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Featuring

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Contents

TIGERPAPER

FOREST NEWS

TIGERPAPER is dependent upon your free and voluntary contributions in the form of articles, news items, and announcements in the field of wildlife and nature conservation in the region. In order to better serve the n eeds of our readers please write to us and send in the information you have or let us know if there is any information that you need. We appreciate receiving your letters and make all efforts to respond.

Front cover: Red panda (Photo courtesy of Naveen Mahato)

A LONG-TERM COMMUNITY-BASED MONITORING AND CONSERVATION PROGRAM FOR RED PANDA IN UNPROTECTED FORESTS OF EASTERN NEPAL

by Naveen K. Mahato, Kamal Kandel and Sunil Shakya

Project background and significance

Red Panda Network, Nepal (RPN) has initiated a conservation project for Red panda in eastern Nepal along the Singhalila Range in partnership with local organizations and community-based organizations. Administratively, the area is situated in Taplejung, Panchthar and Ilam districts along the Indo-Nepalese border (Fig. 1) with a population density of about 83.2/km. The increase in conservation areas on adjacent Indian territory, e.g., Singhalila National Park, has placed a tremendous pressure on the Nepalese part of Singhalila Range in the form of intensive livestock grazing and harvesting of forest products for domestic and other uses. As a result, forest shrinkage and fragmentation has increased threats to the habitats of the endangered Red panda and other species (Oli, 2008). RPN initiated a conservation project in order to safeguard the critical habitat for Red panda by promoting community protection for the Red panda habitat.

The project area forms the lower part of the Kanchenjunga Mountain Landscape and is recognized as a region of international importance for biodiversity due to species diversity, species endemism and the number of rare and threatened species hosted by the area (Shakya & Joshi, 2008). Leading conservation organizations have recognized this area as a high priority conservation site, e.g., WWF's Global 200 ecoregions (Olson & Dinerstein, 2002); "Himalayan hotspot" of Conservation International; it includes 2 Important Bird Areas (IBA) identified by BirdLife International (Baral & Inskipp, 2005); and is included within the Sacred Himalayan Landscape by the Ministry of Forests and Soil Conservation, Nepal and WWF (Gurung *et al.*, 2006). This area also forms a central linkage in the Kanchenjunga Mountain Complex, providing

trans-boundary connectivity between Kanchenjunga Conservation Area in Nepal, Kanchendzonja National Park (Sikkim), Singhalila National Park (Darjeeling) and Barsey Rhododendron Sanctuary (Darjeeling) in India (CEMP Consult, 2001). This area has also been proposed as one of the five corridors (Eastern Nepal Connectivity Corridor) needed in order to maintain linkages in the Kanchenjunga Mountain Complex by the International Center for Integrated Mountain Development (ICIMOD) (Chettri *et al.*, 2008; Shakya & Joshi, 2008).

Red panda *Ailurus fulgens* is a rare and elusive mammalian species endemic to the Eastern Himalayas with a known distribution confined to only 5 countries – Nepal, India, Bhutan, China and Myanmar (Glatston, 1994). Despite being a member of the order Carnivora, Red panda is a specialized herbivore with a low nutrient diet. More than 86% of its diet is ringal bamboo (Pradhan *et al.*, 2001; Yonzon & Hunter, 1991). Further, Red pandas are habitat-specialized with narrow ecological requirements (Yonzon & Hunter, 1991), which makes it sensitive and hence vulnerable to smaller environmental changes. Because of the specialized diet and narrow range of habitat, Red panda has been considered an indicator species of ecosystem health in eastern Himalayan broadleaved and conifer forests (Yonzon *et al.*, 2000).

Project introduction

The project goal is to preserve Red panda and its habitat through an innovative community approach by utilizing indigenous and scientific ecological information. Through local educational programs RPN aims to develop a local appreciation for Red panda within the communities and train a local community member in forest stewardship. The project area covers 17 village development committees (VDCs) in Ilam, Panchthar and Taplejung districts covering an area of 780 km^2. These VDCs host approximately 398 km^2 of forest area potentially suitable to Red panda, which also provides refuge to other endangered species such as Clouded leopard *Neofelis nebulosa*, Himalayan black bear *Selenarctos thibetanus*, Himalayan serow *Naemorhedus sumatraensis*, Musk deer *Moschus chrysogaster*, Leopard cat *Felis bengalensis*, and Assamese macaque *Macaca assamensis* and wide array of avifaunal diversity. However, these forests are highly fragmented by various anthropogenic factors as a result of the growing human population. These 17 VDCs in total are populated by approximately 64,000 people (CBS, 2001).

Table 1. Human population (source: CBS 2001) and potential area (in km^2) available to Red panda (highly suitable area in parenthesis) in three districts in RPN's project area.

Districts	Total area	Red panda habitat	Human population
Ilam	234	102 (21.3)	24,495
Panchthar	380	191.8 (92.7)	33,571
Taplejung	165	104.2 (51.2))	5,680
Total	**779**	**398 (165.2)**	**63,746**

Community-based Red panda monitoring

In 2006, RPN initiated an innovative approach to monitor Red panda in the community forests and adjoining national forests in Ilam, Panchthar and Taplejung. The project began with 6 forests in 4 VDCs – Maimajhuwa and Mabu in Ilam district and Prangbung and Siddin in Panchthar district. Later, in 2008, with support from the Critical Ecosystem Partnership Fund (CEPF), the community-based monitoring was extended to 6 additional forests, totaling 12 forests in 9 VDCs in two districts (Fig. 1, Table 2). The main objectives are to estimate the relative abundance of Red panda in different forests and to monitor the Red panda population trend over a period of time.

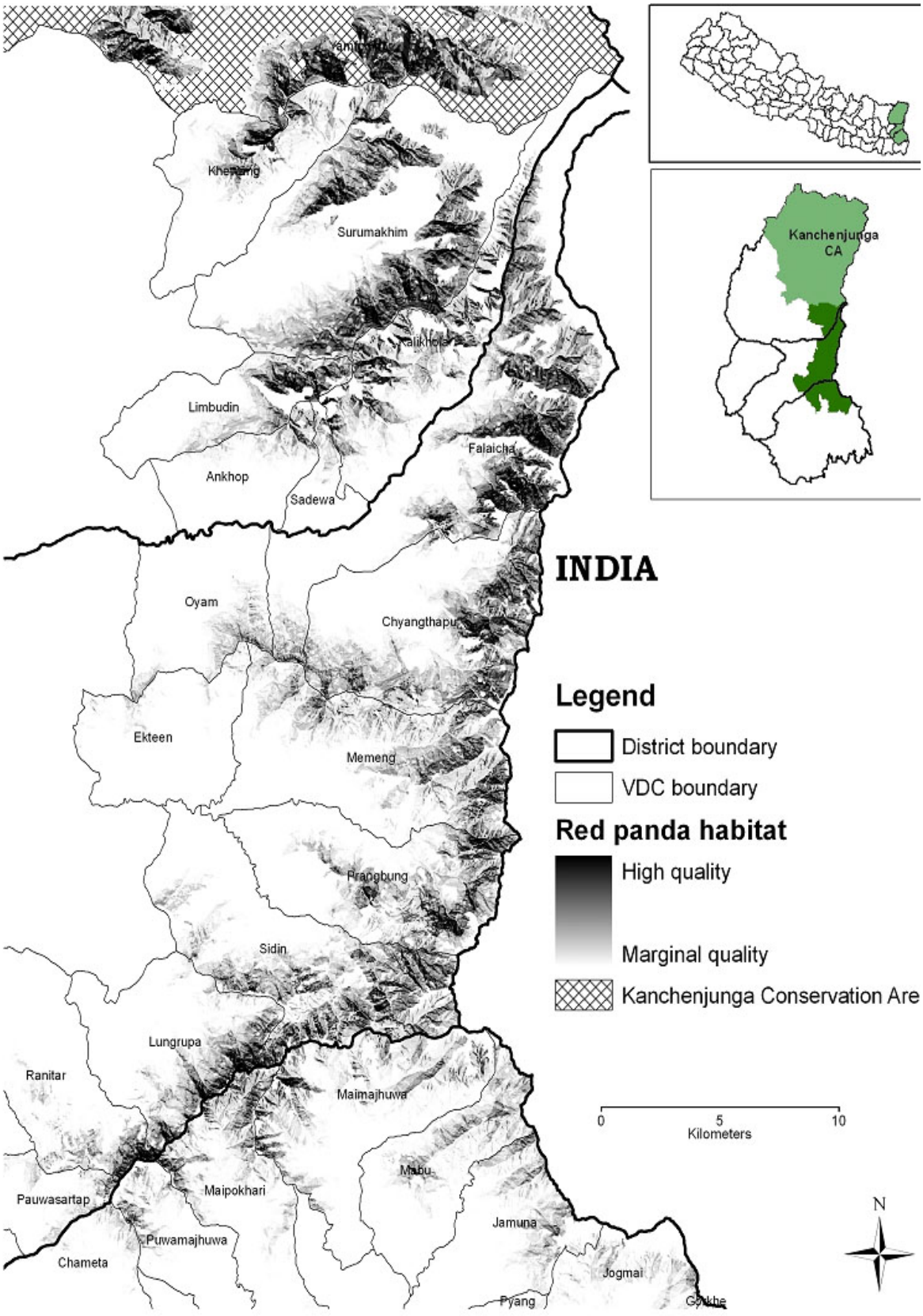

Figure 1. Total Red panda habitat in eastern Nepal. (Shaded area denotes the areas where RPN is currently active, rest green areas are to be covered soon)

In October 2006, consultations were carried out to identify potential Red panda forests. Members (or leaders) from the local community, local partners and local forest authorities were interviewed to collect information on previous Red panda records. Their opinions were verified by rapid forest visits. Based on this information, the monitoring forests were selected in consultation with respective community forest user groups and district forest authorities. The spatial distribution of forests selected included as many environmental variables as possible, and community willingness and support to the project's innovative approach were the main factors in selecting the forests.

Horizontal transects perpendicular to the elevation gradient at intervals of 100 m were established in each of the selected forests to monitor Red panda (Pradhan *et al.*, 2001, Mahato, 2003, 2004). Eighty-two transects, totaling 129,540 m in length in 12 forests (Table 2) were established in forests within available Red panda habitat. The beginning and ending points of each transect were determined by permanent natural features like ridges, drainages and gorges. These points were physically marked as well as recorded by GPS for future reference. Transects were marked every 100 m to ensure that surveyors followed the same path during all surveys.

A trained biologist assisted by two forest guardians surveyed each transect to record direct sightings and indirect evidence (e.g., dropping, scraps, etc.) of Red panda. Recorded data included the number of Red panda sighted, its signs encountered, and habitat characteristics of the sites around the sign (e.g., elevation, aspect, forest type, canopy, dominant species, etc.). Thereafter, the forest guardians surveyed each transect every month for Red panda signs and sightings. A standard simplified survey and data collection protocol was developed in the Nepali language for the forest guardians to use. Signs and sightings of other mammals were also recorded along transects. These transects have been maintained every year since 2007.

Preliminary outcomes (Relative abundance of Red panda in various forests)

The relative abundance of Red panda was estimated by recording the number of Red panda signs (fecal deposits) as an index of abundance. The overall rate of Red panda sign encounters was 1.76 signs/km (Table 2). The highest rate of Red panda sign encounters was observed in Hangetham Community Forest at 8.43 signs/km, followed by Dhanepa Community Forest with 3.21 signs/km. The highest rate of sign encounters was observed at 3,300m (9.84/km) and 3,400m (5.66/km). However, the sampling effort was less at these elevations (only 3 transects, totaling less than 2.5 km transect length). Ignoring these elevations, the highest sign encounter rate was observed at 3,200 m elevation, which is close to the recorded mean altitude of Red panda occurrence on the other side of the ridge in Singhalila National Park in Darjeeling (Pradhan *et al.*, 2001).

While the use of direct censuses to estimate Red panda's population size and abundance is extremely difficult, time consuming and expensive due to its small size, elusive nature and inaccessible habitat, the indirect sign surveys provided indices of abundance in the form of sign encounter rates. These sign encounter rates are influenced by various factors such as weather and visibility, the forest terrain, canopy density and forest structure, and substrate used by Red panda for defecation. For example, in the forests with tall trees like fir (*Abies spectabilies*), Red panda droppings may be deposited high on the trees rather than on the ground, thereby going undetected and resulting in a low sign encounter rate. However, in our project area, the forest types did not vary much, therefore the sign encounter error was considered constant. Nevertheless, canopy density, weather and terrain may have influenced the sign encounter rate. Despite these factors, the sign encounter rate provides indices of relative abundance of Red panda among various forests and at various elevations.

Photo captions:
Top: Red panda habitat in Eastern Nepal
Center left: Recording Red panda droppings
Center right: Recording Red panda paw mark on wet ground
Bottom: Transect monitoring through rugged terrain and dense understory in the habitat.

Table 2. Transect length (m) and respective sign encounter rate (signs/km) at various elevations in 9 monitoring forests

Forest Name	Elevation (meters)													Total length (m)	Er ra (p
	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400		
Todke Chantalung CF (Maimajuwa, ILAM)	-	-	2450	2400	2900	3100	2070	800	400	-	-	-	-	14120	0.(
Sandakpur Dhanepa CF (Maimajuwa, ILAM)	-	-	1530	1500	1400	1700	1600	1800	1500	1050	800	720	1060	14660	3.:
Chintapu CF (Maimajuwa, ILAM)	-	-	1400	2300	1560	1600	1500	2300	-	800	-	-	-	11460	0.:
Surke NF (Mabu, ILAM)	-	-	1330	1780	1720	800	1160	900	620	-	-	-	-	8310	0.'
Kanyadevi CF (Siddin, PANCHTHAR)	-	-	-	-	-	-	600	1250	2250	1500	150	-	-	5750	1.'
Jaljale Pokhari CF (Prangbung, PANCHTHAR)	-	-	-	-	-	1300	1400	1800	1900	2300	600	500	-	9800	0.!
Choyatar CF (Jamuna, ILAM)	-	2470	2470	2300	2100	2000	-	-	-	-	-	-	-	11340	2.'
Hangetham CF (Jamuna, ILAM)	-	-	-	1400	1400	1400	1400	1400	-	-	-	-	-	7000	8.4
Kalikhop Dadhali CF (Jogmai, ILAM)	2800	2400	2120	2100	1700	2100	800	-	-	-	-	-	-	14020	2.'
Jarbutte Bhalupani CF (Maipokhari, ILAM)	-	-	-	1400	1300	1200	2200	2120	1260	740	-	-	-	10220	0.

Makaibari Thulodundh CF (Lungrupa, PANCHTHAR)	-	-	-	-	700	400	1700	1700	2000	1960	820	-	-	9280	1
Ahale Narelung CF (Memeng, PANCHTHAR)	-	-	-	-	2000	1420	2000	1300	2360	2000	2500	-	-	13580	1
Total length (m)	2800	4870	11300	15180	16780	17020	16430	15370	12290	10350	4870	1220	1060	**129540**	
Encounter rate (per km)	0.36	4.52	1.5	1.19	1.07	1.82	0.49	2.99	1.46	0.48	5.34	9.84	5.66		**1**

Forest guardians

"Forest guardians" are RPN's local conservation ambassadors. They are villagers selected in consultation with the community, based on their interest and knowledge of local forests and wildlife. RPN trains them to conduct forest monitoring and educates them on conservation of Red panda and other wildlife. They are responsible for conducting village- and community-level outreach programs. In March 2007, RPN in coordination with District Forest Offices conducted training on Red panda monitoring which was attended by 12 forest guardians and 2 forest guards from the District Forest Office, Ilam. In February 2009, an additional 12 forest guardians were provided similar training. The main topics covered during the training include monitoring techniques, field data collection, basic Red panda biology, introductory conservation and wildlife-related regulations, and the role of community forests, community forest user groups and the forest guardians in wildlife conservation.

Community education and outreach

RPN believes in community involvement in conservation. Therefore, RPN conducts various outreach programs, basically categorized into the following three groups, to increase awareness and community involvement in Red panda conservation.

Forest guardian education

Besides the basic Red panda and forest monitoring training, the forest guardians also attend refresher workshops every year. Each refresher workshop is 2 days long. RPN also calls for bi-monthly meetings for forest guardians (FG) to interact to share their experiences and knowledge. The following programs were conducted for forest guardians:

- Initial training on Red panda monitoring: RPN has conducted 1 week-long training for new FGs to educate them on the techniques of Red panda monitoring.
- Periodic refresher workshop: RPN has conducted 2 refresher workshops every year, each 2 days long, for forest guardians to make sure they are maintaining the monitoring theme.

- Bimonthly FG interactions: Six interaction programs were organized every year to bring all forest guardians together and to allow them to exchange their findings and experiences.

School outreach

Various school outreach programs were conducted in order to educate over 600 school children about Red panda and its importance to healthy mountain ecosystems. The purpose of the school outreach programs is to create a future generation of stewards for Red pandas. School outreach programs include class-room teaching, quiz contests, drawing competitions and the involvement of school children in rallies and celebrations of various events, e.g., Mountain Day (December 11), World Biodiversity Day (May 22), Environment Day (June 5) and National Wildlife Week.

Public outreach

Community involvement is central to the success of a conservation project. RPN has conducted an array of activities such as consultation workshops, community meetings, group discussions and conservation workshops to educate the community on conservation. Over 20 such programs have been organized in 12 VDCs of Ilam and Panchthar involving more than one thousand participants.

Red panda habitat improvement

Based on field surveys, monitoring and community consultations, RPN has identified several critical areas for Red panda and is working with the community for their restoration. So far, more than 15,000 saplings of native plant species have been planted in a 10 ha area that now provides a linkage between two forest patches important for Red panda. The planted species include *Abies spectabilies*, *Tsuga dumosa*, *Prunus* spp., *Magnolia* spp., *Taxus baccata*, *Michelia* spp., *Alnus nipalensis*, *Lithocarpus elegans*, *Schefflera* spp. and various species of *Rhododendron*. Similarly, restoration of waterholes for Red panda and other wildlife species was also carried out. These activities prevent the confinement of Red panda populations to isolated forest patches and hence support and maintain habitat connectivity and viable populations in the area.

Alternative sustainable livelihood

RPN explores and promotes conservation-friendly livelihood alternatives to help reduce a community's dependence on Red panda habitat. RPN also facilitates sustainable development to provide conservation benefits to the communities. RPN has piloted community-based Red panda tourism as an approach to conserve Red panda and generate conservation incentives (Timsina & Mahato, 2010) and is planning to expand this concept to adjoining areas.

Conclusion

Since RPN framed the idea of Red panda conservation by bringing the unprotected forest area under community protection in 2006, it has expanded the community-monitored forests from 6 to 12. RPN has not only been successful in establishing a mechanism of long-term monitoring of Red panda as a community approach and raising community awareness about Red panda, but has also successfully implemented community-managed ecotourism in order to support the community in conservation efforts. The program has been a model project and recently has also been partially replicated in Makalu-Barun National Park in Sankhuwasaba district near the project area (RPN, 2010).

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References

Baral, H.S. and C. Inskipp. 2005. **Important bird areas in Nepal: Key sites for conservation.** Bird Conservation Nepal, Kathmandu, Nepal and BirdLife International, Cambridge, UK.

CBS. 2001. **National population census 2001.** Central Bureau of Statistics, National Planning Commission, Kathmandu, Nepal.

CEMP Consult. 2001. **Kanchanjunga Landscape Complex Biodiversity Assessment.** Final Report submitted to Nepal Biodiversity Landscape Project, WWF Nepal, Kathmandu.

Chettri, N., Bajracharya, B. and R. Thapa. 2008. **Feasibility assessment for developing conservation corridors in the Kanchenjunga Landscape**. In: Chettri, N. Shakya, B. and Sharma, E. (eds) *Biodiversity Conservation in the Kanchenjunga Landscape*. pp 21-29. International Center for Mountain Development, Kathmandu, Nepal.

Glatston, A.R. (compiler) 1994. **The Red panda, Olingos, Coatis, Raccoons and their relatives. Status Survey and Conservation Action Plan for Procoyonids and Ailurids**. IUCN/SSC Mustelid, Viverrid, and Procyonid Specialist Group. IUCN, Gland, Switzerland.

Gurung, C.P., Maskey, T.M., Poudel, N., Lama, Y., Wagley, M.P., Manandhar, A., Khaling, S., Thapa, G., Thapa, S. and E.D. Wikramanayake. 2006. **The Sacred Himalayan Landscape: conceptualizing, visioning and planning for conservation of biodiversity, cultures and livelihoods in the eastern Himalayas.** In: McNeely, J.A., McCarthy, T.M., Smith, A., Olsvig-Whittaker, L. and Wikramanayake, E.D. (eds) *Conservation Biology in Asia*. pp. 1-10. Society for Conservation Biology Asia Section and Resources Himalaya, Kathmandu, Nepal.

Mahato, N.K. 2003. **Status of Red panda *Ailurus fulgens* (Cuvier, 1825) in the Kanchenjunga Conservation Area, Nepal.** B.Sc. project paper submitted to Institute of Forestry, Tribhuvan University, Pokhara, Nepal.

Mahato, N.K. 2004. **Baseline survey of Red panda *Ailurus fulgens* status in the buffer zone of Sagarmatha National Park.** A report submitted to WWF Nepal Program, Kathmandu, Nepal.

Oli, K.P. 2008. **Pasture, livestock, and conservation: Challenges in the transborder areas of eastern Nepal**. In: Chettri, N. Shakya, B. and Sharma, E. (eds) **Biodiversity Conservation in the Kanchenjunga Landscape**. pp 91-96. International Center for Mountain Development, Kathmandu, Nepal.

Olson, D.M. and E. Dinerstein. 2002. **The Global 200: Priority ecoregions for global conservation**. *Ann. Missouri Botanical Garden* 89:199-224.

Pradhan, S., Khan, J.A. and G.K. Saha. 2001. **Feeding habits of the red panda *Ailurus fulgens* in the Singhalila National Park, Darjeeling, India.** *Journal of Bombay Natural History Society* 98(2): 224-230.

Pradhan, S., Saha, G.K. and J.A. Khan. 2001. **Ecology of the red panda *Ailurus fulgens* in the Singhalila National Park, Darjeeling, India**. *Biological Conservation* 98 (1):11-18.

RPN. 2010. **Community-based Red panda monitoring in Sankhuwasava district.** Unpublished report. Red Panda Network-Nepal, Kathmandu, Nepal.

Shakya, B. and R.M. Joshi. 2008. **Protected area and biodiversity conservation in the Hindu Kush-Himalayan region with special reference to the Kanchejunga Landscape**. In: Chettri, N. Shakya, B. and Sharma, E. (eds). *Biodiversity Conservation in the Kanchenjunga Landscape*. pp 13-20. International Center for Mountain Development, Kathmandu, Nepal.

Timsina, B. and N.K. Mahato. 2010. **Community-managed ecotourism – an effective means of red panda awareness and conservation.** Refereed Academic Research Presentation. 2nd World Ecotourism Conference (WEC 2010). July 8-11, 2010, Kuala Lumpur, Malaysia.

Yonzon, P. B. and M.L. Hunter. 1991. **Conservation of the Red Panda *Ailurus fulgens***. *Biological Conservation* 57: 1-11.

Yonzon, P., Pradhan, S., Bhujen, R., Khaling, S., Lachungpa, U. and C. Lachungpa. 2000. **Kanchenjunga Mountain Complex. Biodiversity Assessment and Conservaton Planning.** WWF-Nepal, Kathmandu, Nepal.

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CLIMATE CHANGE AND ITS RISK REDUCTION BY MANGROVE ECOSYSTEM IN THE COASTAL COMMUNITY OF BANGLADESH

by Subrata Sarker

Introduction

Bangladesh is a coastal country bounded by the Bay of Bengal on its southern part, and there natural disasters are an ongoing part of human life. The impacts of climate change alter the function, diversity and productivity of the ecosystem and people's livelihoods. Climate change keeps the coastal community at risk and destroys property. Natural disasters related to climate change can damage sanitation facilities, homes and drinking water. Food crises arise and there are outbreaks of disease. With a population of 130 million, Bangladesh is already facing the impacts of climate change. No other country knows about the impacts of climate change better than Bangladesh, where millions of people are already suffering. The lives and livelihoods of coastal people are more vulnerable than in inland areas of Bangladesh because they are continuously facing natural calamities, especially cyclones, storm surges and floods, and becoming victims of them. To reduce the impact of climate change, mangrove forests are playing an important role, and are also vital for the country's socio economic development. A large portion of the population of Bangladesh lives in coastal areas and depends on local natural resources for their livelihoods. Mangroves play an important role in maintaining the coastal ecosystem and provide a variety of environmental supports. They serve as protection for a myriad of juvenile aquatic species, function as a habitat for a variety of terrestrial fauna and are a source of nutrients that help to sustain many complex food chains. In the mangrove ecosystem area of Bangladesh, the economic, social and cultural life is closely related with mangrove flora and fauna, its lunar, tidal and seasonal cycles and the associated fish, shrimps and crabs found there.

Mangrove vegetation helps to shield the coastline from cyclones, storm surges and other natural disasters by reducing the wave energy and stabilizing sediment.

Mangrove ecosystem in Bangladesh

Mangrove is a type of forest growing along tidal mudflats and along shallow water coastal areas, extending inland along rivers, streams and their tributaries where the water is generally brackish. The mangrove ecosystem is dominated by mangrove trees and acts as a primary producer. About 587,380 ha of natural mangroves and 100,000 ha of planted mangroves are supported by the coastal area of Bangladesh and locally known as *Perabon*. The Sundarbans, a major continuous block of mangroves, is situated at the southern part of Khulna, Bagerhat and Satkhira districts of Khulna civil division, covering an area of 577,040 ha. It is the world's largest mangrove forest ecosystem. The Sundarbans has a considerably high floral diversity and supports 245 genera and 334 plant species. It is known that there are 289 terrestrial faunal species of 185 genera and 219 aquatic faunal species of 146 genera in

the Sundarbans forests. The Sundarbans mangrove ecosystem produces a huge amount of fish for the community and many people near and far from the forest area fish in and around the Sundarbans all year round. The leaves of golpata (*Nipa fruticans*) are harvested by local communities for thatching purposes. The Sundarban mangrove reserve has great economic importance for Bangladesh and provides livelihood options for 300,000 people.

Another natural mangrove forest of Bangladesh is the hundred-year-old Chakaria Sunderbans. It is one of the oldest mangrove forests in the subcontinent and has been subjected to heavy human interference. This mangrove ecosystem is situated in Cox's Bazar district, southeastern Bangladesh, along the northeastern coast of the Bay of Bengal. Due to excessive human interference and the extension of shrimp farming the entire forest has been cleared, except for a remnant of only 11 sundari trees (*Heritiera fomes*). Clearance of mangrove in this area has caused loss of coastal habitat and aquatic resources, increased erosion and vulnerability to natural disaster.

Climate change in Bangladesh

Bangladesh is located between the Himalayas in the north and the Bay of Bengal in the south. These two settings regulate and modify the climate of this region. Bangladesh is one of the countries which are suffering from the adverse impacts of climate change. The geographical location of Bangladesh makes the country vulnerable to climate change. Threats include rises in the sea level, droughts, floods, cyclones, land erosion, salinity intrusion and epidemic disease. As Bangladesh is a disaster-prone country with a high population density, the above-mentioned types of disasters make the lives of people more complicated. Due to the increase of greenhouse gases in the atmosphere from the combustion of fossil fuels and from industrial sources, global warming causes the sea level to rise. Rises in the sea level as a consequence of global warming are caused by an increase in seawater temperatures resulting from the thermal expansion of water and melting of glacier and polar land ice (Kennedy *et al.*, 2002).Two estimates of potential future sea level rise for Bangladesh are 0.30-1.5 m and 0.3-0.5 m for 2050 (DOE, 1993). Ali and Ahmad (1992) estimated potential coastal and inland inundation in Bangladesh due to different sea level rise scenarios. These estimates show that a rise of 1.0 and 1.5 m would inundate 10% and nearly 16% of the country, respectively.

Most of the impact of climate change comes to the country from the Bay of Bengal and the adjacent Indian Ocean. The Bay of Bengal is a place of cyclone generation. Gray (1968) estimated that 10% of the world's tropical cyclones form in this bay. About 14% of cyclones that formed in the Bay of Bengal between 1881 and 1990 (110 years) hit in Bangladesh and 49% of deaths in this country are due to cyclones. Between 1991 and 2000, 93 major disasters were recorded in Bangladesh. The impacts of climate change affect communities badly and the coastal community of Bangladesh felt it first in 1970 and then in 1991, when two super cyclones hit the country and caused the deaths of about 500,000 and 138,000 people respectively. The southwest part of the country was affected by a Category 4 Cyclone (Cyclone Sidr), in November 2007. Cyclone Nargis also occurred in 2007 and caused loss of forest in Myanmar. Cyclone Aila began as a disturbance on 21 May in the Bay of Bengal, strengthened to a Category 1 cyclone, and caused the death of about 200 people and left hundreds of thousands more homeless. More than 2 million people became victims of Cyclone Aila.

The flood-affected area of Bangladesh has also undergone a significant increase. Flood records exist from 1954 onwards. Significant peak flooding occurred in 1955, 1974, 1987, 1988, 1998 and 2004; in 1988 and 1998, about two-thirds of the country was flooded, which caused significant loss of life and property.

Land erosion is another concern for the coastal communities of Bangladesh. High wave action, astronomical tides and storm surges from the Bay of Bengal are the main causes of coastal land erosion.

Mangrove and risk reduction of climate change

Climate change constitutes a significant impact on the coastal areas of Bangladesh. Mangroves provide economic and environmental benefits that extend well beyond the function served in reducing the impacts of climate change-related disasters. Mangroves can fix greater amounts of CO_2 per unit area than in the tropical ocean, where it is fixed by phytoplankton. Mangroves are also capable of accumulating and storing carbon in the soil in huge amounts. A 20-year-old mangrove stores 11.6 kg m^{-2} of carbon with a C burial rate of 580 g m^{-2} yr^{-1} and hence, a plantation of mangroves provides great benefits to control global climate change by stabilizing atmospheric carbon (Fugimoto, 2000). The mangrove foliage produces flavonoids that serve as UV-screen compounds (Moorthy and Kathiresan, 1997 a, b). Mangroves protect the environment by protecting coastal areas and communities from storm surges, waves, tidal currents and typhoons. Mangroves act as a buffer against wave energy.The structure of the trees enable them to withstand the occasional heavy wave impacts and help to dissipate wave action from severe storms. Analytical models show that 30 trees per 100 m^2 in a 100 m wide belt may reduce the maximum tsunami flow pressure by more than 90% (Hiraishi and Harada, 2003). The crowns and stems of mangroves serve as physical barriers against wind action. Mangrove forest is a network of coastal defenses and is capable of absorbing 30 to 40 per cent of the total force of a tsunami or typhoon and reducing waves before they swirl over inhabited areas by the shore. Their specialized fringe-like root system traps and holds sediments and reduces coastal erosion. The accumulation of sediment by the roots in mangrove forests also helps build land mass. Mangrove vegetation can alter topography and bathymetry through the process of sedimentation and reduce the vulnerability of the landscape to inundation due to sea level rises. Further, mangroves promote clear water by filtering and assimilating pollutants.

It seems clear that in regions of the coast where extensive mangrove forests exist, they will help ameliorate the impacts of climate change. For example, in November 2007, a coastal community in the southwest region of Bangladesh was less affected when the Category 4 Cyclone Sidr hit in this region due to the presence of mangroves. But the impact from the destruction of the mangrove forest in the southeast coastal region of the country was first felt in April 1991, when a super cyclone hit the country and caused the deaths of 138,000 people. That cyclone reminded us of the importance of mangrove forest as a 'bio-shield' to safeguard the coastal people. The rapid rate of emissions of greenhouse gases such as carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons from anthropogenic sources such as burning of fossil fuels, tropical deforestation and other human activities resulted in an increase in global temperatures, otherwise known as global warming, and was responsible for rises in the sea level. A 1 m rise in sea level would inundate 16% of Bangladesh's total land area and 15% of the country's population would be left landless. Mangrove trees produce peat from decaying leaf litter while the growth of pneumatophores, roots, rhizomes and stems trap sediment in the water, including leaf litter. The process of building peat and accumulation of sediment helps coastal areas to cope with the rise in the sea level. Mangroves function in flood control by decreasing the velocity of excess water during heavy rainfall. As water flows into mangrove forests, it naturally loses velocity as it collects and continues to spread out. Mangrove vegetation provides another natural barrier to fast-moving water and therefore aids in flood speed reduction. The result of mangroves activity during floods is often decreased damage of surrounding areas. Thus, mangroves are a part of the solution to climate change in the coastal community of Bangladesh by stabilizing and protecting coastal regions and providing environmental resources.

Mangrove and livelihoods

The environmental benefits of mangroves, as well as their commercial uses, have made mangrove forests very important ecosystems. Mangrove forests serve as a diverse habitat for many species, including fish, birds, reptiles, amphibians, mollusks, crustaceans and many other invertebrates. Mangroves act as roots of the sea and, if there are no mangroves along the coast, there will be no or fewer fish in the sea and the sea will be like a tree without its root. Mangroves provide nursery grounds for fish, prawns and crabs, and support

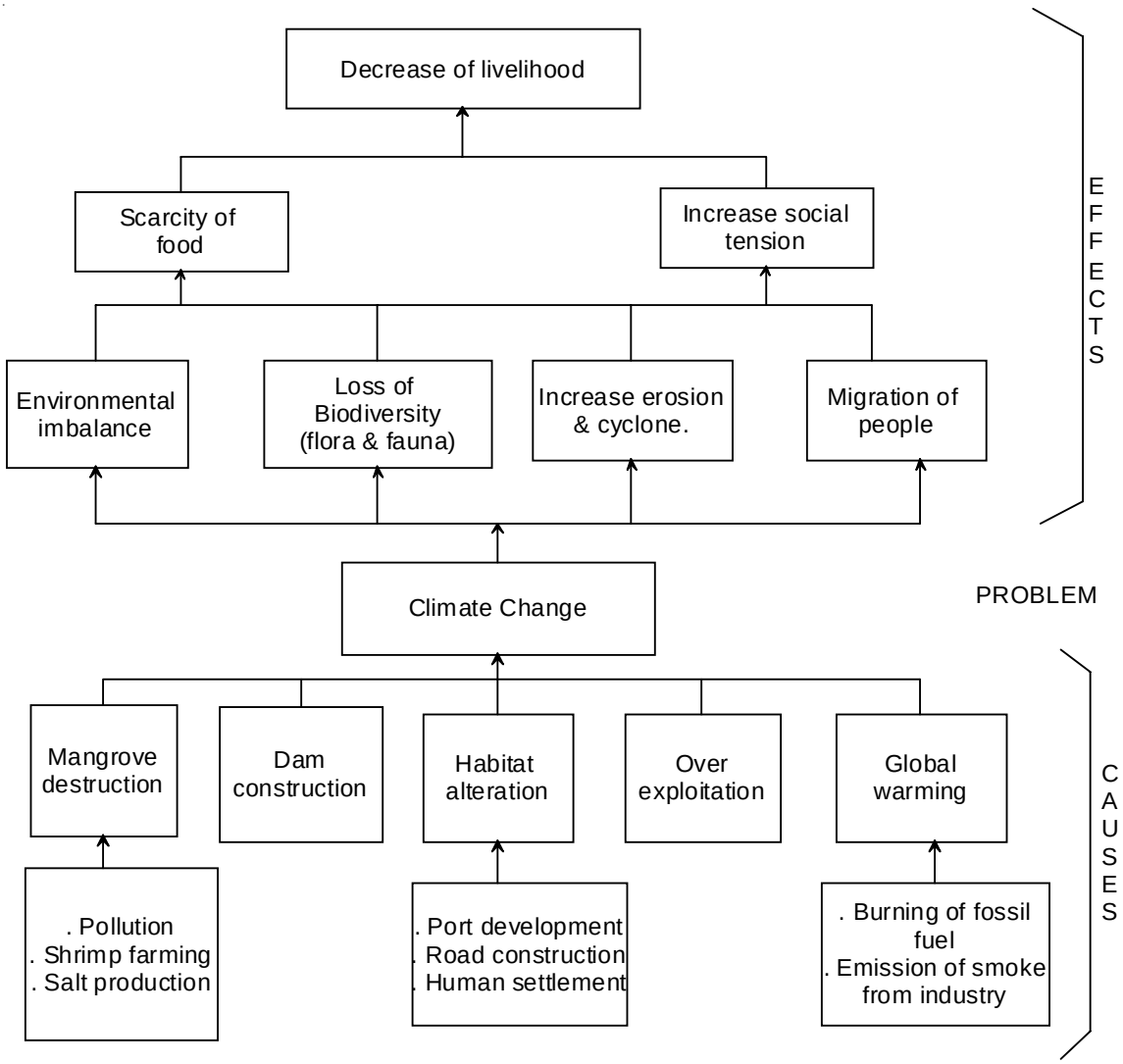

Figure 1: Problem tree analysis for climate change

fisheries production in coastal waters. The exposed prop roots and pneumatophores provide ample hiding places for fish. Many commercial shrimp and fish species are commonly available here. Mangroves produce leaf litter and detritus matter, which are valuable sources of food for animals in coastal waters.

Up to 80% of global fish catches are directly or indirectly dependant on mangroves. From the Sundarbans mangrove forests, an average of 6,000 ton/ha are released per year and provide a great source of natural food. Mangroves also serve as recreational grounds for bird watching and observation of other wildlife while providing shelter for local and migratory wildlife. Mangroves are a good source of wood, timber and housing materials, firewood, charcoal, and poles for fish traps. Fish, crustaceans and mollusks can be harvested from mangroves. Aquaculture and commercial fisheries also depend on mangroves for juvenile and mature fish species. And last but not least, mangroves are sources of tannin, alcohol and medicine. The annual economic value of mangroves is estimated to be US$ 200,000 - $900,000 per ha (Wells, 2006). A survey by IUCN in Kapuhenwala village (Sri Lanka) indicates that intact and healthy mangroves can have an overall yearly use value of as much as US$14,000/ha/household. Mangrove forests offer good opportunities for ecotourism and economic benefits to local coastal communities of Bangladesh. The mangrove forests have been shown to sustain more than 70 direct human activities, ranging from fuel-wood collection to fisheries (Dixon, 1989; Lucy, 2006). For the coastal dwellers of the mangrove ecosystem area, the value of mangroves is not surprising. The local communities have long recognized the socio economic values of mangrove ecosystems for their lives and livelihoods. These resources help to eliminate poverty. The local people are depending largely on the natural resources of mangrove forest for their living.

Major activities in mangrove forest areas are shrimp farming, salt production, collection of fuel wood, fry collection, cattle grazing and human settlement. Mollusc shells are collected from mangroves by fishermen for lime preparation. Mangrove twigs are used as firewood by the local people due to the high caloric value. Mangrove wood with its high content of tannin is used as timber for its durability. The pneumatophores of mangrove trees are used by local fishermen for stopper and float making. Mangrove extracts are used in making indigenous medicine; for example, *Avicennia* species have a tonic effect. The fruits of *Sonneratia* species are used for beverage preparation. Extracts from mangroves seem to have a potential for human, animal and plant pathogens and for the treatment of viral diseases like AIDS (Kathiresan, 2000).

So, mangroves play an important role in improving the livelihood of local communities by interconnecting them with the ecosystem.

Conclusion

Climate change has had a significant impact on the coastal rural people of Bangladesh, changing their life style and destroying livelihood options. A well-developed mangrove forest could ensure different goods and services for local people and attract mangrove-dependent species to enhance biodiversity. As the natural disasters are increasing around the globe it is essential to protect mangroves for human welfare to improve protection against typhoons, storm tides, tsunamis and other ensuing catastrophic consequences.

References:

Ali A. and A.A~Z.Ahmad 1992. **Impact of sea level rise on other disasters in Bangladesh.** Presented at an IOC/UNEP Workshop on Impact of Sea Level Rise Due to Global Warming for the South Asian Region, 16-19 December, Dhaka, Bangladesh.

Biswas, S. 2009. **Cyclone AILA destroyed the coast: Experiences from Southwest Bangladesh**. In: Hossain, M.S. (Ed.), *Climate Change Resilience by Mangrove Ecosystem.* pp. 13-18. PRDI, Dhaka, Bangladesh. 33pp.

Chowdhury, M.S.N., Nabi, M.R and N.G. Das. 2009. **Socio-environmental support of m mangroves in the Teknaf Peninsula, Bangladesh**. In: Hossain, M.S. (Ed.), *Climate Change Resilience by Mangrove Ecosystem.* pp. 19-23.PRDI, Dhaka, Bangladesh. 33pp.

Day Jr., J.W., Boesch, D.F., Clairain, E.J., Kemp, G.P., Laska, S.B., Mitsch, W.J., Orth, K.,

Mashriqui, H., Reed, D.J., Shabman, L., Simenstad, C.A., Streever, B.J., Twilley, R.R., Watson, C.C., Wells, J.T and D.F. Whigham. 2007. **Restoration of the Mississippi Delta: Lesson from Hurricanes Katrina and Rita.** *Science*, 315: 1679-1684.

DOE. 1993. **Assessment of the Vulnerability of Coastal Areas to Sea Level Rise and Other Effects of Global Climate Change, Pilot Study Bangladesh**. Report prepared by Department of Enviromnent, Govt. of Bangladesh, Dhaka.

Fujimoto, K. 2000. **Below ground carbon sequestration of mangrove forests in the Asia-Pacific region**. *Proceedings of Asia-Pacific Cooperation on Research for Conservation of Mangroves, Okinawa, Japan,* pp. 87-96.

Gray W.M. 1968. *Mon. Wea. Rev*. 96, 669.

Hiraishi, T. and K. Harada. 2003. **Greenbelt tsunami prevention in South-Pacific Region.** http://eqtap.edm.bosai.go.jp/

Hossain, M.S. 2001. **Biological aspects of the coastal and marine environment of Bangladesh**. *Ocean & Coastal Management,* 44(3-4): 261-282.

Hossain, M.S. 2009. **Coastal community resilience assessment: Using analytical hierarchy process.** In: Hossain, M.S. (Ed.), *Climate Change Resilience by Mangrove Ecosystem*. pp. 1-11. PRDI, Dhaka, Bangladesh. 33pp.

Hossain, M.S., Lin, C.K. and M.Z. Hussain. 2001. **Goodbye Chakaria Sunderban: the oldest mangrove forest**. *SWS (Society for Wetland Scientist) Bulletin,* 18(3): 19-22.

Hossain, M.S., Sam, W. and M. Shamsuddoha. 2008. **Care mangrove forest care coastal people.** Institute of Marine Sciences and Fisheries, Chittagong University, Bangladesh.

Hossain, M.S., Sam, W. and M. Shamsuddoha. 2009. **Mangrove forest conservation for climate change risk reduction with emphasizing the socio-ecological resilience of coastal community in Bangladesh**. Paper presented at The Third World Climate Conference (WCC-3) in Geneva, Switzerland from 30 August to 04 September 2009.

Kathiresan, K. 2000. **A review of studies on Pichavaram mangrove, southeast India**. *Hydrobioloica*, 430: 185-205.

Kennedy, V.S., Twilley, R.R., Kleypas, J.A., Cowan Jr., J.H. and S.R. Hare. 2002. **Coastal and marine ecosystems: Potential effects on U.S. resources and global climate change**. Pew Center on Global Climate Change.

Moorthy, P and K. Kathiresam. 1997a. **Photosynthetic pigments in tropical mangroves: impacts of seasonal flux on UV-B radiation and other environmental attributes**. *Botanica Marina*, 40: 341-349.

Moorthy, P and K. Kathiresam. 1997b. **Influence of UV-B radiation on photosynthetic and biochemical characteristics of mangrove *Rhizophora apiculata* Blume.** *Photo-synthetica*, 34(3): 465-471.

Samsuddoha, M and R.K. Chowdhury. 2009. **Destruction of Chakaria Sunderban: A case of ecological debt in Bangladesh**. In: Hossain, M.S. (Ed.), *Climate Change Resilience by Mangrove Ecosystem.* pp. 31-33.PRDI, Dhaka, Bangladesh. 33pp.

Wells, S. 2006. **In the front line: Shoreline protection and other ecosystem services from mangroves and coral reefs.** UNEP-WCMC.

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STATUS OF MAMMALS WITH SPECIAL REFERENCE TO MUNTJAC (*Muntiacus muntak*) IN KHULGARH WATERSHED AREA OF KUMOAN HIMALAYAS

by Kaleem Ahmed and Jamal A. Khan

Introduction

A single species approach to conservation, management, and monitoring is insufficient to combat the threat to the overall biological diversity of an area. Multi species-based monitoring approaches are needed to provide reliable, timely, and informative measures of change in the status of populations, communities and biological diversity (Manley *et al*., 2005).

The Himalayas offer great challenges to wildlife biologists in studying aspects of ecology, conservation and management of animals. The low density of animals and harsh climatic conditions are the major reasons for this. The varied topography of the area does not allow systematic sampling using the conventional methods. Thus, the status, distribution and relative abundance of many of the Himalayan mammalian species are not fully known.

There is a great need for conservation of mammalian species in most of the parts of the Himalayas that have a rich diversity of mammalian fauna, like the Kumaon Himalayas (Sultana, 2002). In the present study a base line survey was conducted in Khulgarh watershed area of Kumoan Himalayas in an attempt to determine the status and population structure of mammals by considering the watershed as a biodiversity hot spot.

Study area

The Khulgarh Watershed Area (KWA) lies between 29°34'31" to 29°41'N and 79°32'15" and 79°37'E in Almora district of the Kumaon Himalayas, Uttarakhand. The area spreads over 32 km^2, and represents the middle Shiwaliks. It is situated 15 km west of Almora town and is inhabited by 34 villages. There are three distinct seasons: summer, winter and monsoon. The average annual temperature in the watershed is 20°C, which varies between 25.2°C and 13.6°C. The general elevation of the area ranges from 1,100 to 2,200 meters above mean sea level (amsl) (Ahmed, 2010). The watershed is drained by Khulgarh stream, a tributary of the Kosi River, which merges with the Ramganga River in the plains of Uttar Pradesh. The vegetation is temperate and the dominant tree species in the study area is *Pinus roxburghii*, both in forested and outside forest areas. The other major tree species found in the area are *Quercus incana* and *Lyonia ovalifolia.*

Results and discussion

During the study period, 8 species of mammals were recorded. The encounter rate of rhesus macaque was highest (9.52 individuals/km) among all other mammalian species, followed by langur (4.99 animals/km) and wild boar (0.14 animals/km). The encounter rate of muntjac was found to be 0.11, which is same as the value in Binsar Wildlife Sanctuary (Ilyas, 2001). Muntjac were found to be solitary animals as groups of one individual accounted for more than 85% of the population. These findings are in conformity with Barrette (1977) and Ilyas (2001), who recorded 64.5% and 80% respectively of muntjac groups to consist of single individuals. The encounter rate for all the mammalian species was higher in summer compared to winter and the difference was not found to be significant (Table 1).

Group size

A total 7,325 individuals were counted in 393 groups. The largest number of groups were among rhesus macaque (192), followed by hanuman langur (149), muntjac (31), jackal (8), wild boar (7) red fox (4) and leopard (2). In terms of total number of individuals, the rhesus macaques had a

higher number of individuals (4,764), followed by hanuman langur (2,499), muntjac (41), jackal (8), wild boar (7), red fox (4) and leopard (2).

The highest mean group size was recorded for rhesus macaque (24.70 ± 0.96), followed by langur (16.77 ± 0.89) and muntjac (1.44 ± 0.05). The difference was found to be significant (F = 83.50, df = 2, P = 0.000) (Table 2). Mean group size of langur and rhesus macaque was highest in summer and the difference was found to be significant (F = 12.403, df = 1, P = 0.001; F = 89.81, df = 1, P = 0.000 respectively). The highest group size of muntjac was also recorded in summer, but the difference was not found to be significant (Tables 3 and 4). Group size of muntjac was found to be 1.14. These values were similar to those found by Ilyas (2001) in Kumoan Himalayas and Barrett (1977), but higher than Mishra and Johnsingh (1996) in Majhatal Wildlife Sanctuary.

Sex ratio

Langur

In total, 2,499 individual langurs were counted, out of which 589 (23.57%) were adult males, 1,104 (44.18%) were adult females, 163 (6.52%) were sub-adult males, 260 (10.40%) were sub adult females, 311 (12.44%) were infants and 76 (3.04%) remained unidentified. There were 28.17 fawns per 100 females.

Rhesus macaque

A total of 4,744 individual rhesus macaques were observed, out of which 1,136 (23.95%) were adult males, 1,761 (37.12%) were adult females, 285 (6.01%) were sub-adult males, 562 (11.85%) were sub-adult females, 603 (12.71%) were fawns and 104 (2.19%) could not be classified. Adult male to adult female ratio was 64.50:100 and sub adult male: sub adult female ratio was 50.71:100. There were 34.24 fawns per 100 females.

Wild boar

Males constituted 14.29%; females 28.57%; and 57.14% remained unidentified. The sample sizes of wild boar, jackal, red fox, yellow throated martin and leopard were too small to calculate the sex ratio.

Muntjac

In total, males constituted 23.64%, females 67.27%, fawns 9.09% and 3.64% remained unidentified. Male: female ratio was 35.13:100 and there were 13.51 fawns per 100 females.

The sex ratio of all the mammalian species in the study areas favored females. Female bias has already been reported in many studies, e.g., Khan *et al*. (1995) for chital; Ahmed (2007) and Ahmed and Khan (2008) for swamp deer; and Rahmani (1990) for chinkara. The disparity in the adult sex ratio in favor of females has been attributed to several factors such as misclassification of individuals (Mishra, 1982); higher mortality of male fawns (Schaller, 1967); selective predation on males (Schaller [1967] for sambar, Karanth and Sunquist [1992] for chital, sambar and wild boar). Karanth and Sunquist (1992) suggested that the female bias may be due to the male's solitary habits, their proneness to injuries from intra-specific aggression and lack of alertness during rut and dispersal behavior that may render them vulnerable to predation.

Habitat use of muntjac

The overall mean pellet group density of muntjac was 26.87/ha ± 5.55. It was found to be highest in dense forest (81.39/ha ± 11.57), followed by moderate forest (39.81/ha ± 7.96) and open forest (2.27/ha ± 1.28). The difference was found to be significant (F = 54.41, df = 2, P = 0.000).

Use of tree cover, shrub cover, slope, altitude, habitat and aspect by muntjac in KWA

Muntjac seemed to prefer 51-75% tree cover categories (χ^2 = 2.15, df = 2, P = 0.05) and used all shrub cover categories in proportion to their availability in the study area (χ^2 = 13.01, df = 2, P = 0.01). It seemed to avoid steeper slopes (51-75°) and used other slope ranges in proportion to their availability (χ^2 = 8.21, df = 2, P = 0.05). This is similar to the observations made by Sathyakumar (1994). Although muntjac used all tree and shrub cover categories in proportion to their availability,

(continued on p.17)

(Continued from p.16)

most of their sightings were in high tree and shrub cover categories. Small forest ungulates like muntjac choose to inhabit and hide in thick cover to avoid predation (McCullough *et al*., 2000). For muntjac, seeking dense canopy cover is an important thermal strategy in winter (Mysterud and Ostbye, 1995) and provides a means to avoid heat stress during summer (Sargeant *et al.*, 1994). Muntjac preferred to inhabit the 1,600-2,100 m altitude range but used all elevation ranges in proportion to their availability in the study area ($\chi^2 = 4.57$, df = 3, P = 0.05). In the different habitat categories muntjac showed preference towards dense forest and used all other habitats in proportion to their availability ($\chi^2 = 45.32$, df = 3, P = 0.01). Muntjac were encountered mostly in the northern and western aspects and showed preference towards northern aspects ($\chi^2 = 33.29$, df = 3, P = 0.01), which is similar to the observations made by Sathyakumar (1994) in Kedarnath Wildlife Sanctuary.

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Table: 1 Encounter rate (animals/km) in Khulgarh Watershed Area

Season	Muntjac	Wild boar	Langur	Rhesus macaque	Jackal	Red fox	Leopard
Winter	0.08	0.02	2.82	5.72	0.01	0.004	0.00
Summer	0.14	0.16	7.17	13.33	0.02	0.012	0.008
Overall	0.11	0.14	4.99	9.52	0.06	0.008	0.004
***Man Whitney U Test**	P>0.05	P>0.05	P<0.05	P<0.05	P>0.05	P>0.05	P<0.05

*Man Whitney U Test to know significant difference between the seasons

Table: 2 Overall mean group size of different mammalian species in KWA

Species	Number	Minimum	Maximum	Mean ± SE
Muntjac	31	1	3	1.14 ± 0.05
Rhesus macaque	192	1	55	24.70 ± 0.96
Langur	149	1	41	16.77 ± 0.89

Table: 3 Mean group size of different mammalian species in winter in KWA

Species	Number	Minimum	Maximum	Mean ± SE
Muntjac	10	1	2	1.11 ± 0.07
Rhesus macaque	87	3	35	16.43 ± 0.76
Langur	27	1	21	10.33 ± 1.12

References

Ahmed, K. 2010. **A study on faunal diversity of Dabka and Khulgarh watershed area of Kumoan Himalayas, Uttarakhand, India.** PhD Thesis, Department of Wildlife Sciences, Aligarh Muslim University, Aligarh 276pp.

Ahmed, K. 2007. **Ecology and conservation of Swamp deer in Terai grasslands of Uttar Pradesh, India.** M.Phil dissertation. Department of Wildlife Sciences, AMU, Aligarh. 109pp

Ahmed, K. and J.A. Khan. 2008. **Food habit of Leopard in tropical moist deciduous forest of Dudhwa National Park, Uttar Pradesh, India.** *Inter. J. Ecol. Environ. Sci.* 34(2): 141147.

Karanth, K.U. and M.E. Sunquist. 1992. **Population structure, density and biomass of large herbivores in the tropical forests of Nagarahole, India**. *J. Trop. Ecol.* 8: 21-35.

Khan, J.A., Chellam, R., Rodgers, W.A. and A.J.T. Johnsingh. 1996. **Ungulate densities and biomass in dry tropical forest of Gir, Gujarat, India.** *J. Trop. Ecol.* 12: 149-62.

Manley, P.N., Schlesinger, M.D., Roth, J.K. and B.N. Horne. 2005. **A field-based evaluation of presence-absence protocol for monitoring ecological–scale biodiversity**. *J. Wildl. Manage.* 69(3): 950-966

McCullough, D.R., Pei, K.C. and Y. Wang. 2000. **Home range, activity patterns, and habitat relations of Reeve's muntjacs in Taiwan.** *J. Wildl. Manage.* 64: 430–441.

Mishra, H.R. 1982. **The ecology and behaviour of Chital (*Axis axis*) in the Royal Chitwan National Park. Nepal.** PhD. thesis, University of Edinburgh.

Mysterud, A. and E. Ostbye. 1995. **Bed-site selection by European roe deer (*Capreolus capreolus*) in southern Norway during winter of south central Washington**. *Canadian J. Zool. Lond.* 73: 924–932.

Rahmani, A.R. 1990. **Distribution of the Indian Gazelle or Chinkara *Gazella bennetti* (Sykes) in India.** *Mammalia* 54(4): 605-620.

Sargeant, G.A., Eberhardt, L.E. and J.M. Peek. 1994. **Thermoregulation by mule deer (*Odocoileus hemionus*) in arid rangelands.** *J. Mammal.* 75: 536–544.

Sathyakumar, S. 1994. **Habitat ecology of major ungulates in Kedarnath Musk Deer Sanctuary, Western Himalaya.** PhD thesis, Saurashtra University, Rajkot. 242pp.

Schaller, G.B. 1967. **The Deer and the Tiger.** University of Chicago Press, Chicago. 370pp

Sultana, A. 2002. **Ecology and Conservation of avian communities of Middle Altitude Oak forest of Kumoan Himalaya, Uttar Pradesh, India**. PhD. thesis. Department of Wildlife Science, AMU, Aligarh

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Table: 4 Mean group size of different mammalian species in summer in KWA

Species	Number	Minimum	Maximum	Mean ± SE
Muntjac	21	1	3	1.16 ± 0.08
Rhesus macaque	105	1	55	31.56 ± 1.30
Langur	149	1	41	18.19 ± 1.08

ETHNOBIOLOGY, ETHNOMEDICINE AND ETHNOPHARMACOLOGY PRACTICES AMONG THREE TRIBES OF SIMILIPAL BIOSPHERE RESERVE, ODISHA

by S.K. Sahu, A.K. Sharma and J.K. Nayak

Introduction

Ethnobiology is the scientific study of dynamic relationships between people, biota and environments from the distant past to the immediate present (NSF, 2003). Ethnobiology is a subfield of ethnoscience and emphasizes the people's or participant's perception of the relationship between man and environment. More specifically, ethnobiology is the systematic cross cultural study of how people learn, name, use, and organize knowledge about the biota around them. "Folk biology" is a term commonly used by ethnobiologists to refer to biological classification and reasoning particular to cultural groups (Casagrande, 2004). Naturalists have been interested in local biological knowledge since the time Europeans started exploring the world, from the 15th century onwards. Ethnobiology itself, as a distinctive practice, only emerged during the 20th century as part of the records then being made about other peoples and other cultures. As a practice, it was nearly always ancillary to other pursuits when documenting other's languages, folklore, and natural resource use. By the turn of the 20th century, ethnobiological practices, research and findings had a significant impact and influence across a number of fields of biological inquiry including ecology, conservation biology, development studies and political ecology. This field has become for anthropologists a characteristically academic pursuit interested largely in human cognitive capacities explored through exotic classification of flora and fauna (Sillitoe, 2006).

All societies make use of the biological world in which they are situated, but there are wide differences in use, informed by perceived need, available technology, and the culture's sense of morality and sustainability. Ethnobiologists investigate what life forms are used for what purposes, the particular techniques of use, the reasons for these choices, and the symbolic and spiritual implications of them. The National Science Foundation (NSF) Biocomplexity Workshop Report (2003) defines both the scope and the recent intellectual developments in ethnobiology by dividing it up into five main general subjects: 1) knowledge system; 2) medicine, health and nutrition; 3) ecology, evolution and systematic; 4) landscapes and global trends; and 5) biocomplexity and ethnobiology.

Ethnomedicine is a subfield of ethnobotany and medical anthropology that deals with the study of traditional medicines; not only those that have relevant written sources (e.g., Ayurveda), but especially those knowledge and practices that have been orally transmitted over the centuries. In the scientific arena, ethnomedical studies are generally characterized by a strong anthropological approach, or by a strong biomedical approach, particularly in drug discovery programs. Tribal medicine and medicine men in consonance with the theme of ethnomedicine have a very significant dimension in the contextual frame of medical pluralism.

Ethnopharmacology is the scientific study correlating ethnic groups, their health, and how it relates to their physical habits and methodology in creating and using medicines. As an amalgamation of the social science of ethnology and the medical science of pharmacology, ethnopharmacology studies the pharmacological aspects of a culture's medical treatment as well as its social appeal, including taste, symbology and religious context.

Through this, a culture's exposure to pharmacological substances can be determined. Studies of tribal medicine and medicine men in Odisha are few and far between. They encompass such significant aspects as pre-literate indigenous medical systems and configurations especially of health status, illness, diagnosis, healing practices, etc. Keeping in view the above-mentioned statements, an attempt was made to study those aspects of three tribes, namely, Bhumij, Kol and Birhor of Similipal Biosphere Reserve (SBR).

Biodiversity can be described as the diversity of life on Earth. Simply put, biodiversity is the variety of all living things, the place, the inhabitants, and the interaction between the tribes. Biodiversity is directly responsible for around 40% of the world economy, particularly in sectors such as agriculture and forestry, and for providing ecosystem services such as clean water and soil fertility. Seventy percent of the world's poor live in rural areas and depend directly on biodiversity for their survival and well-being. It is estimated that approximately 60 million indigenous people are almost wholly dependent on forests, 350 million people depend on forests to a high degree for subsistence and income, and about 1.2 billion people rely on agroforestry farming systems. These people lack the basic necessities to maintain a decent standard of living such as sufficient and nutritious food, adequate shelter, access to health services, energy resources, safe drinking water, education and a healthy environment. More then 1.6 billion people depend to varying degrees on forests for their livelihoods, e.g., fuel wood, medicinal plants, and forest food. Approximately 300 million indigenous and tribal groups depend on forests. Forests play a key role in the economy of many countries (World Bank, 2004; IUCN, 2010).

Similipal is considered as the Himalaya of Odisha, because of its enormous influence over the climate, the environmental system of the state of Odisha and its neighbours, particularly Bihar, Chhatisgarh, Jharkhand, Madhya Pradesh, and West Bengal. It is situated between 20° 17' to 22° 34' North latitudes and 85° 40' to 87° 10' East longitudes. The study area was concentrated in and around the deep forest pockets of tribal villages which come under Similipal Biosphere Reserve (SBR) located in Mayurbhanj District of Odisha, India.

The forest dwellers, mostly the tribals, have been wisely using and conserving the natural resources of Similipal since time immemorial. The Similipal hill covers an area of 2,848.89 km^2 in the south-west region of Mayurbhanj District. The area is extremely wild with deep forest growth and several ridges and valleys. This land is situated 3,000 feet above mean sea-level. Several streams and perennial rivers originate from these hills and many of them have waterfalls and rapids coming out of the hills into the plains. The average annual rainfall of this area varies from 40" in the north-eastern part to more than 80" in the central and southern parts. The climate in the upper area is quite pleasant. The winter is very cold with regular heavy frost at many places, indicating temperatures nearing freezing point.

The people of Similipal Biosphere Reserve

The different tribal communities that have dwelled in Similipal since beyond memory are part and parcel of the ecosystem. The majority of people inhabiting in the district constitute aborigine tribes, e.g., Santal, Kol, Bhumij, Bhuyan, Gond, Sabaras, Bhanja-purana, Khadia and Birhor (Mankidia). The tribes and their knowledge of ethnic medicine, their harmonious association with nature, rituals, culture and lifestyle have contributed a lot to the protection of natural resources.

There has been significant growth in some non-timber forest produce (NTFP) markets with the extension of the market system to more remote areas, a growing trade in products such as herbal medicine, foods from the wild, handcrafted utensils and decorative items, and the development of projects focused on production and trade of NTFPs. A few NTFPs have large reliable markets at Kuliana, Sirsha, Jharpokharia, Sarat, Udula, Jashipur, Singida, etc. in Mayurbhanj district, and those tend to be supplied by specialized products using a more intensive production system, Many other NTFPs are vital to the livelihood of the poor, but have little scope for commercialization. The tribes mainly collect minor forest produce like honey, wax, resin, arrowroot and wild mushrooms on a daily basis. In addition, people from outside the reserve collect the bark of the Paja tree (*Litsea monopetala*), flowers and seeds of Mahua, seeds of Sal, etc.

The festivals and the dances of these tribes also form a part of their socio-cultural values. The Santal, in contrast to the Khadias, Kol, Munda, Mahali, Mankadia, have their own dialects such as Kolarian, Mundari, Santali, etc.

The Bhumij and Kol are hardworking and most of them engage in agriculture and forest-based livelihoods.

The Mankidia lead a nomadic life, collect Siali fibers, make ropes, and capture and eat monkeys (Mishra *et al.*, 2001).

The whole rubric of the Birhor subsistence base involves on the one hand the exploitation of forest resources and on the other the economic interaction with the large peasant society. From the forest they garner two dozen varieties of animal food and many types of plant food. They also collect ants and other insects, honey, roots, tubers, various fruits, algae, mushrooms and bamboo shoots. The green leaves of munga (*Moringa oliefera),* pankar (*Ficus cordifolia),* koenar (Bauhinia *purpurea)* amit (*Antidesma diandrum),* Kelha (*Grewia tillifolia),* etc. form their essential food items. The Birhor are excellent monkey catchers. They eat monkey flesh and trade with monkey skin. But the Wildlife Protection Act 1972 does not allow such types of animal hunting activities; as a result, the Birhor found themselves facing nutrition deficiencies and a food crisis.

Every indigenous tribe has their own identity with traditional knowledge in health care and maintaining their livelihoods. This traditional knowledge should be integrated with scientific knowledge to promote and conserve biodiversity. The indigenous tribes depend solely on the surrounding forests for most of their requirements – from food to medicines. The ethnobotany of Similipal is known through the earlier works of Bal (1942), Mudgal and Pal (1980), Pandey and Rout (2002, 2006), Saxena and Dutta (1975), Saxena *et al*. (1988) and Yogunarasimhan and Dutta (1972).

Methodology

In view of the importance of traditional medicine, which provides health services to 75-80% of the world population, the increased demand of herbal drugs by the pharmaceutical companies, and depleted natural plant resources, it is high time to document the medicinal utility of lesser known plants available in remote areas of country. Following the method of Jain (1991) and Jain and Goel (1995), information regarding the usage of medicinal plants available in the local area for treating various ailments and diseases was collected directly by contacting the tribal medicine men of three tribes – Bhumij, Kol and Birhor (Mankidia) – who have knowledge about the medicinal plants of Similipal Biosphere Reserve. Regular field visits were made from December 2009 to February 2010 to collect data about the various medicinal and food values of the roots, fruits and tubers. The study area is rich in medicinal plant resources. An attempt was also made to collect information on the traditional medicinal knowledge present with the local tribes. However, more in depth information may be gathered from the tribes residing in the remote part of the Similipal forest. We carefully documented the plants with their values and cultural importance among the three tribes. The medicinal value of each plant was enumerated in the following pattern: botanical name; family; vernacular name in Oriya (Or.) and Kol (K.); the parts of plants used; and ethnomedicinal uses.

Results and discussion

It was learned that the Kol, and Bhumij tribes of SBR either work as labourers or cultivate crops such as paddy, mandia or jhoar, and mostly depend on the forest and forest products to sustain their livelihoods. The tribals have inherited a rich traditional knowledge about the medicinal uses of the flora investigated and apply this knowledge to make crude phytomedicines to cure infections and a number of ailments ranging from simple colds to other more complicated diseases. Traditional knowledge forms the basis for the origin of not only alternative medicines, but has also led to the evolution of a gamut of new and novel modern medicines. But this knowledge is mostly unknown to the scientific world and faces a slow and natural death. It is paradoxical to see the modern world of late, focusing more on alternative medicine which has a predominantly herbal base.

The ethno-medicinal uses of 33 plant species recorded from the Bhumij, Kol and Birhor (Mankidia) tribes of Similipal Biosphere Reserve are reported in **Table 1**.

Table 1: Ethnomedicinal uses of plants in Similipal Biosphere Reserve, Odisha.

S. No	Botanical name, family and local names	Parts used	Ailments	Mode of preparation
1	*Agave sisalana* Peer. ex Engl., Agavaceae, Sisal (Or.)	Leaves	Tongue infection	Leaf juice applied with honey on tongue.
2	*Alstonia scholaris* (L.) R.Brown, Apocynaceae, Chhatina (Or.)	Bark	Jaundice	Decoction of bark along with bark of *Piper triocum*, *Mangifera indica* and *Piper nigrum* (10-15 nos) taken twice a day for 3 days.
3	*Andrographis paniculata* (Burm.f.) Wall. ex Nees, Acanthaceae, Bhuineem (Or.)	Whole plant	Headache	Entire plant is made into paste and applied externally on forehead.
4	*Atylosia scarabaeoides* (L.) Benth., Fabaceae, Birhorre (K)	Root	Rheumatism	Roots are ground together with *Vitex negundo* (tender leaves), *Kaempferia rotunda* (root), *Clausena excavata* (root) and boiled in *Pongamia pinnata* oil and the oil is applied externally.
5	*Boerhavia diffusa* L Nyctaginaceae, Pueuni saga (Or.)	Whole plant	Leucorrhoea, Asthma	Decoction of plant is given once a day in the early morning for 15 days for the treatment Leucorrhoea and dried plant powder is smoked as cigarette once a day for treatment of asthma.
6	*Calendula officinalis* L., Asteraceae, Gendu (Or.)	Leaves	Cut	Leaves, upper layer of bamboo and lime are mixed together to form a paste and applied.
7	*Calotropis gigantea* (L.) W.T. Aiton, Asclepiadaceae, Patladhudha (Or.)	Root	Malaria	Two 4-inch-long pieces of root are boiled in 400 ml of cow's milk for 5-10 minutes. One teaspoon of the filtered juice is mixed with sugar for treatment of malaria and taken once in a month as a preventive.
8	*Careya arborea* Roxb. Lecythidaceae, Kumbhi (Or.)	Bark	Piles	50 gm stem bark is boiled with water and taken (1 glass) in empty stomach once a day for 7 days
9	*Cassia fistula* L. Fabaceae, Sonari (Or.)	Leaves	Constipation	Half teaspoon juice extract is taken orally thrice a day.

10	*Catharanthus roseus* (L.) G. Don, Apocynaceae, Sadabihari (Or.)	Flower	Diabetes	Infusion of young leaves and flower is taken in morning daily.
11	*Cissampelos pareira* L. var *hirsute* (Buch. – Ham. ex DC) Forman, Menispermaceae, Pitusing (K.)	Root	Colic	Filtered root juice is taken with water
12	*Clausena excavate* Burm.f., Rutaceae, Agnijhal (Or.)	Root	Bodypain	Root is made into a paste and given internally. Roots are boiled and the water is taken against dysentery.
13	*Crotalaria spectabilis* Roth, Fabaceae, Jhunka (Or.)	Root	Dysentery	Juice extracted is given orally
14	*Curculigo orchioides* Gaertn, Hypoxidaceae, Talmuli (Or.)	Tuber	Snakebite	Tuber is made into paste and applied externally as an antidote.
15	*Curcuma amada* Roxb. Zingiberaceae, Amahaladi (Or)	Whole plant	Piles	Paste of 7 long peppers (*Piper longum*) mixed with 3 gm of plant paste, used twice a day for 3 days for the treatment of piles.
16	*Dalbergia latifolia* Roxb. Fabaceae, Sisso (Or.)	Oil	Eczema	Oil is applied externally to treat eczema.
17	*Desmodium gangeticum* (L.) DC. Fabaceae, Salaparni (Or)	Root	Fever	Decoction of root is taken in empty stomach once a day for 5 days to cure fever.
18	*Elephantopus scaber* L. Asteraceae, Talmuli (Or)	Root	Urine infection	Root paste is taken twice a day for a week for the treatment of pain during discharge of urine
19	*Gloriosa superba* L. Liliaceae, Panchangulia (Or.)	Tuber	Rheumatism	Paste is prepared and mixed with the paste of *Piper longum* and is administered once a day for a month for cure of rheumatism.
20	*Hemidesmus indicus* (L) R. Br., Asclepiadiaceae, Guachemda (K.)	Root	Snakebite	Root is made into paste and applied on wounds soon after snakebite. Paste is given orally too.
21	*Kaempferia rotunda* L. Zingiberaceae, Bhuichampa (Or.)	Bulb	Ulcer	Along with root of *Swertia angustifolia* and honey, made into paste given orally twice a day till cured.

22	*Litsea glutinosa* (Lour.) C. B. Robinson, Lauraceae, Ledhachhali (Or.)	Bark	Wound	Paste is applied on wound for faster healing.
23	*Nyctanthes arbor-tristis* L., Oleaceae, Chirat, Saparon(K.)	Leaves	Cough & cold	Young leaves of *Zingiber officinale*, *Piper triocum* (root) are taken together in equal quantities, boiled with water and taken twice a day for three days.
24	*Oroxylum indicum* (L.) Kurz, Bignoniaceae, Ringevenam (K.)	Bark	Appetite	One glassful of decoction of bark is taken orally in the morning for 3 days to stimulate appetite.
25	*Prureria tuberosa* (Willd.) DC.(Fabaceae) Bhuin kakharu (Oriya)	Leaves, flowers Root,	Cold and cough, rheumatism, erysipelas , aphrodisiac, malarial fever, leprosy, diseases of blood , urinary discharges, use in hoarseness of voice, sore throat and sperm production, sexual enhancement pill.	Tubers are used for the treatment of Dysuria, cough, rheumatism, erysipelas and malarial fever. The roots are used in medicine as a demulcent and refrigerant for fevers; as cataplasm for swelling of joints; and as a lactagogue.
26	*Pterocarpus marsupium* Roxb., Fabaceae, Piasal (Or.)	Bark	Blood dysentery	Paste is made with bark of plant pounded with *Mangifera indica* (bark), *Shorea robusta* (bark) and *Spondias pinnata* (bark) of 2 inch size each and administered once in a day.
27	*Rauvolfia serpentina*, (L.) Benth. ex Kurz, Apocynaceae, Chhedabag (K.)	Root	Malaria	Roots are ground with roots of *Cissampelos pareira* in equal quantities mixed with water and taken orally twice a day for 5 days.
28	*Scoparia dulcis* L. Scrophulariaceae, Chiranta (Ko)	Leaf	Sore throat	Decoction of leaf is taken twice a day continuously for a week for the treatment of sore throat.

29	*Sida acuta* Burm. f., Malvaceae, Ipipijon (K.)	Root	Conjunctivitis	Two drops of juice are put in the eye.
30	*Soymida febrifuga* (Roxb.) A. Juss, Meliaceae, Rohini (Or.)	Bark	Colic	Bark powder is mixed with fruits of *Terminalia chebula* in equal quantities and mixed with water. Taken thrice a day.
31	*Withania somnifera* (L.) Dunal, Solanaceae, Ashwagandha (Or.)	Flower	Spermatorrhea	Decoction of flower is taken with honey once a day in empty stomach for one month for the treatment of spermatorrhea.
32	*Woodfordia fruticosa* (L.) Kurz. Lythraceae, Icha (K.)	Tender leaves	Dysentery	Juice is good for treating dysentery.
33	*Ziziphus rugosa* Lam. Rhamnaceae, Chunkoli (Or.)	Bark	Dyspepsia	Decoction is given orally

Some experienced tribals have shared their knowledge with the authors about the cure of some important diseases like diarrhoea, chronic dysentery, chronic constipation, piles, snakebite, rheumatism, diabetes, leucoderma of skin, malaria, blood purification, sperm production, urinary infection, etc. This information is being reported here for the first time.

The study further shows that the knowledge and usage of herbal medicine for the treatment of various ailments among the Bhumij, Kol and Birhor (Mankidia) tribes is still a major part of their life and culture. In the present paper, first hand information on uses of 33 species under 24 families for different diseases was collected from the different localities of Similipal Biosphere Reserve. This information was also checked with the available literature of Karuppusamy *et al*. (2001), Girach and Aminuddin, (1989) and Mishra *et al*. (2001). The ethno-medicinal information provided in this study is new and has not been reported earlier. Thus, the information presented provides enough opportunities to study their active principles in terms of use in modern drugs. Although the efficacy of these herbal remedies is claimed to be high, detailed clinical and experimental trials are needed for better utilization of ethnobotanical knowledge.

Bhuin Kakharu (*Prureria tuberosa* Willd. DC. Fabaceae) is a perennial woody climber with large tuberous roots that grows up to 6 m in height. The leaves are compound, opposite, trifoliate, ovate and curvaceous.

The flowers are white with a pink tinge in dense panicles. Pods are flat, constricted between seeds. *P. tuberosa* is an important medicinal plant in traditional and folklore systems. In the Ayurveda system the flowers are used as a cooling agent and as an aphrodisiac, while the tuber's roots act as a demulcent and refrigerant in fevers (cold and cough, rheumatism, erysipelas and malarial fever). The root tuber is sweet, oily, cooling and tonic, and the roots contain steroids, sugars, amino acids, sterols, and glycosides and are effectively used in aphrodisiacs and diuretics. It is also used to cure leprosy, blood diseases, urinary discharges, and to relieve hoarseness and sore throats. It is employed as an emetic, tonic and also believed to be a lactagogue (Kirtikar and Basu, 1933). In folk medicine, the root tuber is applied for blood purification and to improve sperm production.

Nowadays, it is used in preparing sexual potency enhancement pills. The shade-dried root powder controls overgrowth in the stomach. The consumption of raw root for one month leads to sterilization in women (Venkata Ratnam, 2006).

Well-managed protected areas support healthy ecosystems that in turn support healthy people. When an ecosystem's health declines, there are increased links to declines in human health and wildlife health. Clearing forest creates "edges" where the interaction among the pathogens, vectors, and hosts are increased. Medicinal plants continue to be an important therapeutic aid for alleviating human ailments. Similipal Protected Area is an important repository for medicinal pants, traditional medicines and traditional knowledge, and offers the prospect of discovering new drugs. Nearly 1.1 billion people depend on forests and protected areas for their livelihoods. Forest-related income provides a significant share of the total household income. The tribals, in particular, consider it to be the source of their livelihood and take extreme care to maintain its health. As Similipal has been declared a national park as well as a wildlife sanctuary since 1958, and a tiger reserve since 1973, restrictions have been imposed on the collection of minor forest produce in the reserve forest area and hunting has been strictly prohibited both in the reserve and protected forests. Non-tribals exploit them beyond their basic need, mostly for commercial benefits. For the forest-based community, forest management has become a vehicle for self-determination for ethnic minorities. Among the tribal groups management is highly participatory, but the best practices are those reflected in the traditional system that has developed over centuries and been embraced by the tribes. The role of culture in their development and continued maintenance is pervasive. In fact, the revival and preservation of traditional management practices not only goes hand-in-hand with maintaining cultural integrity and identity, but they form a symbiosis, the survival of which is as crucial for the people as it is for the forests they manage. The struggle to preserve traditional property rights is also a hallmark in these communities for generations and should be given serious consideration before attempting any changes. If it wasn't of benefit then it would have been abandoned long before now. It has been realized that protecting the biodiversity will preserve the future of humans in the long run.

Conclusion

India is a veritable emporium of herbs. The inhabitants of India knew of the medicinal use of plants from time immemorial. Every herb may potentially be of medicinal value. We are still ignorant of many such species and have yet to include them in the list of medicinal plants. The time is ripe to concentrate our efforts on identifying the medicinal plants by consulting the Vedas, Samhitas, and other pre-historic and historic documents on medicinal flora. The present study confirms that the knowledge and usage of herbal medicine in the treatment of various ailments among tribes is still a major part of their lives and culture. The present practices involving medicinal herbs that still prevail among the tribal inhabitants of forests as well as rural dwellers should not be ignored. The tribal population's well-developed traditions of nutrition and health based on the knowledge of the plant properties are now on the wane due to the pressures of modern life. Market-dependent urban food practices are replacing indigenous food habits.

Under the impact of State-sponsored economic development programmes and processes of modernization, the traditional cultures of tribal communities have begun to change. Deforestation and the replacement of natural forests by commercial Teak-Sal plantations have in many areas reduced the availability of forest produce including vegetables, fruits and meat. Tribal development and forest development cannot be separated without listening to the concerns of the tribals for the forests in the country. Only after achieving such knowledge can we look forward to a better future.

References

Bal, S.N. 1942. **Useful plants in Mayurbhanj State in Orissa.** *Rec. Bot. Surv. India* 6: 1-119.

Casagrande, D. 2004. **Ethnobiology lives: Theory, collaboration, and possibilities for the study of folk biologies**. *Reviews in Anthropology* 33: 351-370.

Girach, R.D. and Aminuddin. 1989. **Ethnopteridological notes on *Lygodium flexuosum* (Linn.) Sw.** *Journal of Economic and Taxonomic Botany* 13: 255-257.

IUCN. 2010. **Global Biodiversity Outlooks 2.** CBD, UNEP, IUCN, Canada.

IUCN. 2010. **Sustainable forest Management, Biodiversity and livelihoods: A Good Practice Guide.** Montreal, 47+ iii pages, SCBD, IUCN, ITTO.

Jain, S.K. 1991. **Dictionary of Indian Folk Medicine and Ethnobotany.** Deep Publications, New Delhi. pp. 135.

Jain, S.K. and A.K. Goel. 1995. **A Manual of Ethnobotany.** Edited by Jain S K Scientific Publishers, Jodhpur.

Karuppusamy, S., Karmegam, N. and K.M. Rajasekaran. 2001. **Enumeration, Ecology and Ethnobotany of Ferns of Sirumalai hills, South India.** *J. of Economic and Taxonomic Botany* 25: 631-634.

Kirtikar, K.R. and B.D. Basu. 1933. **Indian medicinal plants. Vol. I – IV.** International Book Distributors, Dehra Dun.

Mishra, R.C., Panda, P.C. and P.A.,Das. 2001. **Taxonomic study of the ferns and ferns allies of Gandhamardan hills, Orissa**. *J. of Economic and Taxonomic Botany* 25: 577-590.

Mudgal, V. and D.C. Pal. 1980. **Medicinal Plants used by tribals of Mayurbhanj (Orissa)**. *Bull. Bot. Surv. India* 22:59-62.

NSF. 2003. **Intellectual Imperatives in Ethnobiology: NSF Biocomplexity Workshop Report.** Missouri Botanical Garden.

Pandey, A.K. and S.D. Rout. 2002. **Medicinal Plants of Similipal Biosphere Reserve-Perspectives of Plant Biodiversity.** (A.P. Das, Ed.) Bishen Singh and Mahendra Pal Singh, Dehra Dun. : 681-696.

Pandey, A.K. and S.D. Rout. 2006. **Ethnobotanical uses of plants by tribals of Similipal Biosphere Reserve, Orissa.** *Ethnobotany* 18:102-106.

Saxena, H.O. and P.K. Dutta. 1975. **Studies on the ethnobotany of Orissa**. *Bull. Bot. Surv. India* 17: 124-131.

Saxena, H.O., Brahmam, M. and P.K. Dutta. 1988. **Ethnobotanical studies in Similipal Forests of Mayurbhanj District (Orissa)**. *Bull. Bot. Surv. India* 30: 83-89.

Sillitoe, P. 2006. **Ethnobiology and applied anthropology: Rapprochement of the academic with the practical.** *L. Roy. Anthrp. Inst.* (N.S.): 119-142.

VenkataRatnam, K, 2006. **Medico-botanical, phytochemical and antimicrobial properties of certain rare and endemic medicinal plants from Gundla-brahmeswaram Wild Life Sanctuary, Andhra Pradesh, India**. Ph.D. Thesis, S.K. University, Anantapur.

Yoganarasimhan, S.N. and P.K. Dutta. 1972. **Medicinal Plants of Orissa- a preliminary survey of Similipahar Forests, Mayurbhanj District, Orissa**. *Nagarjun*15:25-27.

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(Photo: Courtesy of Goutam Sharma)

OCCURRENCE AND DOMINANT BEHAVIOUR OF SINGLE RHESUS MACAQUE FEMALE IN A UNI-MALE BISEXUAL TROOP OF HANUMAN LANGUR AROUND JODHPUR, RAJASTHAN (INDIA)

by L.S. Rajpurohit, G. Sharma and Chena Ram

Introduction

In animal behavior social dominance refers to a learned relationship between individuals such that in agonistic encounters, the subordinate immediately engages in behavior to terminate the encounter such as fleeing or other submissive signaling (Bernstein, 1981). The encounter is unidirectional with the dominant showing aggressive signals or no signal and the subordinate retreating or otherwise submitting. Many people use 'dominance' to mean "priority of access to incentives," because a dominant individual could theoretically use agonistic behavior as an instrumental act to achieve this functional outcome (Carpenter, 1950). Many view dominance in terms of its theoretical function and speculate that dominant individuals use their superiority to obtain whatever improves their genetic fitness and the chance of obtaining mates, food, shelter and social services. Natural selection favors individuals that survive, reproduce more successfully and maximize the survival of their offspring.

In macaques the hierarchy is upward. However, this pattern is not universal in primates. In some species of New World monkeys (e.g., *Cebus apella*), more grooming is directed down the hierarchy (Parr *et al.*, 1997). Further, grooming should be more among similar ranks. A species with the above pattern of grooming, with grooming being related to the encounter rates, would be classified as more despotic than egalitarian.

Dominance is a function of age and social context, which cannot be genetically encoded. The genetic benefits of dominance are not clear. For example, one study found that the causes of mortality differed for high and low ranking individuals and that no clear survival advantage could be demonstrated as a function of rank (Cheney *et al.*, 1981). In other studies the genetic consequences of dominance have been assumed on theoretical grounds alone or assumed based on the high mating success of males during the time that they were dominant. Moreover, studies correlating dominance with paternity are not consistent (e.g., Shively and Smith, 1985; Stern and Smith, 1984).

The present paper deals with the correlation of dominancy behavior between members of a langur family unimale bisexual troop and a female Rhesus macaque near Jodhpur.

Material and methods

Jodhpur is located in Rajasthan at the eastern fringe of the Thar desert. The town was founded in 1498 AD and erected on a hilly sandstone plateau of approximately 150 km^2, surrounded by flat, semi-desert lands. This plateau is inhabited by a geographically isolated population of about 1,900 langurs which has been studied by various Indian and foreign researchers for more than four decades.

The climate here is dry with maximum temperatures of 48°C in May/June and minimum temperatures around 0°C in December/January. Jodhpur receives 90% of its scanty rainfall (average 380 mm) during the monsoon in July-September. The natural open scrub vegetation is dominated by xerophtic plants including *Prosopis juliflora, Acacia senegal, Prosopis cineraria* and *Euphorbia caducifolia*. There are numerous irrigated parks and fields. In the open scrub habitat, langurs spend an average of 66% of their feeding time on natural foods and the remainder on food provisioned by local people for religious reasons. The langurs here are well habituated and are seen on the ground during most of the day time and therefore easy to observe in nature.

The habitat used by these langurs includes open scrub forests, fields, human habitations, parks and orchids. Water is available to all groups throughout the year from man-made ponds which collect rainwater. For age categorization, physical growth, genital development and incisor-canine were used as the major criteria (Rajpurohit and Sommer, 1991). The physical marks, scars, deformities or their typical movements and sitting postures were used to identify individual animals.

Hanuman langur (*Semnopithecus entellus*) is the best studied and most adaptable South Asian Colobine. The species has a highly variable social organization. The two basic types of social groups are bisexual troops and all-male bands. The bisexual troops are matrilineal groups of adult females and offspring with either one adult male (unimale bisexual troops) or more than one adult male (multimale troops). The percentage of unimale troops versus multimale troops and the corresponding number of extra troop band males varies from site to site (Newton, 1988). The unimale bisexual troops are predominant around Jodhpur, where aside from temporary multimale groups formed during male band invasions, 99% the reproductive social units are one-male bisexual troops or harems. Genus Macaca has many species and is widely distributed; it is said to be the most successful non-human primate genus. Because *Macaca mulatta* has historically often been used as a subject for experiments, it has been widely researched.

The langur population of about 1,900 in and around Jodhpur is organized into 49 groups (35 unimale bisexual troops and 13-14 all-male bands). Each troop occupies its own home range of about 0.5-1.5 km^2. Females remain in their natal troops for life. Males emigrate or are expelled, usually as juveniles, to join unisexual all-male bands whose home ranges can be as large as 20 km^2. The present study focuses on a langur bisexual troop which has one rhesus female showing dominant behavior toward troop members.

Data were collected by observers after establishing the individual identification of all the members of the two focal groups. Focal animal sampling and all-occurrence scan (Altmann, 1974) techniques were used for the purpose. The animals quickly became habituated to the observer, who never carried food and never chased the langurs, although counter charging was required during the first 2-3 weeks. The observer was individually recognized by animals and treated differently than people who either fed or chased them. The langurs sometimes approached and allowed observer to walk within 1m of them without disturbance.

Observation and results

The authors studied the bisexual langur troop Bhimbhark (B-22) near Kailana Lake of Jodhpur that consisted of 111 animals, including one rhesus female. Data was gathered by scan sampling and focal animal sampling. It was observed that the rhesus female living in this troop for the past five years showed a dominant nature. The main

determinant of dominancy in this troop was displacement. It was for food procurement, for macaque females while interacting with troops, or to occupy the better places. Rhesus society is a strong linear hierarchy among adult males and females of langur societies. They are cooperative at group activities. We also observed that both species groom each other. Alpha males and rhesus females also participate together in foraging, feeding, grooming and it was observed that the dominance rank of a rhesus female rises, but rhesus females groom alpha males more than the reverse.

Other determinants were chasing, fights, and harassment of langur females during interactions with the troop members. In troop B-22, dominance behavior of the female macaque was determined on the basis of several dominance interactions like displacement during the food procurements and grooming. It has been found that each individual knows its status and follows the social hierarchy. Most of these status interactions were nonviolent and the macaque dominance is maintained without serious fights. To reconstruct a displacement hierarchy, there was a linear and stable rank over short periods, but which fluctuated according to the age composition of the troop, resulting in an age-inversed dominance structure.

The maximum episodes of displacements by dominate to subordinate individuals were for food procurement, for the possession of estrous females, for better places and other behaviors such as allomothering, or just to exhibit the status amongst themselves. In many cases dominant males chased and gave threats to subordinates during the male band invasions of bisexual troops or when low ranking individuals disturbed sexual acts.

Discussion

Dominance has been identified as a determinant drive of social behavior in infrahuman primates (Maslow, 1935). Since then, studies relating to it have proliferated (e.g., Bernstein, 1970; Richard, 1974; Loy, 1975; Roonwal, 1976). Veritably, the organization and behavior of primate groups revolve around the dominance network, but the way it is expressed is so intricate that it seems to be erratic in measurement. The diffusion of dominance-related concepts, viz. group hierarchy (Carpenter, 1964), looped hierarchy (Kummer, 1968), basic/dependent rank (Kawai, 1958), and sub-sets of age-sex classes (Loy, 1975), has complicated the multitude of various competitive (e.g., Syme, 1974; Farres and Haude, 1976), as well as social measures (e.g., Bernstein, 1970; Richards, 1974).

Recent studies of dominance in free-ranging conditions (e.g., Crook, 1970; Rowell, 1972) have initiated a controversy that dominance hierarchies are expressions or an artifact of stress or captivity.

It is hypothesized that measures having high internal validity will be represented by a "general factor," whereas measures having high external validity should correlate significantly with other measures. Thus, factor analysis was thought to be an accurate multivariate technique to evaluate internal and external validity in the psychometric fashion. The measures selected were: 1) competitive feeding; 2) grooming of others; 3) grooming by others; 4) withdrawal on others' approach; 5) others' withdrawal on approach; 6) aggression toward others; 7) aggression by others; 8) submission to others; and 9) submission by others.

A reasonably linear dominance hierarchy could be produced for the 20 adult langurs of two focal groups. And there is a significant correlation between social rank and resource utilization among Hanuman langurs around Jodhpur. The present study strongly suggests that the prime adult females as well as males enjoy the top ranks until the next younger one emerges as the new prime. This study further suggests that the ousted resident males failed to regain residency in any bisexual troop and even fell in rank in their band on rejoining. The most dominate male or on rare occasions the beta male, becomes resident wherever a band invasion is successful. The vacant position of alpha or beta male in a male band is filled/occupied by the next ranking male and this pattern of filling and elevating of ranks goes on (also see Rajpurohit and Mohnot, 1988). Koyoma (1967) observed falls in rank due to ageing in wild Japanese monkey troops at Arashiyama.

Acknowledgements

The authors are grateful to S.M. Mohnot, Emeritus Professor of Zoology and Chairman, Primate Research Center, Jodhpur for his continuous encouragement. Thanks are also due to Prof. Devendra Mohan Head, Department of Zoology, J.N.V. University, Jodhpur, for providing facilities and logistic support during the study and to UGC, New Delhi, for financial support under the major project (No. F.30-460/2008 (SR) dt.02 Jan 2009).

References

Altmann, J. 1974. **Observational study of behaviour-sampling methods**. *Behaviour*, 49: 227-269.

Bernstein, I.S. 1970. **Primate status hierarchies**. In: (Ed. L.A. Rosenblum) *Primate behaviour: Development in Field and Laboratory Research*, Vol. I, New York Academic Press, pp. 71-109.

Bernstein, I.S. 1981. **Dominance: The baby and the bathwater**. *Behav. Brain Sci*., 4: 419-457.

Bernstein, I.S. 1969: **Stability of the status hierarchy is a pigtail monkey groups (*Macaca nemestrina*)**. *Anim. Behav*., 17: 452-458.

Carpenter, C.R. 1950. **Social behaviour of non-human primates. Structure at physiologiedes societies animals: Colloques Internationaux du centre National de la ReCherche**. *Scientifique*, 34: 227-246.

Carpenter, C.R. 1964: **Naturalistic behaviour of non-human primates**. Pennsylvania State Univ. Press, Pennsylvania.

Cheney, D.L., Lee, P.C. and R.M. Seyfarth. 1981. **Behavioural correlates of non-random mortality among free-ranging female vervet monkeys**. *Behav. Ecol. Sociobiol.*, 9: 153-161.

Crook, J.H. 1970. **Social organization and environment: Aspects of contemporary social ethology.** *Anim. Behav.* 18: 197-209.

Farres, A.G. and R.H. Haude. 1976. **Dominance testing in rhesus monkeys: comparison of competitive food getting, competitive avoidance and competitive drinking procedure**. *Psychol. Rev*., 38: 127-134.

Kawai, M. 1958. **On the rank system in a natural group of Japanese monkeys.** *Primates*, 1 (2): 111-148.

Koyama, N. 1967. **On dominance rank and kinship of wild Japanese monkey group in Arashiyama**. *Primates*, 8: 189-216.

Kummar, H. 1968. **Social organization of hamadryas baboons**. Chicago, University of Chicago Press.

Loy, I. 1975. **The descent of dominance in macaca. Insights into the structure of human societies.** In: (Ed R.H. Tuttle) *Socio-ecology and psychology of primates*, pp. 153-180.

Maslow, A.H. 1935. **The dominance drive as determiner of social behaviour in infrahuman primates**. *Psychol. Bull*., 32: 714-715.

Newton, P.N. 1988. **The variable social organization of Hanuman langur (*Presbytis entellus*)**. *Int. J. Primatol*, 8: 199-232.

Paar, L.A., Matheson, M.D., Bernstein, I.S. and F.B.M. de Waal. 1997. **Grooming down the hierarchy: allogrooming in captibrown capuchin monkeys (*Cebus apella*)**. *Anim Behav.*, 54: 361-367.

Rajpurohit L.S. and V. Sommer. 1991. **Sex differences in mortality among langurs (*Presbytis entellus*) of Jodhpur, Rajasthan**. *Folia Primatol*. 56:17-27.

Rajpurohit, L.S. and S.M. Mohnot. 1988. **Fate of ousted male residents of one-male bisexual troops of Hanuman langur (*Presbytis entellus*) at Jodhpur, Rajasthan (India)**. *Hum. Evol.*, 3: 309-318.

Richards, S.M. 1974. **The concept of dominance and methods of assessment.** *Anim. Behav.*, 22: 914-930.

Roonwal, M.L. 1976. **Dominance behaviour in South Asian Primates.** *Journal Sci. and Industrial Research*, 35: 224-260.

Rowell, T.E. (Ed.). 1972. **The social behaviour of monkeys.** Penguin, Baltimore.

Shively, C. and D.G. Smith. 1985. **Social status and reproductive success of male (*Macaca fascicularis*).** *Amer. J. Primatol* 9 129-135.

Stern, B.R. and D.G. Smith. 1984. **Sexual behaviour and paternity in three captive groups of rhesus monkeys (*Macaca mulatta*).** *Anim. Behav.* 32: 23-32.

Syme, G.J. 1974. **Competitive orders as measures of social dominance.** *Anim. Behav.*, 22 : 931-940.

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FOREST NEWS

Vol. XXV: No. 1 Jan-Mar 2011

THE WORLD CELEBRATES 2011 THE INTERNATIONAL YEAR OF FORESTS!

Let's celebrate! The United Nations has declared 2011 as the International Year of Forests to raise awareness on the sustainable management, conservation and development of all types of forests. The decision was taken by the UN General Assembly in recognition that forests and sustainable forest management can significantly contribute to sustainable development, poverty eradication and the achievement of internationally agreed development goals, which include the Millennium Development Goals.

"Forests for People" is the main theme of the Year, highlighting the dynamic relationship between forests and the people who depend on them.

IYF 2011 provides an unprecedented opportunity to bring attention to the interconnectivity between people and forests. National, regional and local organizations around the world are organizing IYF 2011 events in line with their own interests and, making special efforts to reach out to those in fields not traditionally considered directly related to forests. In fact, forests are important to nearly all kinds of human activity: providing shelter to people and habitat to biodiversity; as a source of food, medicine and clean water; and playing a vital role in maintaining a stable global climate and environment.

The UN declaration calls for concerted efforts to focus on raising awareness at all levels to strengthen conservation of forests.

Forests make up about 31 percent of the total landmass of the globe. The livelihoods of an estimated 1.6 billion people are dependent on forests, while 300 million people live in forests.

The United Nations Forum on Forests (UNFF) Secretariat serves as the focal point for the implementation of the year. This is being done in collaboration with governments, the Collaborative Partnership on Forests, of which the UN Food and Agriculture Organization (FAO) serves as the chair, and international, regional and sub-regional organizations.

The UN has called for voluntary partnerships among member states, international organizations and major groups to facilitate and promote activities related to the year at local and national levels, including the creation of national committees or focal points in their respective countries.

Scenes at the FAO Regional Office for Asia and the Pacific:
Top left: IYF banner on FAO building; Top right: Chutarat Damrongsrisakul; Bottom (L-R): Kallaya Meechantra, Sverre Tvinnereim, Hiroyuki Konuma (FAO Assistant-Director General and Regional Representative), Patrick Durst, Simmithiri Appanah

FOREST RESOURCES ASSESSMENT (FRA) 2010: KEY FINDINGS AND UPDATES

Contributed by Monica Garzuglia, FAO Forest Resources Assessment Officer

The Global Forest Resources Assessment 2010 (FRA 2010) is the most comprehensive assessment of the world's forests and forestry to date – not only in terms of the number of countries and people involved – but also in terms of scope.

It covers 233 countries and areas and examines the current status and recent trends for about 90 variables for the period 1990 to 2010, covering the extent, condition, uses and values of forests, with the aim of assessing all benefits from forest resources.

FAO worked closely with countries and specialists in the design and implementation of FRA 2010 – through regular contact, expert consultations, training for national correspondents and 10 regional and sub-regional workshops.

More than 900 contributors were involved, including 178 officially nominated national correspondents and their teams. The outcome is better data, a transparent reporting process and enhanced national capacity in developing countries for data analysis and reporting.

The main report of FRA 2010 was released and distributed in English at the occasion of the 20th session of the FAO Committee on Forestry (COFO) and World Forest Week in Rome, in October 2010.

In the FRA 2010 main report, seven core chapters evaluate the status and trends for key aspects of sustainable forest management: extent of forest resources; forest biological diversity; forest health and vitality; productive functions of forest resources; protective functions of forest resources; socio-economic functions of forests; and the legal, policy and institutional framework guiding the conservation, management and use of the world's forests. Based on these results, the report analyzes progress being made towards sustainable forest management over the past 20 years, with a series of "traffic lights" indicating where there is cause for optimism and where there is cause for alarm.

This report is an essential reference for anyone interested in the status of the world's forests and will support policies, decisions and negotiations in all matters where forests and forestry play a part.

One of the key findings from FRA 2010 is that the world's forests cover just over four billion hectares, or 31 percent of the total land area.

FRA 2010 also estimated that deforestation, mainly the conversion of tropical forests to agricultural land, has decreased over the past ten years but continues at an alarmingly high rate. Globally, around 13 million hectares of forests were converted to other uses or lost through natural causes each year between 2000 and 2010 compared with around 16 million hectares per year during the 1990s.

Afforestation and natural expansion of forests in some countries and regions have reduced the net loss of forest area significantly at the global level, from -8.3 million hectares per year in the 1990s, to -5.2 million hectares per year in the last decade.

In Asia and the Pacific region, the net change of forest area shifted from a net loss of -0.7 million hectares per year in the 1990s, to a net gain of 1.4 million hectares per year registered in the last decade.

The overall shift from a net loss to a net gain of forest is primarily due to large-scale afforestation reported by China, and to a reduction of forest loss in Indonesia. However, conversion of forested lands to other uses continued at high rates in many countries in the region.

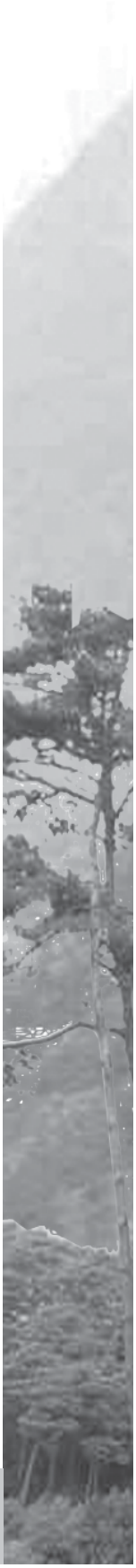


TABLE 9.7
Progress towards sustainable forest management in Asia, 1990–2010

Thematic element	FRA 2010 variables	Data availability	Annual change rate (%)		Annual change		
			1990–2000	2000–2010	1990–2000	2000–2010	Unit
Extent of forest resources	Area of forest	H	-0.10	0.39	-595	2 235	1 000 ha
	Growing stock of forests	H	0.34	-0.17	n.s.	n.s.	m³/ha
	Forest carbon stock in living biomass	H	-0.11	-0.31	-40	-112	million tonnes
Forest biological diversity	Area of primary forest	H	-0.43	-0.31	-504	-342	1 000 ha
	Area of forest designated primarily for conservation of biodiversity	H	0.77	2.08	471	1 461	1 000 ha
	Area of forest within protected areas	H	1.45	1.46	1 292	1 503	1 000 ha
Forest health and vitality	Area of forest affected by fire	H	-2.56	-1.53	-78	-39	1 000 ha
	Area of forest affected by insects	L	13.18	0.32	306	14	1 000 ha
Productive functions of forest resources	Area of forest designated primarily for production	H	0.26	-1.21	662	-2 945	1 000 ha
	Area of planted forest	H	2.00	2.82	1 667	2 985	1 000 ha
	Total wood removals	H	-0.64	0.18	-4 948	1 364	1 000 m³
Protective functions of forest resources	Area of forest designated primarily for protection of soil and water	H	1.75	2.18	1 741	2 638	1 000 ha
Socio-economic functions of forests	Area of forest under private ownership	H	4.79	6.27	2 930	5 572	1 000 ha
	Value of total wood removals	M	-2.97	4.36	-806	1 091	million US$
	Employment in primary production of goods	M	-0.85	-0.10	-73	-8	1 000 FTE
Legal, policy and institutional framework	Forest area with management plan	M	2.68	3.71	4 384	8 291	1 000 ha
	Human resources in public forest institutions	H	-2.14	0.16	-22 922	1 633	total staff
	Number of students graduating in forestry	M	23.89	10.80	3 856	3 522	number of students

Notes: No forecasting to 2010 was done for areas affected by fire and by insects or for the amount and value of wood removals. For these variables estimates were provided for 1990 (an average of the period 1988–1992), 2000 (average of 1998–2002) and 2005 (average of 2003–2007). Data on ownership and employment were requested only for 1990, 2000 and 2005. In all these cases change rates were calculated for the periods 1990–2000 and 2000–2005. Data for human resources in public institutions and the number of forestry graduates are from 2000, 2005 and 2008; change rates are calculated for 2000–2005 and 2005–2008

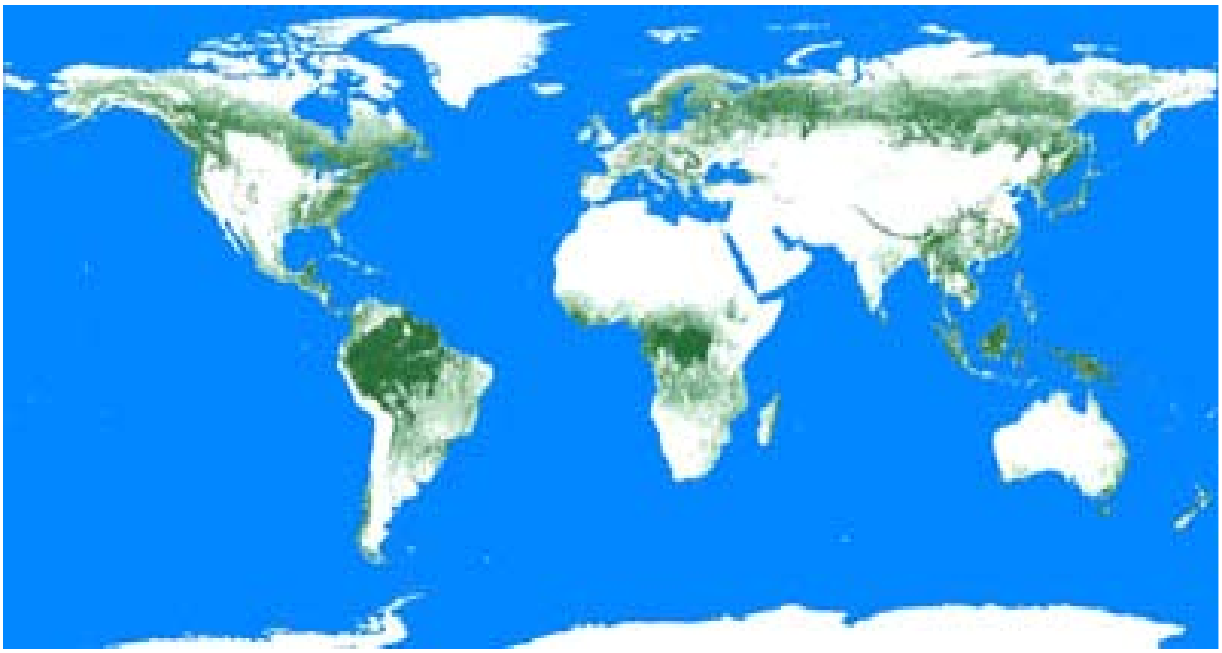
H = High (reporting countries represent 75–100% of total forest area)
M = Medium (reporting countries represent 50–74% of total forest area)
L = Low (reporting countries represent 25–49% of total forest area)

● = Positive change (greater than 0.50%)
● = No major change (between -0.50 and 0.50%)
● = Negative change (less than -0.50%)
– = Insufficient data to determine trend

The Pacific, particularly, experienced a negative trend, exacerbated in the last ten years because of the situation in Australia where a severe drought has led to a substantial loss of forests since 2000.

FRA 2010 also estimated that 19 percent of the forest area in the region, equivalent to 142 million hectares, is composed of primary forest with no visible indications of human activities. Results indicate that the total area of primary forest declined by 7.2 million hectares in the last ten years. This does not necessarily mean that these forests have disappeared; rather, in many cases they have been reclassified because selective logging or other human interventions were carried out during the reporting period.

Although the Asia-Pacific region only accounts for 18 percent of the world's forest area, it accounts for 45 percent of the world's planted forests. Planted forests in the region are mostly established through afforestation (tree planting on land which has not carried forest within living memory) rather than through conversion of natural forests to planted forests. The area of planted forest experienced a substantial increase of more than 29 million hectares within the last ten years. This increase is largely due to China, India and Vietnam, which have all established targets of large scale forest planting aimed at desertification control and conservation of soil and water resources, but also developed programs and incentives for smallholders to plant more trees. However, a contraction of the planted establishment rate has been registered during the last five years compared with the first part of the decade where the planting rate shifted from 3.4 to 2.5 million hectares per year.



Scientific reference for the global percent tree cover map is best located in the following peer-reviewed publication: Hansen, M., R.S. DeFries, J.R.G. Townshend, M. Carroll, C. Dimiceli, and R.A. Sohlberg (2003), "Global Percent Tree Cover at a Spatial Resolution of 500 Meters: First Results of the MODIS Vegetation Continuous Fields Algorithm", Earth Interactions, Vol 7, No 10, pp 1-15.

In terms of the use of the forests, 32 percent of the forests of the region are primarily designated for the production of wood, fibre, bio-energy and/or non-wood forest products.

The conservation of biodiversity and the protection of soil and water together are the primary management purposes for 33 percent of the forests. This area increased by almost 40 million hectares in the last decade.

FRA 2010 also asked countries to provide information on the national legal and policy framework related to forests, given its the importance for sustainable forest management. In the region, 29 countries, accounting for 98 percent of the total forest area, reported that they have a national forest policy, while close to 94 percent of the total forest area of the region is covered by national forest programmes (in various stages of implementation).

An important key message from FRA 2010 is that although the Asia-Pacific region registered a gain in the total forest, deforestation is still taking place at an alarming rate in many countries in the region.

Furthermore, the large tree planting programmes in China, India and Vietnam, accounting for most of the gains in forest area, are scheduled to end by 2020, leaving a short window of opportunity to put in place effective and permanent measures to significantly reduce current rates of deforestation and forest degradation. Without such interventions there is a high risk of a sudden return to the high rates of net forest loss and of carbon emissions from forests seen in the 1990s.

FRA 2010 highlighted that forest biodiversity in the region is at risk because of the decrease in the area of primary forest, but another key message was also that thanks to national forest policies, which are increasingly focusing on the multiple roles of forests, forests in the region are increasingly being conserved and managed for the protection of soil and water resources and for the conservation of biological diversity.

FRA 2010 remote sensing survey

To obtain more detailed and comparable information on forest change dynamics (deforestation, afforestation and natural expansion

of forests) at global, biome and regional levels, a global remote sensing survey is currently being carried out, as part of the Global Forest Resources Assessment 2010.

This global survey is mainly based on the use of available Landsat imagery, but also incorporates auxiliary information such as other remote sensing images, local knowledge and results from existing and past field inventories. Around 13,500 samples, each one representing an area of 10 km x 10 km, are being analyzed. This sample grid provides a sampling intensity of about 1 percent of the global land surface plots, which is the same used for the national forest assessments supported by FAO and by many national forest inventory programmes.

As part of the FRA 2010 Remote Sensing Survey, an updated map of global percent tree cover circa 2005 has been produced by the Geographic Information Science Center at South Dakota State University. The map, and accompanying digital dataset, is created using satellite data from the Moderate Resolution Imaging Spectroradiometer, or MODIS, sensor and has a pixel size of 250 meters. This is a significant improvement in spatial resolution over a similar map published as part of FRA 2005.

A series of regional and sub-regional training and validation workshops took place throughout 2010. A couple of validation workshops are scheduled to take place beginning of 2011, while final results will be available by the end of 2011.

Three workshops were held in the Asia and the Pacific region. The first land cover validation workshop for Mekong countries was held in Bangkok in February 2010. A second workshop was held in Bangkok in August 2010 for validation of land cover and forest land use for South East Asian countries. A third workshop on land cover and forest land use validation was held in Beijing for East Asian countries.

Southeast Asian countries have now completed the Land-cover and Land-use validation of the Global Remote Sensing Survey, which is a great result. China is also working diligently to process the almost one thousand samples after the workshop in October.

FRA 2010 special studies

A series of special studies is also underway to provide complementary information as well as inputs to discussions on how these aspects can be incorporated in future assessments.

Forest degradation

A special study on forest degradation is being carried out in collaboration with members of the Collaborative Partnership on Forests and the UN-REDD programme. This special study aims to identify different aspects of forest degradation and the best practices for assessing them. Expected outputs from this special study are to increase awareness on forest degradation, to define operational definitions of components of forest degradation, and to develop appropriate tools to help assess and monitor forest degradation.

Forests and forestry in Small Island Developing States (SIDS)

In 2008, participants from Pacific island countries to the FRA 2010 regional workshop recommended that a special study on SIDS should be carried out in order to draw attention to forests, forest management and specific forest-related issues in Small Island Developing States. On the occasion of the Asia-Pacific Forestry Commission Session in Bhutan in June 2010, a side event on the SIDS special study was held with the support of the Secretariat of the Pacific Community (SPC). The side event aimed at informing participants on the objectives of the special study and at discussing with them the content, format and scope of the study. During the discussions, main challenges, constraints and opportunities of the forest sector in the SIDS were addressed by the participants, who also provided useful inputs for the further development of the special study and agreed on a workplan.

WHAT CAN FORESTS CONTRIBUTE TO THE POOR?

Contributed by Wang Hong and Jeremy Broadhead

Forests provide a variety of ecological, economic and social benefits for human society. But the utilization of forests differs among countries and even during different development phases in the same country. Although biodiversity conservation and the ecological functions of forests are very important for sustainable development, most developing countries with abundant natural forests in Asia and the Pacific expect forests to provide economic benefits. In most cases, a large proportion of the income from forests ends up in the pockets of companies or the elite due to weak governance, while little trickles down to local communities.

The Asia-Pacific region is home to over 900 million poor (about 2/3 of the world's total). Most are in rural areas and there is considerable overlap with forest areas. As such, the forestry sector developments are intimately engaged with poverty issues. Furthermore, with only a few years remaining before 2015 – the target for achieving the Millennium Development Goals (MDGs) – there is great urgency for all sectors to contribute to poverty alleviation, particularly in rural areas.

To support this effort, the FAO Regional Office for Asia and the Pacific initiated a study in 2010 to assess the contribution of forestry to poverty alleviation. The objective of the work is to identify poverty alleviation opportunities by reviewing the past contribution of forestry to poverty alleviation and the extent to which it can be expected to contribute in the future given national development trends.

In relation to the study, a regional workshop on "The contribution of forestry to poverty alleviation in Asia and the Pacific" was convened 8-9 March 2011 in Chiang Mai, Thailand, in collaboration with the Asia Forest Network (AFN). The workshop brought together 29 participants, including one forestry official and one national consultant from each of 11 countries: Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Nepal, Philippines, Papua New Guinea, Thailand and Vietnam.

The workshop aimed to: i) provide participants with an overview of forestry sector developments in the Asia-Pacific region to 2020; ii) provide an opportunity for national forestry agencies to

Group discussion during workshop.

Orchid collecting brings income from the forest in Lao PDR. (Photo: Jeremy Broadhead)

Forest kids in Lao PDR (Photo: Jeremy Broadhead)

exchange information in relation to past and current poverty alleviation initiatives; iii) facilitate selection of focal areas for study of the contribution of forestry to poverty alleviation in each country; and iv) train participants in field survey techniques and discuss case study methodologies.

The contribution of different areas of forestry to poverty alleviation

The two-day workshop involved discussion among participants not only in relation to forestry and poverty, but also wider social and economic development. Views were shared regarding three areas of forestry and their actual and potential contribution to poverty alleviation: i) traditional and community forestry; ii) commercial and industrial forestry and payments for environmental services (PES); and iii) carbon payments.

Traditional forestry and community forestry

Community forestry has been practiced for around 40 years in the region, often assisting communities to gain title over areas where traditional forestry had been practiced for centuries. Community forestry has played an important role in addressing rural poverty in the region through strengthening tenure and access rights, supporting capacity development, improving local empowerment and gender equality, improving access to markets and adding value, and reinforcing forest conservation to maintain ecosystem services. Therefore, traditional forestry and community forestry are generally recognized as contributing primarily to poverty avoidance rather than poverty elimination.

Even so, in some situations forests can help eliminate poverty where rights are allocated and forests become a foundation for savings, investments or asset creation. Meaningful implementation of policy reforms and careful planning of forestry, economic development and poverty-related programs is the key to poverty alleviation through community forestry. Providing opportunities for investment and skills development through partnership between communities and companies, governments or other institutions can help the poor establish and sustain livelihoods at a satisfactory level. The development and improvement of local infrastructure and basic services can also facilitate poor people's access to markets, services and information.

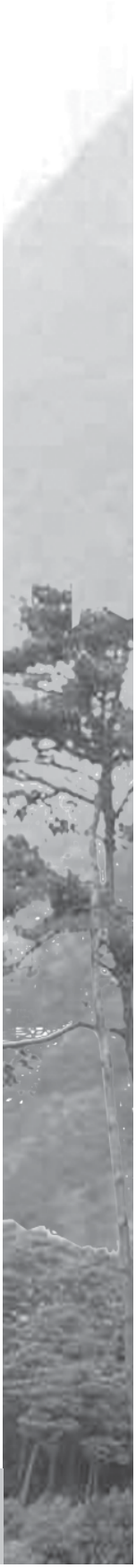
Despite the current trend towards climate change as a priority in forestry, community forestry is still an important area of sustainable forest management and poverty alleviation. Thus, donor funding should continue to support community forestry. Forestry institutions that adopt facilitative rather than command and control roles will also greatly support community forestry.

Commercial and industrial forestry

In general, commercial forestry (e.g., a certain scale of non-wood forest product processing and sale, outgrower schemes, etc.) and industrial forestry (e.g., large-scale logging, plantation development and timber processing) are not areas that the poor have resources to directly engage in. The poor can, however, benefit through employment and associated market opportunities as well as through improvement in basic services or infrastructure that accompany the development of commercial and industrial forestry.

At the national level, commercial and industrial forestry make the greatest contribution to the GDP within the forestry sector but the economic benefits reallocated to rural areas may be small. Commercial and industrial forestry can create jobs but, depending on the level of technology used and skill requirements, the poor may have limited opportunities for employment. Furthermore, although employment may provide income, the poor may not get fair rates, safe working conditions or other benefits. Overall, the share of benefits that reaches the poor in commercial and industrial forestry tends to be low.

Commercial and industrial forestry can also have negative social and environmental impacts through unsustainable operations and neglecting local livelihoods. Unsustainable corporate activities can destroy the local resource base, especially where monitoring and accountability measures are lacking. Considering the future growth of commercial and industrial forestry in developing countries, national environmental and social standards and corporate social responsibility can help ensure that more benefits from forests reach the poor.



Improvements in governance – including greater transparency, an increased role for civil society and more inclusive regulatory mechanisms – are also necessary to improve the accountability of corporate operations and increase equitable sharing of benefits. Training in vocational skills, establishing community organization, accessing marketing and information can help local communities in the development of fair partnerships and attracting investment opportunities. Financial support for forest users, including credit or subsidies, can also help the poor to engage in economically productive activities.

PES and carbon payments

Payments for ecosystem services (PES) are a potential source for financing sustainable forest management and to provide funds supporting basic services and infrastructure development in forest communities.

Ecotourism is often considered as a form of PES and is growing fast in the Asia-Pacific region. Ecotourism serves to encourage local communities to protect and rehabilitate forests. Many countries in the region have placed ecotourism as one of the main priorities in forestry. In Asia and the Pacific region, revenues from the tourism industry are expected to top US$4.6 trillion by 2010 and contribute 6-7 % to overall employment (APFSOS II, 2010).

Water-related PES is seen as another promising area due to the continued growth of the region's economies. Many PES schemes have been developed in relation to specific beneficiaries, such as water supply companies, hydropower plants or metropolises. Although payments for the role of forests in helping to conserve and sustain water supplies may be received, the methods by which funding can assist the poor are not fully developed or tested and much work still needs to be done in this area.

Carbon payments, especially for REDD+, are gaining much interest in the region and are regarded as the new frontier for forestry and poverty alleviation. REDD+ may offer income, employment opportunities and social and environmental safeguards to local communities, but some issues remain unsolved up to the South Africa negotiation in December 2011, including the financing of REDD+ implementation.

PES is still at a nascent stage in all countries involved in the current study. To ensure that payments will result in poverty alleviation, PES policies will need to be carefully thought out whilst avoiding too high a level of regulation that itself may attract significant costs.

Views beyond the forestry sector

At the regional meeting, points were also presented that helped better define the position of forestry in relation to its contribution to poverty alleviation:

- Economic development is a top priority in most developing countries, as it provides governments with the resources to support social services and pro-poor projects. However, the trickle down effect has often been far too weak.
- Most government focus on economic growth has led to tradeoffs with the environment and there is now renewed emphasis on development and environmental sustainability.
- Poverty is complex and multi-dimensional. It is not just about income, but also deficits in relation to governance, institutions and other areas. Thus, economic growth alone is not always sufficient to remove people from poverty. Poverty must be tackled in various ways and through common efforts among relevant sectors.
- Forests can be managed for multiple objectives. If the priority is to manage forests entirely for carbon, other aims, including poverty alleviation, may be sidelined. Therefore, co-benefits of forest management should not be overlooked.
- Recognition of the role of forestry in poverty alleviation does not presume that the forestry sector can solve the problem of poverty alone. However, the fact that forestry sector activities often take place in locations where there is great poverty, means that there is a fundamental and valuable role that forestry can play through better integrating poverty alleviation efforts.

Reference

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

STRATEGIC PLANNING FOR SOUTH ASIAN FORESTRY

Contributed by Patrick Durst and Jeremy Broadhead

Dasho sherub Gyaltshen, Honorable Secretary of Agriculture and Forestry, Bhutan, provided the Keynote Address for the Opening Session of the Workshop on Strategic Planning for South Asian Forestry. (Photo: Chado Tshering)

As part of the Asia-Pacific Forest Outlook Study 2020 (APFSOS), seven countries in South Asia drafted country outlook papers aimed at assessing trends in forestry and developing scenarios for the future to 2020. As APFSOS neared completion, member countries requested FAO to assist countries in making effective use of the findings, data, analyses, and recommendations emerging from the outlook study. The 23rd session of the Asia-Pacific Forestry Commission (APFC) specifically requested FAO to provide support in follow up to the Asia-Pacific Forest Sector Outlook Study, with a focus on strategic planning, rationalization of forest policies, and re-orientation of policies to meet emerging challenges in forestry.

Responding to this request, FAO/RAP, in collaboration with the South Asian Association for Regional Cooperation (SAARC) Forestry Centre, organized the Workshop on Strategic Planning for South Asian Forestry, 16–18 February 2011, in Thimphu, Bhutan. Financial support was provided by the FAO TCP Facility and the National Forest Programme Facility.

The objectives of the workshop were to advance strategic planning in South Asian forestry, identify gaps and weaknesses of existing national forest policies in key areas, and to formulate policy briefs and recommendations for priority issues affecting forestry in South Asia.

The workshop was attended by 26 participants from 7 South Asian countries that had actively participated in the Asia-Pacific Forestry Sector Outlook Study including Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Participants included representatives from government agencies, NGOs and the private sector. Representatives of the SAARC Forestry Centre also participated in the workshop.

Dasho Sherub Gyaltshen, Honorable Secretary of Agriculture and Forestry, was the Chief Guest for the inaugural session and provided the keynote address. Mr. Patrick Durst delivered opening remarks on behalf of FAO. Dr. Sangay Wangchuk, Director of the SAARC Forestry Centre, provided the welcome address.

Following presentations of the key findings from the Asia-Pacific Forestry Sector Outlook Study, and the South Asian subregional outlook report, workshop participants identified key drivers of change influencing forestry in South Asia. The influences of the drivers of change on production forests and forest products production, protection forests and environmental services, and policies and institutions were subsequently considered.

Derived from the discussion on drivers of change and priority needs, the participants identified the six most important issues affecting forestry in South Asia as follows:

- Creating an enabling environment for private sector investment in forestry;
- Accommodating demands for increased environmental services from forests;
- Enhancing stakeholder engagement in forestry (including clarification of tenure);
- Reinventing forestry institutions;
- Support for farm forestry and trees outside forests; and
- Forestry and poverty reduction.

Participants worked in groups to review the forest policy and recent policy statements of their respective countries in relation to the above six thematic priorities, analyzed gaps in current country policies, and identified policy reform requirements. Results of the group work were presented and commented on during the plenary session.

A main outcome of the workshop was the drafting of six regional thematic policy briefs aimed at promoting sustainable forest management in light of current threats and opportunities in the six thematic priority areas.

Workshop arrangements made by the SAARC Forestry Centre were well received and participants felt that the workshop was highly effective in meeting its objectives. In particular, the group exercises and open discussions were appreciated and the policy brief drafting "competition" was widely enjoyed.

EDIBLE INSECTS: LAO SCHOOL CELEBRATES FIRST CRICKET HARVEST

Within the framework of the project "Sustainable insect farming and harvesting for better nutrition, improved food security, and household income generation," which kicked off in January 2011, FAO began introducing small-scale cricket farming at the School for Gifted and Ethnic Students, National University of Laos (NUoL).

Under the pilot project, "Saep E Li - The celebration of the first cricket harvesting" was held in May 2011, which gathered between 300 and 400 students from different schools at the School for Gifted and Ethnic Students. The event provided an opportunity for the students involved in the pilot activity to share and exchange their experiences on cricket farming. The celebration involved insect cooking demonstrations, tasting sessions of free edible insects and lessons on insect breeding and the nutritional benefits of insects.

In promoting greater awareness and appreciation of edible insects in Laos, FAO, together with the Faculty of Agriculture, NUoL, have thus far focused on four different species of insects (house cricket, mealworm and palm weevil are bred, and the weaver ant is semi-bred in trees).

With support from the project, students aged 16 to 18 years were taught techniques of cricket farming and rearing of cricket colonies from eggs until harvesting at their school. The biology and behaviour of crickets was also integrated with a biology lesson aspect for the students. Students were also taught about the nutritional benefits of insects, especially as complementary food in the Lao diet.

Demonstration site – outside view

Demonstration site – inside view

(Photos: Courtesy of Yupa Hanboonsong)

Different trays with different diets.

Students take care of crickets.

Student weighing insects (recording weight gain).

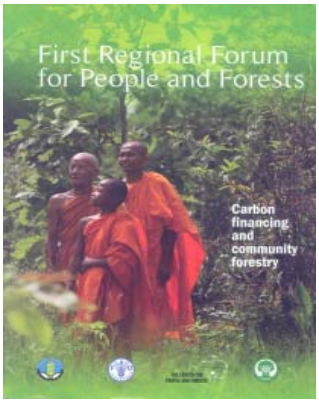
Harvesting/cooking day.

NEW RAP FORESTRY PUBLICATIONS

FIRST REGIONAL FORUM FOR PEOPLE AND FORESTS: CARBON FINANCING AND COMMUNITY FORESTRY

Momentum is gathering for a global forest carbon financing mechanism and Reduced Emissions from Deforestation and Forest Degradation (REDD) is now a hot topic on the world's forestry agenda. Yet many crucial questions remain unanswered, including: How might forest carbon financing initiatives impact local communities and indigenous peoples living in and around forests? What would be the role of these peoples in climate change mitigation initiatives? And would they be important players in the success of such initiatives?

In response to growing interest, the First Regional Forum for People and Forests: Carbon Financing and Community Forestry was held in Hanoi, Vietnam,



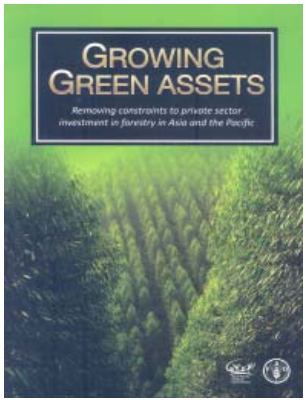
to explore how carbon financing and community forestry could be strongly and positively connected.

The Forum was organized by The Center for People and Forests (RECOFTC), the FAO Regional Office for Asia and the Pacific and the Forest Sector Support Partnership under Vietnam's Ministry of Agriculture and Rural Development.

GROWING GREEN ASSETS: REMOVING CONSTRAINTS TO PRIVATE SECTOR INVESTMENT IN FORESTRY IN ASIA AND THE PACIFIC
RAP Publication 2010/18

For decades, foresters, environmentalists, policy makers and development officials have sought to increase investment in forestry to meet various environmental and economic objectives. A wide range of initiatives and programs ranging from tax credits, low interest loans and other incentives to infrastructure and marketing support, and government-supported research and extension have been introduced in an effort to stimulate more investment in the sector. The results of these efforts have been mixed, but most efforts to stimulate private sector investment in the forestry sector in the Asia-Pacific region have failed to fully meet expectations.

Thus, the members of the Asia-Pacific Forestry Commission requested FAO to coordinate a regional policy study of policies and regulations, "with the aim of identifying approaches for removing unnecessary constraints to private sector investment."



"Growing green assets: Removing constraints to private sector investment in forestry in Asia and the Pacific" presents the results of this study. The study comes at a time of tremendous change in the region, with ever-increasing demands and expectations being placed on forests and forestry by society and new opportunities emerging for financing forest management. It is hoped this study will serve the needs of all concerned in working to attract investment resources needed to realize the full environmental and economic potential of the region's forests.

FAO ASIA-PACIFIC FORESTRY CALENDAR

8-9 August 2011. ***Second Regional Forum on People and Forests, Community Forestry: Key to Solving Current and Emerging Challenges.*** Bangkok, Thailand**.** Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

31 August - 3 September 2011. ***International Training Programme "Innovations in the Management of Planted Teak Forests."*** Peechi, India. Contact: S. Appanah, NFP Advisor (Asia-Pacific), FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Simmathiri.Appanah@fao.org

8-9 September 2011. ***First APEC Meeting of Ministers Responsible for Forestry***. Beijing, China. Contact: Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

10-12 October 2011. ***Workshop to strengthen national reporting in support of the implementation of non-legally binding instrument on all types of forests (GCP/INT/118/JPN).*** Bangkok, Thailand. Contact: Masahiko Hori, Forestry Officer, FOEP, FAO Forestry Department, Via della Termi di Caracalla, 00100, Rome, Italy; E-mail: Masahiko.Hori@fao.org

17-20 October 2011. ***2nd Regional Workshop: Model Forest Development Learning Tour***. Banda Aceh, Indonesia. Contact: Robert Solar, FAO-RAPO TCP/RAS/3210 Consultant and Project Coordinator, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Robert.Solar@fao.org

19-22 October 2011. ***International symposium on the "art and joy of working with wood."*** Bangalore, India. Contact: Adrian Whiteman, Senior Forestry Officer, FOEI, FAO Forestry Department, Via della Terme di Caracalla, 00100, Rome, Italy; E-mail: Adrian.Whiteman@fao.org

26 October 2011. ***Meeting on Forests and Climate Change Adaptation in Asia.*** Bangkok, Thailand. Contact: Jeremy Broadhead, Forestry Consultant, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Jeremy.Broadhead@fao.org

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

21-29 November 2011. ***Training of trainers on enhancing stakeholder participation in nfps.*** Kathmandu, Nepal. Contact: Contact: Fred Kafeero, Forestry Officer, FOEP, FAO Forestry Department, Via della Terme di Caracalla, 00100, Rome, Italy; E-mail: Fred.Kafeero@fao.org

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FORESTRY PUBLICATIONS: FAO REGIONAL OFFICE FOR ASIA AND THE PACIFIC (RAP)

- East Asian forests and forestry to 2020 (RAP Publication 2010/15)
- Forest policies, legislation and institutions in Asia and the Pacific: Trends and emerging needs for 2020 (RAP Publication 2010/10)
- Report of the Asia-Pacific Forestry Commission Twenty-third session (RAP Publication 2010/09)
- Asia-Pacific forests and forestry to 2020. Asia-Pacific Forestry Sector Outlook Study II (RAP Publication 2010/06)
- Forest law enforcement and governance: Progress in Asia and the Pacific (RAP Publication 2010/05)
- Forest insects as food: humans bite back. Proceedings of a workshop on Asia-Pacific resosurces and their potential for development (RAP Publication 2010/02)
- Strategies and financial mechanisms for sustainable use and conservation of forests: experiences from Latin America and Asia (RAP Publication 2009/21)
- Asia-Pacific Forestry Week: Forestry in a changing world (RAP Publication 2009/04)
- The future of forests: Proceedings of an international conference on the outlook for Asia-Pacific forests to 2020 (RAP Publication 2009/03)
- Re-inventing forestry agencies. Experiences of institutional restructuring in Asia and the Pacific (RAP Publication 2008/05)
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- Developing an Asia-Pacific strategy for forest invasive species: The coconut beetle problem – bridging agriculture and forestry (RAP Publication 2007/02
- The role of coastal forests in the mitigation of tsunami impacts (RAP Publication 2007/01)
- Taking stock: Assessing progress in developing and implementing codes of practice for forest harvesting in ASEAN member countries (RAP Publication 2006/10)
- Helping forests take cover (RAP Publication 2005/13)
- Elephant care manual for mahouts and camp managers (RAP Publication 2005/10)
- Forest certification in China: latest developments and future strategies (RAP Publication 2005/08)
- Forests and floods – drowning in fiction or thriving on facts? (RAP Publication 2005/03)
- In search of excellence: exemplary forest management in Asia and the Pacific (RAP Publication 2005/02)
- What does it take? The role of incentives in forest plantation development in Asia and the Pacific (RAP Publication 2004/27)
- Advancing assisted natural regeneration (ANR) in Asia and the Pacific (RAP Publication 2003/19) - 2nd edition
- Practical guidelines for the assessment, monitoring and reporting on national level criteria and indicators for sustainable forest management in dry forests in Asia (RAP Publication: 2003/05)
- Giants on our hands: proceedings of the international workshop on the domesticated Asian elephant (RAP Publication: 2002/30)
- Applying reduced impact logging to advance sustainable forest management (RAP Publication: 2002/14)
- Trash or treasure? Logging and mill residues in Asia-Pacific (RAP Publication: 2001/16)
- Regional training strategy: supporting the implementation of the Code of Practice for forest harvesting in Asia-Pacific (RAP Publication: 2001/15)
- Forest out of bounds: impacts and effectiveness of logging bans in natural forests in Asia-Pacific: executive summary (RAP Publication: 2001/10)
- Trees commonly cultivated in Southeast Asia: an illustrated field guide - 2nd edition (RAP Publication: 1999/13)

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