFS, Director, Directorate of Forest Education, Ms Meera Iyer, IFS and Principal CASFOS, Dehradun and Dr KS Jayachandran, IFS, tour-in-charge and faculty CASFOS, for giving the opportunity for this case study. I would also like to thank the Assam Forest Department, specially Mr Swapan Saikia, DFO, Mr JI Borua, ACF, Mr Atul Das, BO, Mr Dutta and Mr Simata Gogoi of the Jorhat Forest Division for providing all necessary help and support during the case study tour.

WILDLIFE / NAGALAND

Development vs Sanctuary

A railway line passing through the Hollongapar Gibbon Wildlife Sanctuary is creating an artificial barrier for the primate population

Elangbam Nirmala Chanu

Once roaming an uninterrupted continuous forest tract extending up to Nagaland, the Western Hoolock Gibbon is now restricted to the Hollongapar Gibbon Wildlife Sanctuary, which has an area of 20.98 sq. km. But the major problem in the sanctuary is the railway line passing inside it which is separating its last little population in-situ by creating an artificial barrier.

The Hollongapar Gibbon Wildlife Sanctuary, near Jorhat in Assam, is a home to India's only primate Hoolock Gibbon (*Hoolock hoolock*) and six other primate species. These are Assamese macaque (*Macaca assamensis*), Pig-Tailed macaque (*Macaca menestrima*), Rhesus macaque (*Macaca mullata*), Stump Tailed macaque (*Macaca speciosa*), Capped langur (*Presbytis pileatus*) and the nocturnal species Bengal Slow Loris (*Nycticebus coucana*). It has the highest density of primates in the country. The biodiversity of flora and fauna in the sanctuary is exceptional considering its size. It has a forest type of Assam Alluvial Plain Semi-Evergreen Forest and some patches of Evergreen Forest having three different strata of forest. It is also known as haven for butterflies with as many as 172 species found in the area.

The high diversity of flora helps in providing food year round for the wildlife. Thus, resulting in increasing population of all the seven primates and other faunal species, but the area remains the same. The sanctuary also supports around 40 elephants, much beyond its carrying capacity, and the elephants migrate to various places which also lead to human-animal conflict. Thus, the very sustainability of the sanctuary is in question. Surrounded by tea gardens and villages on all sides, it has also created a sharp edge effect which is very detrimental for the wildlife.

Hollongapar Gibbon Wildlife Sanctuary is the only Sanctuary named after a primate, i.e Hoolock Gibbon (Hoolock hoolock), in the country. The Hoolock Gibbon is included in Schedule-I as per India Wildlife Act 1972; has High priority rating in "Priorities of Asian Primate Conservation"; and is in Appendix-I as per Endangered Species Act under CITES (1973).

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The North Eastern Railway Frontier has constructed a railway line passing through the elephant corridor at stretch of 1.5 km inside the sanctuary. This stretch of track has become the grave of many animals starting from small reptiles to large mammals like elephants. Over 14 elephants had died by collision as of April 20, 2014. But one of the worst effects of the construction of the railway line is the artificial barrier thus created for the population of Hoolock Gibbons between Compartment 1 and 2 of the Sanctuary.

The Hoolock Gibbon is an arboreal animal which stays all its life in the tree canopy. They require an uninterrupted canopy for movement. The animal obtains all its requirements from the top canopy of trees and prefers to stay in species like Bon Aam (*Mangifera sylvatica*), Kadam (*Anthocephalus chinensis*), Sam Kothal (*Artocarpus sphaericus*), Hollong (*Dipterocarpus macrocarpus*), etc. In the isolated Compartment 1, there live two families of Hoolock Gibbons and they have been separated from the rest of the group for more than two decades now. The species has high social bondage and a low reproductive turnover, which further increases the threat. Chances of inbreeding and spread of diseases is very high in this Compartment which may lead to complete loss of species in it. Already the species is endangered and if these few numbers are lost, it will be a loss for the nation.

Recently, a steel canopy bridge was constructed connecting Compartment 1 and 2 to allow movement of arboreal animals but it does not serve the purpose. The structure is a completely artificial and has no natural touch is given to it. The Hoolock Gibbon is a shy species, but smart species next only to the chimpanzee in intelligence. In order to make the steel canopy serve its purpose, some naturalist should be consulted to add natural components like linnas, creepers, etc, and at least three such canopy bridges should be constructed.

Due to the railway line, the nearby villagers have easy access inside the sanctuary. Since the sanctuary is surrounded by villages and tea estates, there is high pressure for illegal firewood collection. Earlier, the

List of Schedule-I Wildlife found in Hollongapar Gibbon Wildlife Sanctuary

- Hoolock Gibbon *(Hoolock hoolock)*
- Capped Langur *(Presbytis pileatus)*
- Slow Loris *(Nycticebus coucang)*
- Asiatic Elephant *(Elephus maximus)*
- Leopard *(Panthera pardus)*
- Tiger *(Panthera tigris)*
- Pangolin *(Manis crassicaudata)*
- Indian Python *(Genus python)*
- Common Monitor Lizard *(Varanus grisus)*
- Indian Tent Turtle *(Kachuga tecta tecta)*
- Hornbill *(Ptilolaemus tickali austeni)*
- Indian Pied Hornbill *(Anthracoceros malabaricus)*
- Osprey *(Pandion haliatetus)*
- Hill Myna *(Gracula religiosa indica)*
- Kalij Pheasant *(Lophrus leucomala)*

villagers usually collected the dried branches lying near the railway tract but with growing population, they are now entering inside. They cut or debark saplings or pole stage trees and let it dry for few days. After that they come again and collect it. The Forest Department is trying their best to check this illegal firewood collection but due to less staff and other departmental work, they are not able to monitor the situation on a 24x7 basis. If this practice is not controlled, it will result in reducing regeneration in the already fragile habitat.

The ease access along the railway track also facilitates poachers and hunters. Many youngsters also enter the forest. The possibility of forest fire can also result if fires are lit purposely or accidentally. The resultant damage will be irreplaceable. And the sad part is our Forest Department staff is poorly equipped and very less in number. Not only does more staff need to deployed, the existing ground staff can be made more efficient with training and providing them with all the required equipment.

Accident and mortality of wildlife is another undesired result of the railway line passing inside the sanctuary. The traffic in the region is very high throughout day and even during the night. Almost every 30 minutes, a train passes at full speed. The Railway Authority claims that they move at the speed of 50 km/hour compared to the 100 km/hour in normal condition. The Forest Department has requested the Railway Authority to reduce speed to 20 km/hour but they are not accepting, saying it will hamper timing and traffic of trains. Many elephants, snakes, langurs, and many other small fauna have died unnoticed on this railway track.

In order to mitigate all the problems, here are some suggestions. First and best option is realignment of the railway track in a new route without passing inside the Sanctuary, and regenerating the track area making it a continuous canopy. Further, LPG connections or bio-gas plan for locals must be provided for reducing pressure for firewood, which in turn will help in improving regeneration in the forest close to the tract. The Rain Forest Research Institute and NGOs like the Gibbon Conservation Center are trying their best in improving livelihoods and creating awareness among the local people. Local communities should join in the conservation work.

Humans have already exploited 95.1 per cent of the total geographical area. Should we destroy the remaining 4.9 per cent designated as Protected Areas in the name of development and time management. Won't it be an injustice to the wildlife living there? There will be soon be a time when our children will be reading about an ape that used to be found in India, named Hoolock Gibbon.

Railway line passing inside the Hollongapar Gibbon Wildlife Sanctuary.

Signage indicates that the track passes through the elephant corridor

Firewood collection by the locals

Male and Female Western Hoolock Gibbon

Canopy bridge between Compartment 1 and 2

Wildlife deaths due to railway track (Photo Courtesy: Narayan Sharma)

NAMERI / ASSAM

Maniram Gogoi, birder par excellence

A self-made man, Gogoi not only can identify birds in the forest but also recognises their calls, a gift in the thick semi-evergreen forest of Nameri

Bikram Singh Rongpi

ON December 2, 2015, I reached Nameri National Park and Tiger Reserve (NNP &TR), spread over 344 sq km in the northern part of Sonitpur district of Assam.

The Ranger of the Park, Mr Dilip Kumar Das, came to our lodging resort the next day with a gentleman, whom he introduced as Mr Maniram Gogoi, the trekking guide of NNP&TR. At 5 am on December 4, our guide, Mr Gogoi, who was in his late 30s and around 5.3 feet tall, was waiting for us in his *khaki* dress, equipped with a binocular and a double-barrel gun. "Good Morning sir!" he said, "Let's leave early to catch the sight of birds." We followed him to the bank of River Jia-Bharoli and got on to a boat..

He was adept with the boat, swiftly manoeuvering it even as he kept his sight trained on birds. He named each and every bird not only in its regional name but also informed about the bird's common English name, though his command on English was minimal.

At 6 am we were on the other side of the river and Gogoi told us briefly about the scope of tourism in NNP&TR. During the course of our trek, which lasted for about five hours, he told us about himself. He was enrolled as a Muster Role from 1991 to 1998 at the Western Assam Wildlife Division,

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(left) **Biswajyoti Das,** (centre) **Maniram Gogoi,** (right) **Bikram Singh Rongpi at NNP&TR.**

Gogoi holding the monthly magazine *Hornbill* (left). and a certificate from the Ministry of Tourism, Government of India, for attending the programme for "Tourism Service Providers" (right).

Tezpur, Dulabari. His salary then was only Rs 700 a month. His duties involved cutting the grass, patrolling on elephant back and patrolling at night on foot. Son of Poduram Gogoi and Pomilli Gogoi, he had studied till Class VIII. He was married to Bobi Gogoi, of Doigrung, Golaghat.

He was extremely good as a birder. Not only did he identify all the birds that we saw, but also could identify their calls, an enormous skill in a thick broad-leaf semi-evergreen forest where birds are more often heard than seen. Due to his years of experience in bird watching, he knew on which tree a specific bird species will be found and at what time such birds can be seen in a specific locality. He was also well-versed in differentiating the male and female of many bird species along with their food habits and breeding period.

He started watching birds as a hobby in 2004-2005, when he was assigned the job of a trekking guide for domestic and foreign tourists. Initially, he learned bird identification from some professional bird-watching tourists and

Maniram Gogoi (left), Biswajyoti Das (right)

with the help of his colleagues and local people. Later, for better reference, he purchased the book, *Birds of the Indian Subcontinent*.

To cater to the demands of the tourists at NNP&TR, he attended the training programme for "Tourism Service Providers" on February 21, 2009, conducted under the scheme of Capacity Building for Service Providers, organised by the Government of India, Regional Office (North East), at Nameri.

Gogoi with the 'Certificate of Meritorious Service' from the Wildlife Areas Development and Welfare Trust, Assam

Since then, there has been no looking back in his career. In 2014-2015, he was the main bird-watch guide for 1,035 foreign tourists and 8,448 domestic tourists at NNP&TR. His duties during the anti-poaching operations too got recognition as he and his colleagues confiscated two local-made guns from poachers in 2008 and six such guns in 2010. He, though, for the last 16 years has been working on a monthly salary of Rs 7,000. And, it was only in 2014, that he was issued a pair of binoculars for birdwatching.

Acknowledgement

I would like to give my heartiest thanks to Mr Maniram Gogoi, for his hospitality and cooperation to complete the case study in a short span of time. I would also like to thank Mr Rajendra Garawad, DFO, for his support. My sincere thanks to Mr Dilip Kumar Das for giving us first-hand information about the park.

KHASI HILLS / MEGHALAYA

Community based REDD+ project

The project will protect and restore 27,000 ha of cloud forest, by deploying strategies for both forest protection and restoration

Abbas Ali Dewan

A REDD+ (Reducing Emissions from Deforestation and Forest Degradation) project was started in the East Khasi Hills district of Meghalaya in northeast India in 2005. The project has been validated and certified under Plan Vivo standards (Plan Vivo is a certification and development framework for community-led, land use projects and programmes). The Khasi Hills Community REDD+ Project is India's first community-based REDD+ project and will protect and restore 27,000 ha of cloud forest. It deploys strategies for both forest protection and restoration (Assisted Natural Regeneration, or 'ANR'). It engages 10 indigenous Khasi governments (*Hima*) with 62 villages. It is run by Community Forestry International (CFI) with a Mawphlang tribal community /Mawphlang Welfare Society (Federation) and covers an area of 8,379 hectares.

The Khasi Hills of Meghalaya comprise of small tribal administrative units known as *Hima*. Most of the forests in the project area are under the stewardship of one of the 10 *Hima* and are managed by *Hima Dorbar*, an indigenous council represented by all male adults of every constituent village. Less than 5 per cent of the forests are owned by individuals. The 10 *Hima* approximately covers 62 villages and small hamlets. Community Forestry International, CFI supported the 10 *Hima* in the project area to form a federation to manage the project. The federation is registered under the Meghalaya Societies Registration Act as "Ka Synjuk Ki Hima Arliang Wah Umiam, Mawphlang Welfare Society" of Meghalaya. The area under project management covers 15,217 hectares comprised of approximately 9,270 hectares of dense forests and 5,947 hectares of open forests. Forest area in the project area (60-70 per cent forested) belongs to the community and the community has established ownership rights over the forest.

The REDD+ project aims to preserve sacred groves and other forest areas including the watershed, to re-plant surrounding land and to slow, halt and reverse the loss of community forests by providing support, new technologies and financial incentives to conserve existing forests and regenerate degraded forests and also improve economic condition of local households with priority for lowest-income forest

SFS 2015-17 Batch, CASFOS, Dehradun

families**.** The project intervention area is a global biodiversity hotspot and offers protection and habitat to many endangered plant and animal species.

The primary objective of the project is to deliver long-term strategies to address extreme poverty facing rural families and to establish microfinance institutions run by women. Local Working Committees open accounts (with contributions of Rs. 1000), set up Animal Husbandry Projects (piggery and poultry), provide technical support and develop Eco-Tourism Development Plans with community stakeholders.

Local institutional development is a key part of the project strategy to protect, regenerate and extend these forests. Villages within each *Hima* are clustered into working units, each with an elected committee to organise and oversee activities. The project supports watershed restoration activities including fire control and assisted natural regeneration of forests as well as the protection of riparian habitat. In addition to the project's fire and fuel wood strategies, communities are being encouraged to phase out uncontrolled cattle and goat grazing in favour of more productive and stall-fed pigs. The federation is working with state agencies and mining owners to minimise quarrying and mining by negotiating site closures, building community awareness and sensitisation, and providing training for alternative employment.

Fire control: Activities carried out under this includes cutting of fire lines, awareness on fireand assigning watchers during the dry season. Other activities include establishment of fuel wood plantations using native species and training on manufacturing and installation of smokeless, fuel efficient stoves.

Livelihoods: Women's Micro-Finance Groups (SHG's) receive training, the local Working Committees open accounts and assist families to shift from grazing low value cattle and goats to higher value stall fed pig and poultry raising systems) under the Animal Exchange Program.

Sustainable Farming Systems Program: Under this, training and small seed grants are provided to self-help groups. Other activities include development and promotion of ecotourism plans, Non-timber Forest Products (NTFP) development plan and their implementation through self-help groups. Fuel efficient stoves are provided to households and Government agencies provide assistance by stopping illegal charcoal trade. Improved forestry–forest restoration and conservation–provides employment opportunities as do agricultural and animal husbandry enterprises.

The focus is on building community institutions including the local working committee as an operational Natural Resource Management (NRM) unit and forming Self-Help Groups (SHGs) to foster entrepreneurial activities. Assistance is provided in establishing banking accounts with local banks and in operationalising women administered micro-finance institutions. Jobs will be provided through construction of 50 km of fire lines and 500 hectares of forest restoration activities each

year**.** Commercial animal husbandry enterprises will be initiated by exchanging low quality community cattle and goats for stall-fed pigs and chickens and development of sustainable organic farming and horticultural systems. Another initiative will be the establishment of payment for ecosystem services (PES) contracts, including carbon sales.

The project is engaged in manufacturing and installing fuel-efficient cook stoves and plans to subsidise the majority of the 5,000 households in the project area. As a result of this activity, fuel wood consumption and indoor smoke pollution will be reduced improving forest and family health.The project has prepared village NRM maps and boundary maps of the project area. Nearly 20 km of fire lines have been constructed in areas susceptible to forest fires. Four quarries have been identified for closure and negotiations held with owners, labour and the state government.Twenty nurseries have been established and training provided in indigenous woodlot management. Under social fencing and enrichment planting, 500 ha has been set aside; to reduce fuel wood collection fast-growing woodlots are being established.

The project focuses on reducing the number and severity of forest fires by establishing fire lines which are maintained and monitored during the fire season by local communities, reduce surface mines, check erosion and fuel wood collection near villages to cover the demand for firewood. The project also seeks to improve forest connectivity in order to establish wildlife corridors by regenerating and linking degraded open forest lands.

Of the total carbon credits projected, approximately 69 per cent would be from deforestation and forest degradation which has been prevented, while an additional 31 per cent would be generated through sequestration as degraded forests are restored through assisted natural regeneration. Additional carbon credits may be created through the fuel efficient stove programmes and other initiatives.

Community conservation activities focus on protecting and expanding existing habitat of endemic and endangered orchids and other epiphytes, and amphibians. Sacred groves and community old growth forests cover 9,270 hectares while degraded forest restoration will connect an additional 5,947 hectares creating wildlife corridors and buffering the refuge of the core area. Community-based monitoring of biodiversity will include inventorying endemic and red listed amphibians, orchids, mammals, and birds.

Acknowledgement

I would like to extend heartful gratitude to Mr. WS Manner, IFS, DFO, Khasi Hills WLDivision and special thanks to Mr. Vijay Lyndoh, ACF, Khasi Hills WLDivision for his guidance, inspiration and effort. Mr. Tambor Lyndoh, CCF cum PD, Umium-Mawphlang Welfare Society, for their valuable inputs. I am also extremely grateful to Dr. KS Jayachandran, IFS Faculty cum tour in-charge, for all his guidance, great support, inspiration and motivation.

NORTH BENGAL

Successful mitigation of rail-elephant conflict

Since 2013, several steps taken by the Forest Department, Railways and local people have resulted in a major decrease in elephant deaths

Preeti Buragohain

India is home to the largest number of wild Asian elephants (*Elephas maximus*). The population is estimated to be about 26,000-28,000, or nearly 60 per cent of the total population of the species. The Asian elephant is listed as "endangered" on the International Union for Conservation of Nature (IUCN) Red List while it is a Schedule I animal under Part I of Indian Wildlife Protection Act (1972). Currently, its distribution in India is confined to the forested hilly tracts of four different regions: the foothills of Himalayas in the north; the north-eastern states; the forests of east-central India; and, the forested hilly tracts of Western and Eastern Ghats in southern India.

The development of railways and roads have negatively impacted wildlife populations by fragmenting and degrading their habitat, increasing human access to their habitat and exploitation of species, increasing edge effects, causing loss of ecological corridors for species, impeding animal movements and increasing mortality due to collisions. Dozens of elephants have died in recent years after being struck while crossing railroad tracks that run through India's National Parks and forests. In fact, wild elephants are perhaps one of the most heavily affected wildlife by these linear infrastructures. Recognising the adverse impacts of development and its importance in Indian culture and mythology, economy, etc, Project Elephant was launched in February 1992 to assist the States having free-ranging populations of wild elephants to ensure long-term survival of identified viable populations of elephants in their natural habitats. The Project is being implemented in many States, including West Bengal.

Indian roads and railways often pass through sensitive ecological areas, such as Protected Areas (PAs) and wetlands, and the Siliguri-Alipurduar broad gauge railway in North Bengal is a big concern. This line has a total length of 168 km of which 74 km passes through several Wildlife Sanctuaries and National Parks and Reserve Forests. Predominant among these are: Jaldapara National Park; Chapramari Wildlife Sanctuary; Gorumara National

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Park; Mahananda Wildlife Sanctuary; and, Buxa Tiger Reserve. The entire area forms Eastern Duars Elephant Reserve and the line traverses through several elephant crossing zones; it can be said that the total length of this is an elephant corridor. This railway line is commonly known as the killer line and had already killed 77 elephants from 1974 to 2013, among which one-third (27) were killed prior to conversion of line from metre-gauge to broad gauge in 2004, while two-third (50) died after the conversion.

Causes of train elephant collisions

Most casualties occurred during the winter and monsoon seasons, which are the harvesting seasons of paddy (late October–January) and maize (early May–July). Subsequently, crop raiding by elephants is higher in these seasons. Comparatively fewer incidences were reported during summer season. Again, elephants usually move over large distances for water and food on regular basis and habitat fragmentation comes in their way. It has resulted in increased human–elephant interactions leading to conflict from crop-raiding, property loss, and human injury or death. Also, very little spacing has been left between the wildlife habitat territory and the said railway line.

The Indian railways have often failed to run on scheduled time. In addition to this, frequency of train services have increased manifold in recent times. Irregular timing, coupled with increased frequency of the running trains, especially after the gauge conversion, is also one of the reasons behind these collisions. Before gauge conversion, the trains used to run with regulated limited speed. The speeds are now so high that many a times elephants dash against the trains while crossing the track.

In some stretches, on either side of the railway line, the embankments are found to be very steep, which reduces visibility of approaching animals. It also occurs at turns and tunnels. Headlights of trains impart poor visibility on the sides. Again, light from headlamps of vehicles next to the lines hinders visibility in some stretches at night and visibility is usually reduced when there is foggy weather and heavy rainfall, a common feature in this region. On the other hand, lower visibility during heavy rains and inundation of areas during the monsoon forces the elephants to move out of their habitat in search of safer areas and this results in higher casualties during this season.

Mitigation approaches

Certain initiatives have been taken up by the Government to mitigate potential wildlife collisions in these areas, particularly that of the elephants. According to a draft by National Wildlife Action Plan (NWAP) under the Ministry of Environment and Forests (MOEF), Government of India, the Ministry of Surface Transport and Ministry of Railways is required to bypass all Protected Areas and animal corridors while constructing roads and railways. Coordination meeting between Forest and Railway officials worked out certain steps, such as

immediate stoppage of all night trains, including unscheduled goods trains and express trains, immediate restriction on speed limit to 25 km/hr, following alternate track, etc. Yet, railway projects such as these continue to be proposed in ecosystems containing wildlife.

The forest department has always been the forerunner for such noble causes. Some of the significant mitigation activities taken up in the area include habitat management, like plantation of fodder grasses, bamboo, fruit trees and miscellaneous trees, cut back and controlled burning, canopy opening and over-wood removal, weed eradication, creation and maintenance of water bodies and salt licks and creation and maintenance of fire lines. Other measures include construction of engineering structures, like watch towers and underpasses and cleaning of bushes and undergrowth on both sides of the railway track (30 metres). The most effective step taken is the deployment of forest personnel at the Railway Control Room of the District Railway Manager's Office at Alipurduar in two shifts (from 5 pm to 9pm and from 9 pm to 6 am). After getting any information of movement of elephants towards the railway track, they immediately transfer the same to the engine drivers. Elephant squads, or elephant trackers, are established with cooperation of eco-development committees, as well as villagers residing nearby. They inform the forest personnel in the Railway Control Room. Sensitisation programmes are also organised on a regular basis for the engine drivers and co-drivers for their active participation in mitigating this highly sensitive issue.

Challenges

In spite of all these initiatives, the Forest Department has to encounter many challenges. While conservators of forest and wildlife are more concerned with the safety and protection of the wildlife, the railway officials are concerned with efficiency, speed and movement of trains on scheduled time. As such, speed limit is hardly restricted to 25 km/hr during night, as per reports of forest officials. This sometimes results in misunderstandings with the Railways. Another crucial challenge for the forest department is the crunch of sufficient funds and untimely release of the otherwise meagre fund. This leads to delay in timely implementation of many projects. Other challenges are lack of mitigation measures, such as a warning system absence of people patrolling to keep elephants off the railway line, fragmented forests and splinter groups and lone elephants, etc. Interestingly, the headlight beams of trains and loud honking agitates the elephants, causing them to charge at the trains instead of moving away from the line.

Conclusion

Continuous dialogue and coordination between the forest and railway departments, as well as local communities, timely information by forest patrolling staff or villagers living close to the track if elephant movements are around the railway line, construction of underpasses or elevation of lines in

risk zones, etc., have resulted in overall reduction in the numbers of conflicting incidences since 2013. On November 22, 2015, one death due to collision took place but the collision was because of chasing of elephant by the local people as the elephant was raiding their paddy field. The fair reduction in collision indicates that the forest department has been successful to a large extent in their efforts.

ORANG NATIONAL PARK / ASSAM

A Positive Leap for the Rhino

Intro Intro

Rajib Hazarika

The Great Indian One-Horned Rhino (*Rhinoceros unicornis*) was once found across the entire northern part of the Indian sub-continent from Pakistan to the India-Myanmar border, including parts of Nepal and Bhutan. Rhino populations were severely depleted as they were hunted for sport and killed as agricultural pests. This pushed the species very close to extinction in the early 20th century and by 1975, there were only 600 individuals surviving in the wild. As a result, the Indian one-horned rhino has been placed in Appendix I since 1975 by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Similarly, the International Union for Conservation of Nature (IUCN) in their revised categories and criteria, approved by the 40th meeting has rated the one-horned rhino as "vulnerable". The factors responsible for the shrinkage of population are overexploitation through poaching for rhino horn and other products and loss of habitat due to expanding and developing human populations.

In the field of conservation of the Great Indian One-Horned Rhino, Assam occupies a special place. Of the total estimated world population of the animal in the wild of around 3,000, Assam conserves an estimated 2,505, according to the census carried out in 2012 by the Government of Assam–about 83.5 per cent of the total population. The conservation movement in Assam started protecting rhinos at the beginning of the 20th century with the daeclaration of Kaziranga as Proposed Reserve Forest, on June 1, 1905 by the notification of the Chief Commissioner. Despite a combination of successes and failures, rhino conservation initiatives in Assam are giving hope to environmentalists. The present population of the Indian one-horned rhino is distributed in four places of Assam, namely the Kaziranga National Park (NP), Manas NP, Orang NP and Pobitora Wildlife Sanctuary (WLS). Of these, Orang NP holds the second largest population with 100 numbers according to the 2012 census (Table 1).

Orang NP is very unique as it is an isolated patch of 79.28 sq. km, totally fragmented terrestrially. The park is located in the districts of Darrang and Sonitpur and lies between the geographical limits of 92º15'E and

Officer Trainee, 2015-17 SFS Course, CASFOS, Dehradun

Table 1

YEAR	ADULT/SUB-ADULT			CALF		TOTAL
	M	F	Unsexed	<1 Yr.	> 1 Yr.	
1985	30	25	9	1		65
1991	28	42	5	14	8	97
1999	20	19	1	6		46
2006	28	27		4	9	68
2009	16	24	8	5	11	64
2012	20	27	37	8	8	100

(Source: Wild Life Division, Mangaldoi)

Table 2

Sl. No.	Biome	% Area
1	Woodland (with plantation)	16
2	Thatch area	19
3	Tall grass area	41
4	Water bodies/swamps	12
5	Sandy area/*Chapories*	12

(Source: Wild Life Division, Mangaldoi)

92º27'E longitudes and 26º29'N and 26º40'N latitudes.

The present park area was inhabited by people till the year 1900, after which a water-borne epidemic forced the people to abandon the area. In 1915, an area comprising 80.54 sq. km was declared as a game reserve and was part of the Mazbat Range under Darrang Forest Division, Tezpur. Subsequently, softwood plantations were raised in the area under various plans. After enactment of the Wildlife (Protection) Act by the Government of India in 1972, the area was handed over to the Wildlife Wing and was managed as an auxiliary area for Project Tiger. The State Government declared its intention to constitute the area as a wildlife sanctuary on September 20, 1985. Upon settlements of rights, privileges and concessions, the area was finally declared as a wildlife sanctuary with an area of 78.81 sq. km on March 17, 1998. The sanctuary was further upgraded and declared as a national park with the same area on April 8, 1999. An area of 0.47 sq. km was added as first addition to the park vide preliminary notification dated October 28, 2010.

The habitat of Orang NP is characterised by grasslands dotted with woodlands and water bodies. The relative proportions of the various biomes are presented in Table 2.

The grasslands present in the park are of two types–wet alluvial grasslands and dry savannah. Given the similarities in habitat, it is also known as the mini Kaziranga.

The flagship species of Orang NP is the Great Indian One-Horned

Rhinoceros and the park has all habitat components suited to the species. The habitat degradation resulting in loss of area is one of the primary threats for this species along with the threat posed by poachers. However in the recent past, anti-poaching efforts by the Park Authority and the dedication and courage of the park staff, have borne fruit. Better coordination among the various conservation agencies and positive support extended by non-governmental organisations to the Park Authority has paid dividends in rhino protection.

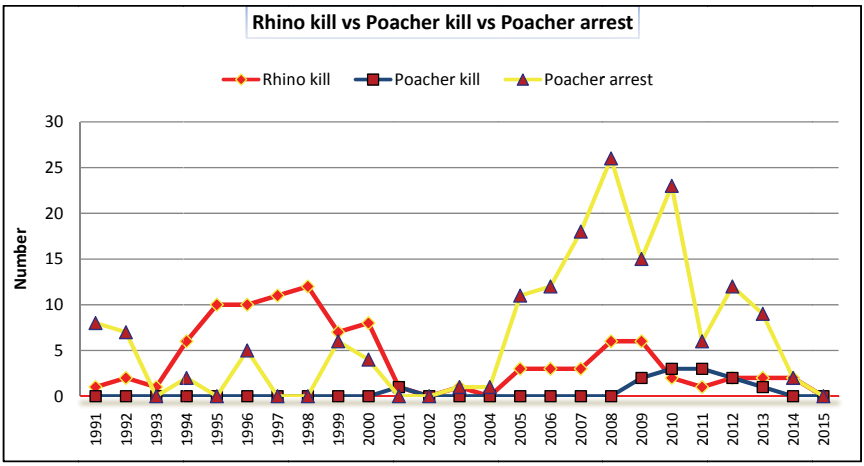
Poaching

The park went through a difficult time from 1994 to 2000, when poachers killed 63 rhinos, reducing the rhino population from 97 in 1991 to only 46 by 1999. However, dedicated forest staff continued their struggle and in recent times, they have successfully reduced the number of rhino poaching incidents in the park. During the period from 2001 to 2015, 32 rhinos were killed as against 12 poachers killed in encounter with the staff. Of late, in the first month of 2016, two poachers were killed in an encounter with the forest staff inside the park. The increase in the casualties to the poachers boosted the moral of the staff as well as created a fear psychosis deterring others who might otherwise attempt to poach rhino in the park. Figure 1 gives an idea of the relationship between rhinos poached with poachers killed or arrested.

Other attributes that help in reduction of poaching activity in the park include:

- Staff: Keeping the full strength of the staff; about 200 frontline staff including the RFO, are very dedicated to their duties.
- Well organised and increase patrolling round the year.

Figure 1



(Source: Wild Life Division, Mangaldoi)

- As many as 40 anti-poaching camps were established. The camps are distributed very well and are in accordance with the risk of poaching and the concentration of the flagship species.
- Watch towers: Nine tall watch towers were constructed for observation and surveillance at strategic locations inside the park.
- Wireless Sets and Binoculars: For effective communication, three fixed wireless stations have been created at Range Office HQ in Silbori, Katahali Camp and Marasali Camp, which are manned 24 hours. All other camps are provided with VHF wireless sets for communication purpose and binoculars for surveillance.
- Roads and Patrolling Paths: Improvement of roads and patrolling paths results in easy maneuverability. The park has about 155 km network of roads and patrolling paths which facilitate effective patrolling.
- Vehicles for Patrolling: The park maintains several vehicles, which include a Diesel Jeep, a Bolero SLX and a Bolero Camper, two Maruti Gypsy and three motorcycles.
- Elephants: Currently, the park maintain a fleet of 30 (24 adults + 6 calves) elephants to facilitate the task of patrolling in the rainy season. These elephants are placed in 20 camps for easy movement of the staff at the time of emergency.
- Boats: Since the park's southern boundary is extended up to the Brahmaputra river, to have effective monitoring and patrolling the Park Authority has two mechanised boats, one floating camp and two speed boats. The speed boats are found to be very effective in anti-poaching operation as stated by the Range Forest Officer of the Park. For the camps and patrolling duty inside the Park, 25 smaller country boats are used.
- Solar Power Fence: A 5.5 km long solar power fence has been installed and is working effectively in the western boundary of the Park from Bejimari to Old Orang.
- Well Established Intelligence Network: The Park Authority maintains a good intelligence network of informers at different levels to keep a check on the activities of poachers.

Besides the above, some very innovative measures adopted by the park management for the control of rhino poaching are:

- There is major emphasis on patrolling specially in the morning, afternoon and early hours of the night.
- Patrolling parties are kept in different locations at different times of the day, so as to keep poachers on their toes.
- Crackers are lit in the night as a sign of alertness.
- Although there are financial constrains, the park management tries to provide all the basic amenities to the frontline staff to do their duty smoothly.
- The authority strictly follows the shoot-at-sight policy inside the park area, which has gone a long way in deterring poaching activity.

Habitat degradation

Apart from poaching, the other major challenge for conservationists in Orang NP is habitat degradation. The key factors responsible for loss of habitat are:

- Invasion of grasslands by trees: The natural succession of the grassland is very fast. Woody plants and shrubs are invading the grassland habitat in the park which leads to shrinkage of habitat for rhinoceros.
- Spreading of invasive weed species: Like *Mimosa sp.*, *Mikania sp.*, *Leea sp.* etc., which ultimately reduces food availability and also hinders the growth of grasses.
- Siltation of wetlands: Siltation results in reduction of depth of water body, leading to scarcity of water.
- Choking of water bodies by aquatic weeds, mainly water hyacinth, makes wallowing difficult for the rhinoceros.

To curb the invasion of grasslands by trees and spreading of invasive weed species, mechanical measures like cutting down trees, pull out the sapling, controlled fire burning and manual weeding is carried out regularly. To rejuvenate the wetlands, the *beels* are de-silted in the months of January and February. A limited number of *beels* are de-silted every year due to shortage of funds. De-silting is done manually. Generally water hyacinth flushed out at the time of high floods. But if floods do not occur, then it is cleared manually. The activity is carried out before deepening the silted-up water bodies during December-February every year.

Although great success has been achieved in controlling rhino poaching inside the park, the efforts of the park authority are now directed to the safety of the stray away population from the park area as the last poaching incident happened in a distant location. Also, more emphasis is being given to the habitat improvement so that the population does not need to venture out of the park area.

Acknowledgement

My thanks go to Mr SK Daila, IFS, Conservator of Forests, Mangaldai Wildlife Division and all other officials and staffs of the division for all-round help and providing all the necessary inputs writing of this article.

Reference

1. Management Plan of Orang National Park, 2015-16 to 2019-20.
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DARJEELING / WEST BENGAL

Saving the Lesser Panda

The species has been successfully bred in captivity at the Padmaja Naidu Himalayan Zoological Park and reintroduced into the wild

Vahneichong Singson

Little did I know about the Lesser Panda, commonly known as Red Panda, and the threats it faced until I went and saw this cute mammal in the Padmaja Naidu Himalayan Zoological Park (PNHZP), Darjeeling. It made me curious to know what is being done to save this tiny mammal. This article is a result of that curiosity and my understanding of the issues once I researched on it.

The Red Panda is about the same size as a large housecat, with a cat-like face and a long, bushy tail which has stripes of alternating light and dark rings and rusty coloured thick fur covering the body. The Red Panda (*Ailurusfulgens*) is an endangered species according to the IUCN Red List and has been given the highest legal protection as per the Wildlife (Protection) Act, 1972 in India by placing it in Schedule I of the Act. Its range extends from Nepal in the West to a few provinces of China in the East. In India, it is found in the Darjeeling and the Sikkim Himalayas and in the state of Arunachal Pradesh.

With the rise in human population, these animals have been facing serious threats due to habitat fragmentation and disturbance, hunting and illegal trading. The Red Panda population has declined by 50 per cent over the last three generations, a trend that is projected to continue in the next three generations. The estimated population of Red Panda in the wild is less than 10,000 (Wang *et.al*. 2008).

The Padmaja Naidu Himalayan Zoological Park (PNHZP) started a conservation breeding programme in 1994 in response to the IUCN recommendation and the Global Captive Breeding Masterplan followed by Gangtok Zoo. The founder population consisted of nine pandas. Of the nine pandas, four were born in the wild and five were brought from European zoos. Now, the PNHZP has extended its conservation breeding facilities in Topkeydara, Darjeeling.

The Red Panda has an average lifespan of about 15-16 years and attains maturity at 18-20 months.Their breeding season starts from the last week of December and ends in the last week of January. A female panda gives birth to 1-3 cubs per year and takes two years of maternity rest. The zoo undertakes careful steps for properly managing the animals. They maintain a keeper's diary where the keeper keeps a

Officer Trainee, SFS 2015-17 Batch

Red Panda in Topkeydara Conservation Breeding Centre.

record of the animal routine, behaviour, health and diet. The daily diet chart prepared consists of apple, banana, sweet bun, honey, egg, milk, bamboo and water.

The zoo also keeps a studbook which has all the details of the captive animals, like unique specimen identifiers, sex, and identities of both the parents, births and death dates, full transaction histories and reproductive/contraceptive status. Each animal is given a unique studbook number. The zoo sends this studbook to a studbook holder who enters new animal records, edits the existing records and co-ordinates transfer between institutions after running a demographic and genetic analysis. The studbook holder also produces a population management plan and recommends pairings for breeding.

Effort is to maintain minimal disturbance during mating season and take extra care in nursing the mother panda right after it gives birth, using a CCTV camera installed in the coving box. Besides all these measures, the zoo also provides facilities for adopting the animals.

The captive population is usually characterised by overlap of generations and inbreeding. In PNHZP, a small proportion of breeding individuals and variation in the number of offspring has resulted in a low genetic diversity in the population. Another important consequence of the small population and few breeders is the increase in relatedness, therefore further limiting mating choices. However, only two animals in the living population are inbred. In all other animals, inbreeding has been avoided by regulated mating choices. Besides, the studbook keeper recommends exchanges between institutes and pairing of individuals after careful analysis of the animals. After 2008, intensive population management efforts has once again raised the genetic diversity to the level of 87 per cent.

By 2003, the population of Red Panda

in PNZHP was 22, which was assumed to be stable and good enough for taking a step forward by reintroducing some animals into the wild. Two young females, Sweety and Mini, were selected as it was felt that female pandas were more likely to contribute to the wild population. They were first acclimatised from the zoo diet to a natural diet based largely on bamboo for six months and then transferred to a special soft release facility that had been constructed in Gairibas area of the Singalila National Park for another seven months. This park was chosen for the reintroduction as it is the only national park in the vicinity of the zoo that supported a wild population of red pandas. This increased the likelihood that the two females would find mates.

Moreover, the Singalila forest had a dense vegetation of maling bamboo (*Arundinariamaling*), the pandas' preferred diet. After the animals were totally acclimatised to its natural diet, they were released in the wild. On July 7, 2004, Sweety gave birth to a single cub in a tree hollow nest while Mini, unfortunately, fell prey to a clouded leopard. Two more female pandas were released later on in the same area. Post release monitoring of the pandas were done using radio collar signal and their behaviour was observed and studied so as to inform the next release programme.

The reintroduction of Red Panda in Singalila National Park, however, is also not free from disturbance due to tourism, habitat destruction and exploitation of maling bamboo by the local people. The porous boundary leads to improper regulation of the park, facilitating illegal activities like hunting and poaching. Despite all these obstacles, the Forest Department has been making a tireless effort in protecting the panda. They closed the park for tourists during the mating season and trained the guides and porters working in the park. They also regulated the number of vehicles entering the Park as well as the hotels inside the national park.

The current living population of Red Pandas in the PNHZP is 17 while the estimated population in Singalila National Park is 27 (Roka and Jha, 2014).

The PNHZP has been successful in conservation breeding of the Red Panda. Besides its management strategy, research studies on the animal biology, behaviour, diet, healthcare and constant monitoring of the animal have also contributed in successfully breeding the animal and reintroducing it into the wild. Had the Forest Department done nothing to save this precious animal, a day would have come sooner or later when it would have been too late to save the animal.

Acknowledgement

I am indeed very grateful to Shri MP Singh (Director of Forest Education, CASFOS), Mrs. Meera Iyer (IFS, Principal CASFOS), and Dr KS Jayachandran (IFS, Course Director, CASFOS) for allowing me to conduct this case study. I am also equally grateful to the Forest Department of Darjeeling Wildlife Division for their invaluable information and guidance during the whole course of the study.

GUWAHATI / ASSAM

At the brink

The Pigmy Hog Conservation Programme is a broad-based research and conservation programme

Mriganka Borah

The Pygmy Hog (*Porcula salvania*) is the smallest and rarest of wild species in the world. Today, it is at the brink of extinction as only a few isolated and small populations survive in the wild. They were found in the tall, wet grasslands in the Himalayan foothills from Uttar Pradesh to Assam, through the Nepal *terai* and Bengal *duars*. Currently, however, they are restricted to a few areas along Assam's border with Bhutan and Arunachal Pradesh. In fact, the only viable population of the species exists in the Manas Tiger Reserve and nowhere else in the world.

The main threats to the survival of the pigmy hog are loss and degradation of habitat due to agricultural encroachments, flood control schemes, human settlements, and improper management. Some management practices, such as planting of trees in the grasslands and indiscriminate use of fire to create openings and to promote fresh growth of grass, have caused extensive damage to the habitat.

The survival of pigmy hogs is closely linked to the existence of the tall, wet grasslands, which besides being a highly threatened habitat itself, is also crucial for survival of a number of other endangered species such as the one-horned rhinoceros (*Rhinoceros unicornis*), tiger (*Panthera tigris*), swamp deer (*Cervus duvauceli*), wild buffalo (*Bubalus bubalis*), hispid hare (*Caprolagus hispidus*), Bengal florican (*Eupodotis bengalensis*), among others. The wellbeing of the pigmy hog is one of the most useful indicators of current wildlife management practices in these habitats as it indirectly supports some other species of this habitat. It is, therefore, important to understand why it is disappearing faster than other less sensitive species and take remedial measures if we wish to conserve the original habitats. This approach will eventually benefit all species of these threatened habitats. Preserving these important habitats will also help in maintaining the long-term ecological and economic balance of the region.

The Pigmy Hog Conservation Programme (PHCP) at Basistha in Guwahati is a broad-based research and conservation programme with aims to save the smallest and the rarest wild species in the world, the pygmy hog. The World Conservation Union (IUCN) has accorded this species the highest priority rating and it is considered to be amongst the most endangered

SFS batch 2015-17, CASFOS

species of all mammals. It is also listed in the Schedule I of the Indian Wildlife (Protection) Act, 1972.

The PHCP is a collaborative project of IUCN/SSC Wild Pig Specialist Group, Durrell Wildlife Conservation Trust, Forest Department, Government of Assam, and the Ministry of Environment & Forest, Government of India. It is implemented in Assam by the Rare & Endangered Species Conservation Unit (RESCU) of EcoSystems-India. Organisations or individuals who have given significant contribution to the project include European Commission (EU), Darwin Initiative (darwin.defra.gov.uk), IUCN-SOS (www.sospecies.org) Critical Ecosystems Partnership Fund (www.cepf.net), US Fish & Wildlife Service (www.fws.gov), ZGAP, Germany (www.zgap.org), Mr. Jo Mayo, USA, the Assam Valley Wildlife Society and Durrell Wildlife Conservation Trust (www.durrell.org).

The conservation breeding programme aims to reintroduce them to selected sites from where they have disappeared as well as serve as an insurance against early extinction of the species in the wild. The objective is to plan accurate management practices for maintenance of optimal diversity of these habitats and reintroduction of viable number of pigmy hogs for their long-term survival in the wild, and monitoring the reintroduced populations. It also aims at establishing a captive breeding programme as a safeguard against extinction, behavioural-ecology and habitat management requirements along with its conservation issues and suggests solutions to revive the population in the wild.

The PHCP has a breeding centre at Basistha in Guwahati and a pre-release centre at Potasali near Nameri. Wild hogs were caught from Manas National Park and transferred to the custom-built research and breeding centre, Basistha. The rapidly increasing captive population necessitated transfer back to the wild. They were released at two places, Sonai Rupai Wildlife Sanctuary and Orang National Park.

The more number of wild hogs in the captive population, the more will be the release every year. There is an urgent need to develop an alternative research and breeding site as Basistha is the only one of its kind in the world. There is also need to establish pre-release enclosures for reintroduction back into the wild. Only one pre-release centre has been established, at Potasali in the Nameri Tiger Reserve in Assam. Here, holding enclosure and pre-release enclosures were constructed to make the animals familiar with the natural habitat. Re-introduction into natural habitats started in 2008 with the release of 12 pygmy hogs in Sonai-Rupai Wildlife Sanctuary. But a pre-release enclosure or provision of a second site became necessary, as till then the captive population of the pygmy hogs at Basistha had been the only home of the entire global population of captive pygmy hogs

Dr. Goutam Narayan, Scientist and Project Director, PHCP, said "The pygmy hog is at the brink of extinction and this project is and its recommendations are vital as it presents the last hope for the pygmy hog." He has chosen to dedicate his life to the resurrection of the species

and researching this "evolutionary species" and breeding them in captivity, the study of which also won him honour from the International Union for Conservation of Nature. In 1995, Dr. Narayan set up the Pygmy Hog Research & Breeding Centre (PHRBC) in Basistha, with the help of the Assam Government, the Durrell Wildlife Conservation Trust (DWCT), and IUCN Wild Pig Specialist Group chair William Oliver, in his endeavour to restore this critical species to its natural environment. Another motivation was the opportunity to introduce conservation and management of one of India's most biodiversity rich habitats.

The pygmy hog is an important indicator species whose rapid disappearance is linked to the degradation of Assam's grasslands. The modification and destruction threats to the habitat are the usual suspects such as agriculture, human settlements including those by illegal immigrant settlers, overgrazing by cattle, thatch-grass harvesting, encroaching farmland, overuse of land by livestock and commercial forestry flood control programmes and uncontrolled seasonal burning. All these have not only damaged the grasslands, but led to its systematic eradication in some areas. The future of the pygmy hog is not only dependent on whether the captive-raised hogs are able to survive, adapt and breed in the wild, but also on how their habitat is restored and managed.

Dr. Narayan says that the pygmy hog could be a key indicator for ongoing wildlife management practices in the country. The disappearance of the species from grasslands that still support some other habitat species can help us understand what lies in store ahead for other less sensitive species. Once the habitat of the pygmy hogs is protected, it would eventually help in the survival of all species living in those habitats.

Modern technology is undoubtedly offering us a chance to protect the species, but it depends on how we convert this chance into an opportunity to minimise the extinction of the pygmy hog and other endangered species.

Acknowledgement

At the foremost I convey my sincere thank and gratitude to our principal Mrs. Meera Iyer, IFS, Principal, CASFOS, Dehradun, for the support and guidance in all aspects for successful completion of our East India case study tour scheduled in December 2015 at Kamrup East, Guwahati.

I owe my sincere thanks to our course director and tour incharge, Dr KS Jayachandra, IFS, and Dr. Surabhi Rai, IFS faculty member, who has guided us in all aspect in the entire tour and making it a success.

My sincere thanks to the Forest Department of Kamrup East, Guwahati, and the officials of the entire department for helping us in all aspects for making our tour successful. My special thanks to the DFO, ACF&RO of Kamrup East Division, Guwahati who provided us the opportunity and also shared their valuable experiences.

I would also like to thank my group members and my colleagues of SFS batch 2015-17 for their kind cooperation.

NORTH-EAST INDIA

Challenges in the bamboo value chain

A critical study of issues that hamper the growth of the bamboo industry in the region, which has a huge growth potential

Saumitro Das

Enduring, versatile and highly renewable bamboo has an immense cultural significance in South Asian countries. Astonishingly, bamboo has more than 1,500 documented applications ranging from medicinal to nutritional and from toys to aircraft (Gupta, 2008). Due to its importance, bamboo is considered as 'Green Gold' in Asia. India is fortunate to have abundant bamboo resources and is the second richest country in the world after China. Not only in stock, India is also rich in bamboo diversity as 23 genera are recorded here, of which about 19 are indigenous. So, resource management and technical improvement can convert this fast growing grass into durable raw material for construction purposes and wide range of semi-industrial products. New industrial applications and modern designs have both demonstrated bamboo's huge potential. The combined value of internal and commercial bamboo in the world is about Rs 50,000 crore annually (Anon, 2015).

Statement of problems

India has failed to tap its bamboo potential, unlike China which is far ahead in alleviating poverty and economic growth. North-East India occupies pole position in terms of bamboo reservoirs, accounting for two-third of the bamboo stocks of the country spreading over 3.10 million hectares (Anon, 2015). This valuable resource of nature, if harnessed properly, can be very helpful in generating income and employment, especially in North-East India. But, sadly, we are not utilising it because at every stage of bamboo value chain – from Production to Consumption – there are problems. To better understand the challenges in the bamboo value chain in the North-East region, the problems are broadly classified in three stage categories: Production, Transformation and Consumption.

Challenges in Production System

Archaic legislation and lack of awareness have inhibited the growth of bamboo industrialisation in the North-East. The bamboo is classified as a tree in Indian Forest Act, 1927; the Forest Department thus has monopoly over felling of bamboo. Moreover, felling and transportation of bamboo grown on private land requires certificate of origin and has to be obtained for each

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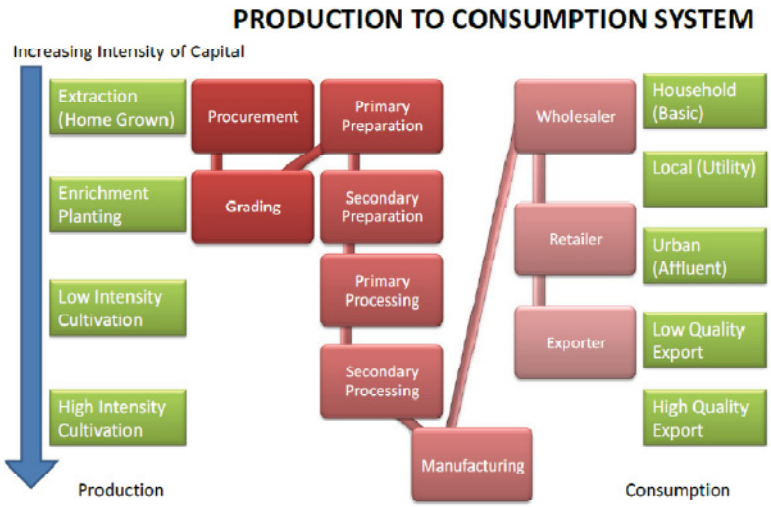

Production to Consumption system of bamboo developed by Belcher, 1995.

individual shipment. And, it takes up to 6 months for obtaining grants. However, there is relaxation for the Scheduled Tribes and Other Traditional Produce, over which STs have full rights of ownership and transportation without a Transit Pass. But, the tribals still suffer from Transit Pass issues.

Poor yield of bamboo is also a major problem in the Production system. In contrast to China's average yield of 50T/ha, the maximal range yield in India is 10-15T/ha. This figure indicates the poor management of Indian bamboo plantation. In addition to the outmoded policy and transit pass regimes, volatility of bamboo market price is also a major factor in discouraging bamboo industrialisation in the region. The private enterprise shows no or little interest in commercial forestry of bamboo due to fluctuation of market price of bamboo. Lack of market also hinders the growth of bamboo industrialisation. Unlike other farm products, such as rice and wheat in which case the price is available continuously and continually updated via SMS services and portal agrmarknet.nic.in, the bamboo sector lacks such kind of services. Consequently, bamboo farmer merely rely upon the traders to determine the price for them, which results in low-income return.

Challenges in Transformation system

Poor quality and low volume of bamboo supply are major challenges face by institutions in the Transformation system. The bamboo reaches the manufacturer through a chain of middlemen, who collect bamboo harvested by cultivators and sell them in bulk to the manufacturer. Tribals, who harvest bamboo, tend to do so from nearby forests and are, in

general, not careful about the quality and quantity of bamboo they sell to the trader. Aggregator middlemen perform crucial function of grading and sorting bamboo. However, lack of education and expertise implies that manufacturers still receive unsorted bamboo poles of varying quality. Bamboo supply depends on the yield of the smallholding owned by the tribal; on an average, this yield is about 2-3 tonnes per hectare, which explained low volume of bamboo supply.

Lack of availability of trained labour is also a major constraint in the Transformation system. Certain degree of technical proficiency is required in bamboo processing. While most Indian artisans are still naturally trained at working with handicrafts, their skills are insufficient to allow them to cope up with the requirement of an industrial process, including efficiency. The input requirement is very high in case of bamboo processing units in terms of electricity and water. It also requires several chemicals for primary and secondary treatment of culm. The North Eastern region, with otherwise tremendous potential for bamboo industries, lacks access to such basic industrial inputs. Also high costs of machineries and lack of capital investment cause hurdles in starting of small-scale bamboo industry. Fragmentation of industry is also an issue. Insufficient contact between manufacturers and producers and domination of many small firms result in low annual turnover (about Rs 20-30 million), which is not a profit model. Besides, absence of standardisation in bamboo products has created a significant problem for exports in India.

Challenges in Consumption system

The bamboo value chain ends somewhere towards the upper end of the Consumption system, between consumption for personal and household utilisation and consumption by rural markets and underdeveloped urban market. The demand of bamboo is very low due to the poor quality perception. In India, upper middle classes view bamboo as an input in tribal handicraft industries. Poor involvement of retail chains in the Consumption system is responsible for the poor growth of bamboo industrialisation. These challenges indicate that there is minimum level of value addition and minimal level of capital intensive production. It is now time to take certain steps to make bamboo a booming industry. Here are some recommendations to deal with the challenges:

- The land tenure reforms must be directed towards liberalisation of landholdings from collective ownership and must provide long-term ownership to individual households.
- Education and technical support must be given following secure land rights system.
- There must be an adequate market mechanism to decide bamboo prices daily, based on demand and supply. This mechanism must incorporate dissemination of information to farmers, who must be aware of the price of bamboo regularly.

- A large demand of bamboo products must exist in the local markets. If not, such demand must be created through aggressive promotion and government intervention in the short run. The demand must allow for remunerative pricing for manufactures in the bamboo sector. This demand is essential for production of higher value products and to provide capital investment.
- The emergence of small industrial units specialising in processing of bamboo must be promoted with the view to distribute activities along the value chain amidst small stakeholder. The aim should be to promote specialisation and consequently increase efficiency.
- The linkage between small processing houses and relatively large industrial production houses must be strong enough to ensure that firms are able to get the orders delivered on schedule as per their orders. This also requires contract enforcement through the stringent rule of law.

Acknowledgement

I sincerely acknowledge and thank Dr RSC Jayaraj IFS, Director, RFRI, Jorhat, for allowing me to stay and carry out case study in RFRI campus. I am very grateful to Dr RK Kalita, who made all necessary arrangement for our one week training and accommodation in RFRI. I am also thankful to Dr Tridev Goswami, Head, Department of Cellulose and Paper, NEIST, Jorhat, and other resource persons for sharing their knowledge and valuable information about issues of bamboo and ongoing research works. I also thank our Course Director, Dr KS Jayachandran, IFS, CASFOS, for his moral support, constant guidance and helpful suggestion during the case study tour.

Note: Articles may be sent at the following email ID:
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Evaluation and Review System

There will be two layers of review of the contributions; Faculty and the Directorate review. Evaluation and review at the faculty level in the training institutes/academies will be undertaken under the guidance of Director/Principal/Head of the institutions. Even very specialized and technical topics shall be presented in simplified format so that frontline staff and forest community are able to appreciate and understand the topics. Articles shall be written in a popular style, easily understandable and in simple English.

However depending on the response to this programme, arrangements can be made for translation of the magazine into the vernacular. A short note about the contributor and the reviewer shall accompany the article. The note shall contain name, age, postal and e-mail address, course, academic accomplishments, and important assignments held. The evaluation would be done on following criteria:

a. **Style**: The article should be interesting and informative. The introduction should draw the reader in and convince them that the remainder is worth reading. The remaining should be written in a lively and concise style, and should leave the reader convinced of the importance of the topic.
b. **Structure**: The article should be within 1000 words, and formatted in 1.5 line spacing in Times New Roman 12 point font.
c. **Organization**:
    - Instead of an abstract the article will give information on the location, the period when the field work was carried out
    - Integration - the article organized in a coherent form and all ideas are clearly leading to a single main argument.

The review at the Directorate level will be done through an editorial board constituted by the DFE, which will be responsible for the content, design and review of the journal articles. The editorial board shall consist of expert/experts constituted by DFE and reconstituted every year, which would screen contributions and recommend their publication. Articles previously published elsewhere, or simultaneously sent for publication elsewhere, may be accepted with modifications. Article submitted shall carry a declaration that the article is original. The Editor would reserve the right to reject articles without assigning any reason and articles not found suitable will be sent back.

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