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FOREST NEWS

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Front cover: Spotted deer *(Axis axis)* in Indian Sundarbans
Back cover: Goliath heron *(Ardea goliath)* in Indian Sundarbans
(Photos courtesy of P.K. Pandit)

BIODIVERSITY OF MANGROVE FORESTS OF INDIAN SUNDARBANS AND ITS CONSERVATION

by P.K. Pandit

Mangrove forests of Sundarbans (Photo: P.K. Pandit)

Introduction

Living along the interface between land and sea, the mangrove forests support genetically diverse groups of aquatic as well as terrestrial organisms. Mangrove habitats constitute a diverse group of habitats such as core forests, water bodies (rivers, bays, intertidal creeks, channels and back waters), mudflats, litter-forest floors and sea grass ecosystem (wherever these occur). Mangroves can exist and flourish under a wide range of salinity conditions, tidal aptitudes, winds, temperatures and in muddy and anaerobic soil conditions. The highly variable conditions make mangrove forests profusely rich in biodiversity and they support huge numbers of plant and animal communities, including many rare, endangered and threatened species. Mangroves are biodiversity hot spots because of the high species richness. The biodiversity of mangroves has also been gaining greater importance because of the conservation of biological biodiversity and also because the mangrove ecosystems are one of the most threatened by global climate changes, especially the rise in sea level. These highly productive and dynamic ecosystems are subjected to different types of threats such as anthropogenic pressure, which includes excessive natural-based resource dependency of fringe villages for the collection of fuel wood and small timbers; over-exploitation of aquatic fauna (e.g., collection of crabs, fishes, tiger prawn seeds); collection of honey and wax; hydrological factors, including an increase of salinity due to reduced flow of fresh water from upstream; the construction of embankment protection bundhs along fringe villages; climate change and global warming; increased levels of

pollution; changing species composition; etc. Many efforts have been made to save the world famous Sundarbans mangrove ecosystem, at both international and national levels.

Study area

The Sundarban mangrove forest is the largest single track of mangrove forest in the world, covering an area of approximately 10,260 km^2 in the delta of the rivers Ganga, Brahmaputra and Meghna. It is shared by Bangladesh (6,000 km^2.) and India (4,260 km^2). The Indian part of Sundarbans is situated in the southernmost part of West Bengal State, in the district of South & North 24-Parganas, lying a little south of the Tropic of Cancer between latitudes 21°312 & 22°312 North and longitudes 88°102 & 89°512 East. A close network of rivers, channels and creeks intersects the whole Sundarbans, which has resulted in the formation of 102 islands, out of which 54 have human inhabitants. The main rivers which flow in and around Sundarbans are Matla, Bidya, Gosaba, Gona, Kalindi, Harinbhanga, Raimangal, Jhilla, Kapura, Thakuran, Muriganga, Hatania and Doania. Raimangal, Harinbhanga and Kalindi rivers separate India and Bangladesh on the eastern side. Sundarbans is bounded by Bangladesh in the east, fringe villages in the north and west and the Bay of Bengal to the South. The enormous amount of sediments carried by the rivers has contributed to its expansion and dynamics; salinity gradients change over a wide range of spatial and temporal states. The area has a sub-tropical monsoonal climate with high humidity and the average annual rainfall is approximately 1,900 mm. High tides and ebb tides occur twice daily and the current changes its direction at six hour intervals. The average elevation varies from 5.8 m to 6.1 m above mean sea level, with several low line depressions. The maximum and minimum tides recorded at Sagar Island are 5.68 m and 0.96 m respectively. Biotic factors at Sundarban play a significant role in physical coastal evolution and a variety of habitats have developed for wildlife, which includes estuaries, beaches, permanent and semi-permanent swamps, tidal flats and tidal creeks. The mangrove vegetation itself assists in the formation of new landmasses and the inter-tidal vegetation plays a significant role in Sundarbans. Every year around 250,000 tourists visit Sundarbans for entertainment, education, interpretation and to provide direct and indirect support to the fringe people.

Floristic diversity

Mangrove and mangrove associates constitute the dominant vegetation type of the area. These salt-loving plants, which are found throughout the tropical and sub-tropical regions of the world, have been variously categorized by different authors. According to Champion and Seth's revised classification, the mangrove forests of Indian Sundarban fall under mangrove scrub (4B/TS1), mangrove forests (4B/TS2), salt-water mixed forests (4B/TS3), brackish water mixed forest (4B/TS4) and palm swamp type (4B/E1). Naskar and Guha Bakshi (1982) grouped these forests into five major zones: i) sea-face of beach forest; ii) formative island flora; iii) flora of reclaimed land and low-lying areas; iv) flora of river banks; and v) swamp forests. The first category is dominated by xerophytic plants due to the dryness of the soil and numerous sand dunes. The formative island flora consists of mainly *Porteresia coarctata, Salicornia brachiata, Suaeda martima, S. nudiflora, Acanthus illicifolius* and a few tree specifies like *Avicennia, Sonneratia* and *Excoecaria*. The reclaimed land and low-lying areas are dominated by mesophytic flora, while the last two zones are dominated by halophytic mangrove forests.

There are 140 flowering plant species under 101 genera and 59 families, comprising true mangroves, mangrove associates, back mangrove trees and shrubs, non-halophytic non-mangrove associates, halophytic herbs, shrubs, weeds, epiphytes and parasitic plants (Naskar, 2007).

Mangrove forest is a special type of vegetation community comprising a variety of salt-resistant species having some special adaptations and characteristics for growing in intertidal areas and the estuary mouth between land and sea. The mangrove forest of Sundarbans is one of the most dynamic ecosystems on the earth (Alongi, 1996). It provides habitat for diverse flora and fauna, including some that are endangered. However, this unique ecosystem is threatened in many places in

the world. Some of the characteristics and adaptations of mangrove species are: i) formation of a lateral root system for secure anchorage against diurnal tidal inundation (e.g., *Excoecaria* sp.); ii) supporting roots such as stilt roots or prop roots, root buttresses, etc. are formed in *Rhizophora* sp. and *Xylocarpus* sp.; iii) vertical knee roots spring from horizontal lateral roots in *Lumnitzera* sp., *Bruguiera gymnorrhiza*, *Kandelia candel*, etc.; iv) formation of pneumatophores or breathing roots; v) viviparous germination (germination on the tree) in *Rhizophora* sp., *Bruguiera* sp., etc.; vi) sunken stomata to prevent water loss; and vii) thick wax-coated leaves.

Some important mangrove families found in the Sundarbans are Rhizophoraceae, Avicenniaceae, Meliaceae, Sonneratiaceae, Sterculiaceae, Myrtiniaceae, etc.

In India, species of mangrove ecosystems are generally in a vulnerable condition. Only two mangrove species, namely *Avicennia marina* and *Excoecaria agallocha* are at lesser risk according to their IUCN category. *Xylocarpus* sp. is becoming rare in Sundarbans due to past over-exploitation (Naskar and Mandal, 1999). A few important mangrove species and their status are given in Table-1.

Table-1: Some mangrove species and their IUCN status

Serial No	Family	Species	IUCN status of species	Occurrence
1	Rhizophoraceae	*Rhizophora apiculata*	LR	C
2	Rhizophoraceae	*Rhizophora mucronata*	LR	C
3	Rhizophoraceae	*Bruguiera parviflora*	VU	C
4	Rhizophoraceae	*Bruguiera cylindrica*	LR	C
5	Rhizophoraceae	*Bruguiera gymnorrhiza*	LR	C
6	Rhizophoraceae	*Bruguiera sexangula*	VU	F
7	Rhizophoraceae	*Ceriops tagal*	VU	R
8	Rhizophoraceae	*Ceriops decandra*	VU	R
9	Rhizophoraceae	*Kandelia candel*	LR	F
10	Meliaceae	*Xylocarpus mekongensis*	VU	C
11	Meliaceae	*Xylocarpus granatum*	VU	F
12	Sterculiaceae	*Heritiera fomes*	VU	R
13	Arecaceae	*Nypa fruticans*	EN	R
14	Acanthaceae	*Acanthus ilicifolius*	LR	C
15	Sonneratiaceae	*Sonneratia alba*	VU	-
16	Sonneratiaceae	*Sonneratia apetala*	VU	F
17	Sonneratiaceae	*Sonneratia caseolaris*	VU	F
18	Avicenniaceae	*Avicennia marina*	LR	C
19	Avicenniaceae	*Avicennia alba*	LR	C
20	Avicenniaceae	*Avicennia officinalis*	LR	C
21	Myrtiniaceae	*Aegiceras corniculatum*	LR	A

EN = Endangered,VU = Vulnerable, LR = Lower Risk, - = Not recorded, A = Abundance, C = Common, R = Rare, F = Frequent

Source: Kathiresan (2000) and Kathiresan and Qasim (2005)

Non-flowering plants: Limited studies have been done on algal flora in Sundarbans, but recently Naskar *et al.* (2004) reported 150 species of algae. According to Santra (1998), 32 species of lichens are found in Sundarbans. The diversity of fungi and bacteria in Indian Sundarbans has not been studied in detail, although bacteria play a significant role in the mangrove ecosystem for the decomposition of litter in the soil.

Faunal diversity

Mangrove fauna, in general, is found to occur in both terrestrial and aquatic ecosystems. These areas can be differentiated into littoral or supra-littoral forests, inter-tidal mudflats and estuaries (Anon, 2011). The faunal diversity of Sundarbans has attracted much attention because of the huge economic importance of many species, as well as the presence of the Royal Bengal tiger. It supports a huge number of coastal and marine fishes, crustacea, honey bees, mammalian species, reptilia, avi-fauna, mollusks, insects and annelids in addition to other mega-fauna.

Mammals: In Indian Sundarbans 31 species of mammals are found (Chowdhuri and Chowdhury, 1994; Sanyal, 1999). Among them, the most important is the Royal Bengal tiger (*Panthera tigris tigris*), which is one of the endangered species. Other important mammalian species existing in Sundarban mangrove forests are fishing cat (*Felis viverrina*), jungle cat (*Felis chaus*), leopard cat (*Prionailurus bengalensis*), spotted deer (*Axis axis*), gangetic dolphin (*Platanista gangetica*), Irrawady dolphin (*Orcaella brevirostris*), Rhesus macaque (*Macaca mulatta*), Wild boar (*Sus scrofa*), smooth-coated otter (*Lutrogale perspicillata*), etc.

Reptilia and Amphibia: The species richness among reptiles and amphibians in Sundarbans is very high; about 59 species of Reptilia and 7 species of Amphians have been recorded in Indian Sundarbans (Sanyal, 1999; Naskar *et al.*, 2004). Estuarine crocodile (*Crocodylus porosus*), another endangered species, is the top predator and largest reptile in the aquatic ecosystem. Water monitor lizard (*Varanus salvator*) is another large reptile found in abundance. Among 14 turtle and tortoise species, six are nearly extinct or threatened. Out of 4 marine turtles, the olive ridley turtle (*Lepidochelys olivacea*), though endangered, is found in Sundarbans. There is a significant population of the river terrapin (*Batagur baska*), which was once believed to be extinct. The green sea turtle (*Chelonia mydas*), Hawksbill turtle (*Eretmochelys imbricata*) and flap-shell turtle (*Lissemys punctata*) are very common here. Around 53 species of snakes (Anon, 2011) are found in this area. Prominent among the poisonous snakes are the king cobra (*Ophiophagus hannah*), monocellate cobra (*Naja naja*), branded krait (*Bungarus fasciatus*), Russel's viper (*Daboia russelli*) and common krait (*Bungarus caeruleus*). Among the non-venomous snakes present are python (*Python molurus*), chequered keelback (*Xenochrophis piscator*), dhaman (*Ptyas mucosa*), trinket snake (*Elaphe helena*), green whip snake, common wolf snake, bronzeback snake, ornamental snake, common vine snake and several other species. The tidal creeks also harbor Homalopsid snakes adapted to living in water, the most common being *Cerberus rhynchops* (dog-faced water snake).

Avi-fauna: Indian Sundarbans is very rich in avi-fauna with 217 recorded species. Moreover, during winter, 52 species of migratory birds visit the Sundarbans. It is called the kingfishers paradise as out of 12 species found in India, 8 are found here, namely common kingfisher (*Alcedo atthis*), black-capped kingfisher (*Halcyon pileata*), collared kingfisher (*Todiramphus chloris*), brown-winged kingfisher (*Halcyon amauroptera*), ruddy kingfisher (*Halcyon coromanda*), white-throated kingfisher (*Halcyon smyrnensis*), stork-billed kingfisher (*Halcyon capensis*) and pied kingfisher (*Ceryle rudis*). During the monsoon, heronries develop in Arbesi block near Samshernagar. Common birds found in the area include herons, darters, spoonbills, cormorants and storks. The most abundant bird species are common sand piper, Indian ringed dove, whimbrel, tailorbird, jungle myna, rose-ringed parakeet, large egret, bronze-winged drongo, magpie robin, pond heron, common iora, red-vented bulbul and brahminy kite. Goliath heron (*Ardea goliath*), an African visitor and the largest heron in the world, is also found in this area. Other birds which are frequently found in this area include large and median egret, white-bellied sea eagle, lesser adjutant stork, osprey, whiskered tern,

Some important fauna of Indian Sundarbans (Photos: P.K. Pandit)

Salt-water crocodile (*Crocodylus porosus*)

Mudskipper (*Periophthalmus nonembradiatus)*

Royal Bengal Tiger (*Panthera tigris tigris*)

Brahminy kite (*Heliastur indus*)

Water monitor lizard (*Varanus salvator*)

brown-winged gull and changeable hawk eagle, among others.

Fishes: Mangrove forests serve as nurseries for shell fish and fin fishes and sustain the coastal fisheries of the entire coast. More than 200 species of fishes are found in the Indian Sundarbans, out of which some are transient (migrant) and some are residents. The residents include *Mugil parsia, M. tade, Polynemous paradiseus, Polydactylus indicus, Otolithoides biauritus, Lates calcarifer, Hilsa toil, Arius jella, Pama pama, Sillaginopsis panijus*, etc. Among the migratory species *Tenualosa ilisha, Pangasius panjasius* and *Polydactylus indicus* are common.

The sharks and rays found in Sundarbans, include Ganges shark (*Glyphus gangeticus*), small-toothed saw fish (*Pristis microdon*), pointed saw fish (*Anoxypristis cuspidate*) and white-spotted shovel-nosed guitar fish (*Rhynchobatus djiddensis*); all are Schedule–I species in the Wildlife (Protection) Act, 1972 of India. In addition to these, *Rhinobatus granulatus, Himantura alcockii, Rhinoptera juanica* and *Sphryna zygaena* are also found.

Invertebrate species: Among the invertebrates, 143 species of mollusks, 201 species of insects, 240 species of crustaceans, 78 species of annelids, 68 species of protozoa and 104 species of nematods are found in the Indian Sundarbans (Chowdhuri and Chowdhury, 1994). Moreover, numerous species of phytoplanktons and zooplanktons are also present. Two species of horseshoe crabs found in the Sundarbans are *Tachypleus gigas* and *Carcinoscorpius rotundicaudata*. They are considered to be living fossils thought to be more than 400 million years old.

Threatened and extinct animals

In Indian mangroves, faunal species are also at threat. It was recorded by Chaudhuri and Chaudhury (1994) that 2 reptile, 3 bird and 5 mammal species are extinct, and 10 reptile, 3 bird, and 2 mammal species are at threat (See Table-2).

Table-2: Threatened species of Indian Sundarbans

Serial No	Category	Family	Animal species	IUCN status
1	Mammal	Felidae	*Panthera tigris tigris*	T
2		Platinistidae	*Platanista gangetica*	T
3	Reptile	Crocodilidae	*Crocodylus porosus*,	T
4		Varanidae	*Varanus salvator*	T
5		Chelonidae	*Chelonia mydas*	T
6		Pelomedusidae	*Eretmochelys imbricata*	T
7		Chelonidae	*Lepidochelys olivacea*	T
8		Chelonidae	*Caretta caretta*	E
9		Dermochelyidae	*Dermochelys coriacea*	E
10		Emydidae	*Batagur baska*	T
11		Tryonychidae	*Lissemys punctata*	T
12		Tryonychidae	*Trionix gangeticus*	T
13		Tryonychidae	*T. hurun*	T
14		Boidae	*Python molurus*	T
15	Avifauna	Pelecanidae	*Pelecanus philippensis*	T
16		Ardeidae	*Ardea goliath*	T
17		Cyconiidae	*Leptoptilos javanicus*	E
18		Theskiornithidae	*Theskiornis melanocephalus*	T
19		Anatidae	*Sarkiodornis melanotus*	E
20		Anatidae	*Cairina scutulata*	E

T = Threatened, E = Extinct

Mammals that have disappeared: Mammalian species that once existed in Sundarbans and have disappeared (Seidensticker and Hai, 1983) over a period of time are:

- Javan rhinoceros (*Rhinoceros sondaicus*) – Last reports of evidence proving the presence of this rhinoceros dates back to the year 1888. In April 2000, skeletal remains of *Rhinoceros sondaicus* were found 2.7 m below the surface in Mollakhali Island under Gosaba P.S.
- Wild buffalo (*Bubalis arnee*) – The wild buffalo roamed in Sundarbans until 1885 and died out at the end of the 19th Century. In March 2001, some bones were recovered from Netidhopani Compartment–I. The bones were sent to ZSI for identification and were identified as wild buffalo.
- Swamp deer (*Cervus duvaucelli*) – This animal was reported to exist in good numbers until the earlier part of the 20th century and were probably extinct by 1930.
- Barking deer (*Muntiacus muntjac*) – This animal was found to exist in the southern part of the Sundarbans even up to 1976. It was also found on Halliday Island.
- Hog deer (*Axis porcinus*) – It was reported to found in the Sundarbans up till 1945.

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In the recent past, fossils of *Rhinoceros unicornis* have been discovered from Bakkhali. Fossils of freshwater tortoise (*Chitra indica*) and jaws of gharial (*Gravialis gangeticus*) were found in the excavations of Dum Dum near Kolkata along with stumps of Sundari (*Heritiera* sp.) and fruits of *Derris* and *Ceriops* species.

Threats to biodiversity

The rich biodiversity of the Sundarbans is threatened continuously by many factors ranging from the evolutionary history and paleoclimate to the current biophysical and anthropogenic factors, plus the nature and intensity of interactions with adjacent systems (Gopal and Chauhan, 2006). Mangroves differ from fresh-water wetlands in their hydrology, as they interact daily with both sea and inland areas.

The major threat to biodiversity is the growing human population, who are dependent on the forest-based natural resources for their livelihood. The population situated around the Sundarbans are economically very backward and have few alternative livelihood choices except rain-fed single cultivation. The main occupations of the villagers are agricultural laborers or household workers, other than cultivating their own land. After cyclone AILA hit in 2009, salt water infiltrated the agricultural land, resulting in big drops in crop production, so the majority of eligible male members had to look for work in construction and other labors in major cities of India. Infrastructure as well as basic amenities in the villages is very limited. There are no good road networks, markets, schools, colleges and or health care facilities. All these factors lead to a high level of resource dependency. Villagers are mostly dependent on mangrove forests for the collection of fuelwood, fodder, small timbers, fishes, tiger prawn seeds, honey, crabs, etc. Out of these activities, fishing, tiger prawn seeds and honey collection are done for commercial purposes. Officially, every day approximately 10,000 fishermen enter the Sundarbans for fishing throughout the year, except for 3 months (April to June). However, unauthorized entry for fishing is very common and it is a major challenge for the Sundarbans management authority, along with the killing of wild animals.

Among the hydrological factors, the inflow of fresh-water is the major factor which influences the salinity as well as the geomorphology of the area. The tidal frequency is a constant factor, but the tidal height is an important matter for inundation, erosion and accretion of soil. The salinity regimes are also affected by tidal heights. Human settlements and their associated activities such as clearing of forests, establishment of a 3,500 km long earthen bund to protect villages from tidal effects and floods, and conservation of land for other uses, directly influences the fresh-water flow and sediment accretion on water-bodies. The nature of the sediment directly influences the flora and fauna of the mangrove ecosystem. Most of the tributaries of the River Ganges on the Indian side have been silted up and do not carry fresh water, which leads to increased salinity and as well as directly affecting the biodiversity. Salt-tolerant species are gradually predominating due to the increased salinity level. Recent studies (Hoq *et al.*, 2006) in Bangladesh have clearly

demonstrated the strong influence of salinity, temperature and conductivity on the seasonal abundance and distribution of shell fishes and fin fishes.

Heritiera fomes, Nypa fruticans, Phoenix paludosa, etc. are species that are declining rapidly in the Sundarbans (Blasco, 1975; Rahman, 1990) and *Heritiera* sp. is being replaced by *Excoecaria* sp. (Christensen, 1984). The forest structure in general is becoming simpler and the average height of the trees is decreasing. In Bangladesh Sundarbans it is estimated that 0.4% of the forest area is replaced by dwarf species every year, which consequently decreases the habitat of arboreal species like birds, monkeys and others. Reports indicate that the changes in herbaceous species are affecting the spotted deer population; however, an increase in *Sonneratia* sp. and *Avicennia* sp. favors the deer because the leaves of mangrove trees constitute the staple diet of spotted deer.

The effect of salinity levels and their seasonal variation is a significant factor in the recruitment and growth of different animals and the effect on their predators (Hussain and Acharya, 1994). Fresh-water inflows upstream have been diverted for irrigation, flood control and hydropower. Farakka barrage in India, on the border with Bangladesh, has been constructed to divert more water to Hooghly river with the aim to keep the river open for navigation from the Bay of Bengal to Kolkata Port. As no detailed study on biodiversity was carried out before the construction of this barrage it is very difficult to assess the extent of qualitative or quantitative changes of flora and fauna since then. But some studies (Sinha and Khan, 2001; Payne *et al*., 2004) clearly indicated that the hilsa (*Hilsa ilisha*) fisheries have declined considerably in the Indian part of Sundarbans, mostly because the barrage acts as a barrier to upstream migration to breeding sites.

The 3,500 km long embankment protection works have altered the flooding regime, increased salinity intrusion, enhanced siltation in the riverbed and reduced the nutrient exchange, which directly affects the biodiversity as a whole (Rahman *et al*., 1992; Bhattacharya, 1999).

Pollution is another threat to the biodiversity of mangrove forests as agrochemicals such as pesticides, fungicides and fertilizers used extensively in the catchment of the river Ganga and its tributaries as well as in fringe villages of Sundarbans has polluted both the water-bodies and the landmass, which directly or indirectly affect the aquatic fauna and flora. Growing industrialization upstream and at Kolkata, particularly the Haldia Industrial Complex, contribute significant amounts of pollutants, which are gradually causing degradation of the Sundarban mangroves. Oil spills from the seaward side cause great damage to aquatic fauna and sea birds (Blower, 1985). The future of the Sundarbans will depend upon the management of the fresh water supply, as well as conservation of biological resources.

Conservation

The first management plan for the Sundarbans was formulated in 1871, designed to regulate harvesting of Sundari. Part of the Sundarbans was declared as Reserve Forest in 1878 (Bhattacharya, 1990). The most comprehensive plan, in the early 1990s, delineated the Sundarbans into management units called "compartments."

In the Indian part, the whole area in 24-Parganas District was declared first as protected forests following a Notification dated 7 December 1878, and the boundaries of the remaining protected forests were fixed by Notification No. 4457-For. – dated 9 April 1926. The protected forests in the Basirhat subdivision of the district, presently Basirhat Range in Sundarban Tiger Reserve, were constituted as Reserve forests as per Government Notification No. 15340-For., dated 9 August 1928. The Indian Forest Act 1927 prohibits or otherwise restricts the carrying of guns, cattle grazing, tree cutting, and removal of forest produces or land clearance. The protected forests of Namkhana Range (except Mahisani and Patibania Islands) were also finally declared as Reserve Forests under Notification No. 7737-For, dated 29 May 1943. After independence, Lothian Island (38 km^2) was declared a Wildlife Sanctuary. The hunting of tiger was banned completely in 1970 after the IUCN listed the Bengal tiger (*Panthera tigris*

tigris) as an endangered species. To protect the tiger, the Government of India initially declared 9 tiger reserves covering a total area of 9,115 km^2, of which the Sundarbans is one (2,585 km^2). In 1976, Sajnekhali Wildlife Sanctuary was declared, covering an area of 362.33 km^2 within the Tiger Reserve. Halliday Island with an area 5.95 km^2 was declared a sanctuary in 1976. An area of 1,330.10 km^2 within the Sundarbans Tiger Reserve (STR) was declared as Sundarbans National Park in 1984. Considering the importance of this bio-geographic region, the national park area of STR was added to the list of World Heritage Sites in 1985 by UNESCO. The whole Sundarbans region south of the Dampier Hodges Line, including the protected areas of STR, was declared a Biosphere Reserve in May 1989.

To involve local communities in the protection of the biodiversity of Indian Sundarbans, 65 Joint Forest Management Committees (JFMCs) have been formed. In this process, 51,092 people from 72 nearby fringe villages are deeply involved in protecting 67,728 ha of mangrove biodiversity. To improve their socio-economic condition and provide alternate livelihood activities, several individual input or community development-oriented activities have been undertaken, including necessary training by the State Forest Department. Some of these activities involve making irrigation channels for irrigation; sinking deep tube-wells to provide drinking water; construction of brick-paved paths; construction of a flood centre for easy communication; digging ponds; and making earthen bunds as protection measures. Moreover, saline-resistant paddy seeds, pump machines, spray machines, cycle van rickshaws, etc. have been distributed. For the health of the fringe villages, both human beings as well as livestock, regular medical camps and veterinary camps are being organized. To increase protection measures, especially in Protected Areas (PAs), the number of protection camps has increased two-fold, and to combat poachers the number of firearms also increased three-fold during the last decade. Moreover, there are protection measures in collaboration with the Border Security Force (BSF) and State Arm Police (SAP) and to strengthen them one BSF camp at Khatuajhuri and one SAP camp at Jhilla have been established. Frequent joint patrolling is being organized in border areas as well as in vulnerable areas as and when necessary. For conservation of biodiversity, plantation of mangrove species in degraded mangrove forests and raised char land is done regularly. To meet the need for fuelwood and small timber, as well as to reduce the biotic pressure on the forest, plantation of non-mangrove species is done regularly along roadsides, canal banks, unused village land and other areas. To encourage the local people in protection efforts, a 25% share of the revenue earned from tourism is distributed equally to all JFMC members in the PAs. Human-tiger conflicts are a major issue in the Sundarbans, so to reduce it net fencing approximately 90 km long and 8-10 feet high has been erected inside the forest along the village boundary; needless to say, it is giving good dividends. Moreover, to further reduce man-animal conflicts, 6 tiger combat forces equipped with all possible facilities have been established at strategic locations.

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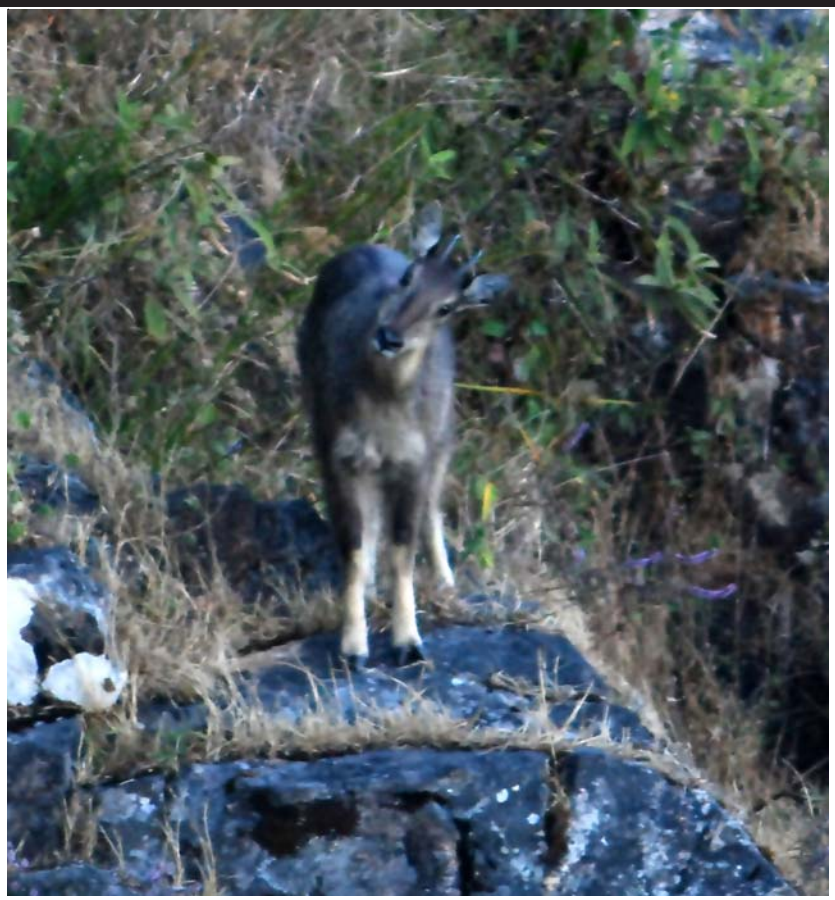
Garjan (*Rhizophora mucronata*) (Photo: P.K. Pandit)

Genwa (*Excoecaria agallocha*) (Photo: P.K. Pandit)

ECOLOGY AND CONSERVATION OF GORAL OUTSIDE PROTECTED AREAS BY COMMUNITY-BASED APPROACH IN THAILAND

by Damrong Pintana and Sureeratna Lakamavichian



Goral at Doi Mhoe Ka Do.

Background and justification

Goral or Chinese Goral belongs to the Order Artiodactyla, Family Bovidae, Sub-family Caprinae. Goral is one of the fifteen reserved wildlife species in Thailand, according to the Wildlife Reservation and Protection Act of 1960, as well as Appendix I of the Convention on International Trade on Endangered Species of Wild Flora and Fauna (CITES). Goral in Thailand is different from *Naemorhedus goral* (Hardwicke, 1825), the original goral found in the Himalaya range of Nepal (Hardwicke, 1825). Wongthirawat (1996) proposed a revision of goral taxonomy in Thailand and concluded the species should be listed as *Naemorhedus caudatus* (Milne-Edwards, 1867). The distribution range of *Naemorhedus caudatus* ranges from India (Kashmir to Assam) to southern China, Myanmar and northern Thailand (Wongthirawat, 1996; Ecological Research Division, 1997). The present research thus emphasizes the latter species, *Naemorhedus caudatus* (Milne-Edwards, 1867).

In general, the goral population is already low in nature resulting in its tendency towards extinction. An additional factor that threatens goral is a belief about goral oil. Many people believe that goral oil can heal broken bones, leg aches and rumatoids, similar to serow oil. It is very difficult to convince the local people, both residing around the forest and in town, that goral oil and meat are not suitable

for consumption. The total number of goral in Thailand has not yet been quantified, and is awaiting accurate population studies. It was estimated by Kekule (2004) that the total population of goral in Thailand was at most 60 animals. Goral hunting is prohibited for trade, only for research, according to the Thailand Wildlife Reservation and Protection Act of 1992 and CITES Appendix I. Goral has also been given "Vulnerable" status by the World Conservation Union (IUCN).

Thailand is the southernmost part of the goral's distribution range. There were reports that goral were found along the watershed areas of the Ping River in Northern Thailand, particularly in the high mountains and cliffs (Parr, 2003; Kekule, 2004). Beginning in 1987, goral was considered absent from Thailand until a wildlife research team led by Sueb Nakasathien discovered goral at the Doi Mon Chong summit (1,929 m elevation) in Om Koi Wildlife Sanctuary, Chiang Mai Province for the first time in 1989 (Nakhasathian, 1991; Lakanavichian, 2010). About 20 goral were found at the Mon Chong mountain by Seub's team in the beginning of 1990. Over the past four decades, large areas of forests in all regions of Thailand have been cleared or disturbed, leading to degraded ecosystems which became fragmented island biogeography. The fragmented forest ecosystems have forced several species of wildlife in Thailand to hold the undesirable "Endangered" status. It is obvious that some wildlife species may have a higher risk of extinction owing to impacts from the island biogeography. Inevitably, it is riskier for a smaller habitat than for a large habitat (Bolen and Robinson, 2003).

It is therefore necessary to study the ecology of goral for better understanding and develop a suitable conservation strategy for this species and its habitat in order to protect the remaining population that is scattered in the forest areas in northern Thailand. Forest destruction and fragmentation have increased the threats to the habitats of goral and other endangered species. Since goral has a relatively low capacity for adapting to changing habitats or ecosystems (Humphrey and Bain, 1990), their livelihoods have been at high risk. Goral prefer specific habitat on the mountain peaks and cliffs: higher than 800 m above mean sea level (amsl.). Human activities (e.g., agricultural practices, irrigation system development, road building and human residences) have reduced the goral habitat enormously in the past four decades (Lakanavichian, 2010). As a consequense, the goral population has been evicted from their original habitats. Goral must look for serene and secure habitats with enough food and water for their survival, so they retreat upwards to the mountain peaks. Goral is therefore one of the endangered species under critical conditions in Thailand due to continuing decrease of its population from hunting and habitat destruction. It is also important to understand that goral groups residing in the forest areas are outside the legal protected areas (officially called "Forest Conservation Areas"), as well as to associate goral with ecotourism conducted by local villagers.

According to the National Park Act of 1961 and the Wildlife Reservation and Protection Act of 1992, the main legal protected areas as wildlife habitats in Thailand comprise: i) National Park; ii) Forest Park; iii) Wildlife Sanctuary; and iv) Non-hunting Area. The wildlife sanctuaries and national parks are mostly suitable as wildlife habitats. In fact, goral have been found in several legally protected areas along the Ping watershed in the upper north. Morever, goral have recently been discovered outside the legally protected areas. It is therefore necessary to study the goral's habitat, population and threats to their existence.

Objectives of the study

1) To study goral distribution in Thailand.
2) To study the ecology, disturbances and population of goral in the following study areas: Doi Mhoe Ka Do and Doi Pa Ti Do,
3) To apply the results of the ecological study in community-based conservation of goral for species and habitat protection.

It is expected that the results of this research can be used to formulate further activities, particularly ecotourism activities. Goral conservation for community-based ecotourism will be based on quantitative ecology and local knowledge regarding seasonal limitations and some important behaviors of goral, which may help design the

appropriate ecotourism activities for each season of the year.

Methodology

Goral ecological study

The purpose of the study was to conduct a wildlife habitat survey (Lakanavichian, 2010; Phumpakphan, 2000) comprising: 1) Habitat assessment; 2) Survey of food species and food sources; 3) Survey of water sources and salt-lick areas; and 4) Study of distribution range and specific niche of the goral.

Goral habitat assessment involves a survey of forest ecosystems which are habitats of the goral. The method is derived from the principles of a forest resource inventory (Kent and Coker, 1992 cited by Kutintara, 1998; Krebs, 1978) and Participatory Ecological Investigation Methodology (PEIM), which was developed by Lakanavichian and Pintana (2002). First, Stratified Random Sampling is applied in a targeted area, and sampling plots are set up in selected forest ecosystems which are classified in a preliminary survey. Second, the PEIM is applied during tree measurements in the sampling plots. The PEIM stresses a genuine collaboration between the researchers and local people who know about trees species in the forest. The knowledgeable villagers may be called "local dendrologists." / The principles of quantitative ecology and PEIM are applied in all sampling plots, including tree species identification, measurement of tree perimeter, height and canopy size. It is based on the fact that local villagers who work as research assistants know their forests and trees in detail as their livelihoods rely on the forests.

A sampling plot 1,600 m^2 (40 m x 40 m) in size is set up in each forest stratum that was classified in the preliminary survey. It was found that goral live and carry out their specific activities in hill evergreen forest or lower montane forest, savanna and grassland. In addition, goral may roam and forage for food in mixed deciduous forest. In this research, a number of sampling plots which are representatives of the study area are based on Avery (1975), applying that a size of 1,600 m^2 (0.2 ha) represents a forest area of 1 km^2 (100 ha).

Measuring perennial trees and the counting of saplings and seedlings are conducted in the sampling plots. Perennial trees in each sampling plot are measured, inclusive of all trees of 5 cm diameter at breast height (DBH) or with a 10 cm circumference. Data collection includes tree circumference at breast height, height and canopy size. Watcharakitti (1982) stressed that the minimum DBH of a perennial tree must be more than 10 cm or have more than a 30 cm circumference. The author adjusted the circumference size for biodiversity purposes.

At each corner of the main sampling plot, sampling plots of 16 m^2 (4 m x m) and 4 m^2 (2 m x 2 m) were set up for sapling and seedling counts respectively. This is to count the number of saplings with a DBH of less than 5 cm or a circumference of less than 10 cm and more than 1.3 m height, while the seedlings must be less than 1.3 m in height. All plant species were identified taxonomically.

After recording all required data, it is necessary to verify the data prior to analysis. The variables for analyses are ecological abundance, dominance, Important Value Index (IVI) and species diversity index (Krebs, 1978). The formulae applied for calculation are based on the work of renowned forest ecologists such as Kimmins (2004), Krebs (1978), Kutintara (1998), and Pintana and Lakanavichian (2012).

Population assessment of goral

Population assessment focused on the case study area – Doi Mhoe Ka Do and Doi Pa Ti Do (Doi = mountain) – which were considered as one habitat of goral outside the legally protected areas. The area encompasses parts of Mae Chaem district, Chiang Mai Province and Khun Yuam district, Mae Hong Son Province, but the political administrative boundary cannot divide the goral habitat. Four methods are used for population assessment, namely, fecal counts on a line plot system, track counts on transects, photography and video recording.

Fecal counts

Wildlife population assessment by fecal counts entails counting feces found in sampling plots on a line plot system. The radius of a circular sampling plot is 1.22 m at the same interval (20 m) on a line plot system (100 m length). After counting fecal groups in each sampling plot, the next step is to count the number of pellets in each fecal group. Wildlife fecal groups are used to prove the existence of a targeted wildlife species in the study area by calculating the number of fecal groups in the sampling plots and the defecation rate. Defecation rates of wildlife species vary. For example, a sambar deer's defecation rate is 12 fecal groups or times per wildlife per day; a red muntjac's defecation rate is 11.88 fecal groups or times per wildlife per day. It is expected that the goral's defecation rate may be similar to that of red muntjac. The formula for calculation is derived from Grieb (1985 cited by Phumpakphan, 2000). However, the fecal counts could not be calculated since the goral did not return to excrete at the same sites.

Track counts

Assessing a wildlife population by track counts is to count tracks in a small sampling plot (6-8 m^2 in size) across a transect. A sampling plot may be circular or rectangular, depending on the wildlife species and its habit. The original method and equation were developed by E. L. Tyson in 1952 and 1959 (Overton, 1971), focusing on a deer species which was walking across the perimeter of a circle regularly. Rectangular sampling plot sizes for track counts are either 6 m^2 (2 m x 3 m) or 8 m^2 (2 m x 4 m) across a transect through regular areas of travel by a targeted species, such as along a road (rugged dirt road), along a stream or near a salt-lick area, according to the preliminary survey. Each transect should be 500 m apart on a parallel basis. The tracks are counted in each sampling plot on the transect and recorded for calculation by the modified formula: Population = track density/area.

Photography

Photographs are used to record the population and behavior of goral.

Video recording

Video taping is also used to record the movements and individual behavior of goral, as well as to help assess the population.

Study of participatory goral conservation

Whether goral conservation is achievable or not depends on community participation, in particular the communities around the goral habitat. Besides the assessment of ecological field data, it is necessary to induce conservation practices in the targeted communities. Methods for studying Participatory Goral Conservation are as follows:

- Preliminary data acquisition from the government agencies around the case study area.
- Data acquisition from local government, i.e., Tambon Administrative Organization (TAO or Ao Bo Toa), Kamnan (Tambon chief), village headmen, village committee members, and natural leaders of each village with attention to forest and goral conservation.
- Data collection on conservation activities from each village through the conservation committee or conservation group members.
- Collaboration with representatives of the village conservation committee for leading the research team to Doi Pa Ti Do and Doi Mhoe Ka Do, and assessment of the areas, including goral ecological investigation.
- Assessment of village profiles in the case study area, and current situation regarding participation in goral and forest conservation.
- Preliminary data analysis and synthesis with the stakeholders for further planning of goral conservation activities.

Results of the study

The study of goral ecology was carried out based on the principles of wildlife ecology, whereas the conservation strategy and ecotourism management by the involved villagers was a consequential case study. Goral distribution areas

were only in the upper Ping watershed and Pai sub-watershed in upper northern Thailand.

Goral distribution in Thailand

Goral have been found in some of the legally protected areas in the upper Ping watershed and Pai sub-watershed as per previous studies. There were 2 new goral habitats discovered: 1) San Pan Daen Wildlife Sanctuary; and 2) Doi Pa Ti Do and Doi Mhoe Ka Do, which is the area between Mae Chaem district of Chiang Mai province, and Khun Yuam district of Mae Hong Son province. The goral habitat covers both mountain peaks and the area between the two mountains.

Goral ecology

The goral ecological study was undertaken at Doi Pa Ti Do and Doi Mhoe Ka Do of Chiang Mai Province, Mae Chaem District and Mae Hong Son Province, Khun Yuam District respectively. The two mountains are connected. The habitat survey comprises identification of habitat types (forest ecosystems), niches and basic needs (water, food and coverage), including specific areas for special activities, such as salt-lick areas, muddy areas, escape cover.

The forest ecosystems of Doi Pa Ti Do are identified as grassland, savanna and lower montane forest or hill evergreen forest (preferred name in this report). Doi Mhoe Ka Do also has similar types of forest, with additional dry evergreen forest along the streams. The major difference between the two mountain ranges is that the researcher team had to travel through

Goral habitat at Doi Pa Ti Do

Goral habitat at Doi Mhoe Ka Do

several mountain ranges covered with abundant forests before reaching Doi Mhoe Ka Do, while Doi Pa Ti Do was mostly accessible by car on a rugged road. Doi Pa Ti Do and Doi Mhoe Ka Do, as a distribution range of goral, cover an area of 64,531.25 rai (103.25 km^2), which allows goral to forage for food, water and other necessities, particularly in the dry season.

The area where the animals forage for food and water, the salt-lick area, as well as the sleeping area, escape zone and area for other activities are considered as a habitat, totaling 937.5 rai (1.5 km^2), which is only 1.45 % of the total distribution range. The habitat of goral is in the highlands and mountains with steep cliffs at elevations between 1,570 – 1,734 m amsl. This research focused on a quantitative ecological survey of goral habitat, requiring sampling plots in the hill evergreen forest and savanna. The ecological survey of goral habitat was undertaken in 3 sampling plots: 2 in the hill evergreen forest and 1 in the savanna. There were 52 tree species found in both hill evergreen forest and savanna, and one unidentified species.

Hill evergreen forest

Species richness. From 2 sampling plots of the hill evergreen forest (HEF) of Doi Mhoe Ka Do, there were 50 tree species, totaling 146 trees. The details of quantitative ecological calculation can be found in Pintana and Lakanavichian (2012). Average density was 73 trees/rai (456.25 trees/ hectare). The most popular species are *Camellia sinensis* var. *assamensis* (Mast.) Kitam, followed by *Wendlandia paniculata* (Roxb.) DC., *Schima*

(continued on p.17)

(continued from p.16)

wallichii (DC.) Korth, *Podocarpus neriifolius* D.Don and *Castanopsis tribuloides* (Sm.) A.DC.

Species dominance. The most dominant species was *Schima wallichii* (DC.) Korth with 15.41% dominance; basal area was 13,930.95 cm.^{2}/rai (8.71 m.^{2}/hectare). The second and third dominant species were *Castanopsis tribuloides* (Sm.) A.DC and *Podocarpus neriifolius* D.Don, with 6.45% and 5.54% dominance and basal areas of 5,832.59 cm.^{2}/rai (3.64 m.^{2}/ha.) and 5,008.82 cm.^{2}/rai (3.13 m.^{2}/ha.) respectively.

Importance Value Index (IVI). The quantitative ecological survey in the HEF of Doi Mhoe Ka Do showed *Schima wallichii* (DC.) Korth as the index species with the highest IVI; 8.4% of all species. It was followed by *Castanopsis tribuloides* (Sm.) A.DC and *Podocarpus neriifolius* D.Don, both with high IVI: 5.19% and 4.28% of all species respectively. The lowest IVI species were *Peucedanum dhana* A.Ham., *Anneslea fragrans* Wall. and *Harpullia arborea* (Blanco) Radlk., with 0.84% IVI of all species in the sampling plots.

Species Diversity Index. The formula used for calculating the Species Diversity Index was the Shannon-Wiener Index (SWI). The SWI of the HEF was 5.07, considered to be relatively high, in comparison with a reference of Species Diversity Index value of 0 - 7 (Kutintata, 1998). It implies that the HEF of Doi Mhoe Ka Do has a relatively high Species Diversity Index.

Savanna

In a sampling plot of savanna at Doi Mhoe Ka Do, there were 6 tree species totaling 54 trees. The species with the highest density was *Wendlandia paniculata* (Roxb.) DC. (70.37%), followed by *Podocarpus neriifolius* D.Don and *Styrax benzoides* Craib with a density of 12.96% and 11.11 % respectively. The most dominant tree species was *Wendlandia paniculata* (Roxb.) DC., 28.73% of all species, with a basal area of 1,159.61 cm^2/rai (0.72 m.^{2}/ha.). It is noted that the area and a number of sampling plots were already higher than what the principles and formula of Avery (1975) recommended. The savanna sampling plot was considered to be an additional plot, in which only the Species Diversity Index was able to be calculated due to missing data on the frequency, making it impossible to calculate the IVI. Based on the formula of the Shannon-Wiener Index (SWI), it was found that the Species Diversity Index of savanna at Doi Mhoe Ka Do was 1.41. It was considered very low compared to the Species Diversity Index reference of 0-7 (Kutintara, 1998). Thus, the low SWI proved an assumption that the species distribution was of savanna type, in which perennial trees were sparse.

It was stressed in a previous study that goral prefers to eat several grass species on the mountainous grassland, and then sunbathe on the rangeland or cliffs (Chairat, 1997). Goral like to reside in caves or holes behind the rocks, or in the dense forests if necessary, for security. Goral must run up and down between the mountain ridges and the streams in the lowland for water each day. In the early morning, gorals lick the dew on grasses as a water source. Water sources and the salt-lick area can indicate the distribution of some wildlife species in an ecosystem. Specific areas are for special activities, e.g., salt-lick area, ruminating area, and secure coverage for their young or offspring. Gorals like to stay in groups of 4-5. Thus, the leader of a goral group knows how and where to select its home range and specific area. Goral prefer a very high mountain with rock croppings to escape from danger. They feed on a variety of grasses and shrubs in the mountainous grassland and savanna or on fodder from some tree species if the quantity of grass is insufficient in the dry season. Due to its small size of about 30 kg weight and 50 cm height in adults, goral does not consume much per day. Table 1 shows the grass species which goral feed on, excluding an unidentified grass species that seems to be significant to the goral's specific habitat near the peak of Doi Mhoe Ka Do.

Table 1 Grass species as Goral food at Doi Pa Ti Do and Doi Mhoe Ka Do

No.	Thai Common Name	Scientific Name	Family
1	Yah Sam Liam	*Cyperus malaccensis* Lam.	CYPERACEAE
2	Yah Whai	*Paspalum longifolium* Roxb.	GRAMINEAE
3	Yah Ka	*Imperata cylindica* Beaur.	GRAMINEAE
4	Yah Nhuad Reusi	*Heteropogon contortus* Beauv. ex Roem.	GRAMINEAE
5	Saab Rang Saab Ka	*Ageratum cornyzoides* Linn.	COMPOSITAE
6	Tong Kong	*Thysanolaena maxima* Ktze.	GRAMINEAE
7	Haew Thai	*Cyperus esculentus* Linn.	CYPERACEAE
8	Yah Kai	*Eulalia siamensis* Bor.	GRAMINEAE
9	Yah Kaab Phai	*Setaria palmifolia* Stapf.	GRAMINEAE
10	Lao	*Saccharum spontaneum* Linn.	GRAMINEAE
11	Mhak Laeb	*Peucedanum dhana* A.Ham.	UMBELLIFERAE

Goral population

Only track counts, photography and video recording yielded an estimate of the goral population. Fecal counts were ineffective due to the fact that none of the goral returned to excrete in the same sampling plots after their feces were examined. It indicated the goral's sensitivity to any interferences. Estimating the goral population by track counts was conducted in 3 transects with 3 sampling plots. The track counts yielded 3.12 gorals on transect 1; 4.81 gorals on transect 2; and 3.44 gorals on transect 3. Thus, there were 11.37 gorals in total by track counts. However, 2 more gorals were found by the photography method.

The two photographed goral adults were obviously different from the goral population assessed based on the track count method. The researcher was taking photographs of goral on the opposite cliff from the summit of Doi Mhoe Ka Do, which was the observation spot in the very early morning before sunrise. The opposite mountain was completely separated from the observation point. Thus, the total population of goral in the case study

Fecal counts on a line plot system

Goral track counts on a transect

area of Doi Mhoe Ka Do - Doi Pa Ti Do was 13.37. If the decimal number is considered as new offspring or young goral, it may imply that the total population of goral was 14.

Community-based conservation of goral

In 2002, the ethnic Karen villagers residing around Doi Mhoe Ka Do, together with some other interested people, formed a group dedicated to conserving the goral and its habitat, named the "Doi Mhoe Ka Do Conservation Club." It was led by a government official of the Hua Pon Community Health Hospital, Mr. Chinnawut Kaiwalrungpipat. The Conservation Club set up a committee consisting of two representatives from each village. There are 8 villages from the participating Tambon (sub-district). The Conservation Club began laying out rules for goral conservation and an ecotourism approach. It has aimed to protect the goral and their habitat, inclusive of the forests and other natural resources, as well as to carry out ecotourism activities for income generation. Ecotourism activities are considered by the Conservation Club as the means for encouraging the participation of the local villagers residing around Doi Mhoe Ka Do and Doi Pa Ti Do in both Chiang Mai and Mae Hong Son provinces.

The eight villages under the administration of Tambon Mae Yuam Noi include Hua Mae La ka, Mae Kopi, Mae Ao, Ma Jae, Mae Haad, Wha No, Hua Pon and Huay Ma Buab. The total population is 1,812 among 474 households. The Conservation Club is still active, although Mr. Chinnawut passed away in February 2012. In fact, the committee of Doi Mhoe Ka Do Conservation Club plans to update the rules and regulations for further implementation of its conservation approach.

The goral conservation scheme will be effective if local villagers understand more about goral – its ecology and forest ecology, as well as their population and behavior in their habitat. In 2012, Mae Yuam Noi TAO formed a new club, namely the "Doi Mhoe Ka Do Resource Protection Volunteer Club," based on the Doi Mhoe Ka Do Conservation Club.

Goral ecology in a specific habitat along with community-based conservation and an ecotourism approach are necessary for the villagers around the forest ecosystems of Doi Mhoe Ka Do. It is also applicable to Doi Pa Ti Do wildlife conservation and regulations at Baan Pang Ung, which have been flexibly enforced. The villagers have so far understood that participatory conservation is necessary for maintaining and protecting the goral population and their habitat.

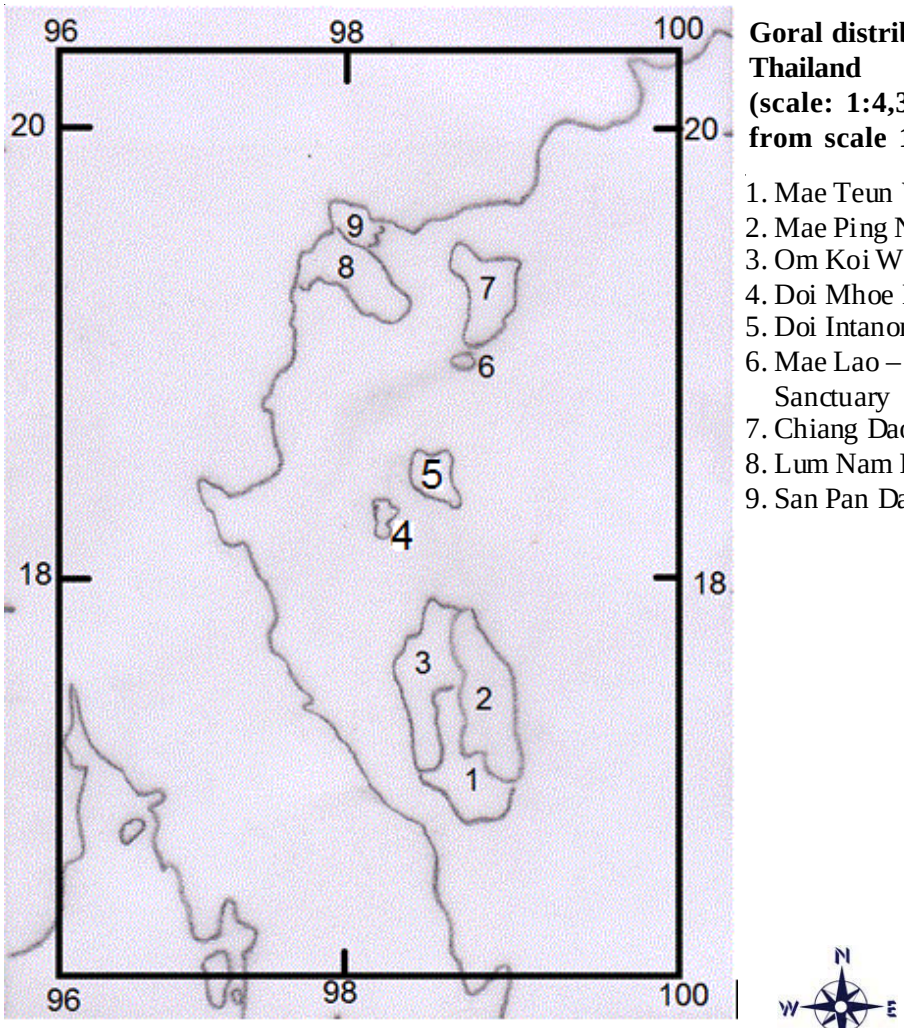
There are several disturbing factors affecting the goral ecosystem and interferences at Doi Mhoe Ka Do and Doi Pa Ti Do, including illegal hunting, forest encroachment for agriculture, forest grazing by domestic animals, forest fires, unsuitable building of roads and shelters for tourists, island biogeography, and "disastrous" tourism.

Conclusion

Gorals use their specific habitat in the high mountains and steep cliffs for grazing, resting, mating and escape. With the exception of Mae Ping National Park, where goral were found at a beach (i.e.,Haad Pha Lhek), all habitats of goral are in the steep mountains and cliffs in the upper north of Thailand. The population of gorals at Haad Pha Lhek may be the result of flooding in the area by the construction of the Bhumibol dam in the early 1960s, so some mountain areas became beaches.

In general, goral have a low capacity to adapt to a new ecosystem. It is thus necessary to understand goral ecology prior to setting up any conservation activities in order to ensure effectiveness and success. Disturbance to the goral livelihood usually causes habitat limitations and accelerates the possibility of extinction. The goral population in the case study area (103.25 km^2) is 13.37, implying 13 adults and 1 offspring or young, which is considered very small.

Thus, it is significant to support goral protection and forest conservation through a community-based approach in order to save the goral from extinction. It is necessary to set up specific rules and regulations which are suitable to the social conditions, culture and livelihood of the local people for goral protection. It is also important to foster



Goral distribution in Northern Thailand (scale: 1:4,300,300 reduced from scale 1:50,000)

1. Mae Teun Wildlife Sanctuary
2. Mae Ping National Park
3. Om Koi Wildlife Sanctuary
4. Doi Mhoe Ka Do – Doi Pa Ti Do
5. Doi Intanon National Park
6. Mae Lao – Mae Sae Wildlife Sanctuary
7. Chiang Dao Wildlife Sanctuary
8. Lum Nam Pai Wildlife Sanctuary
9. San Pan Daen Wildlife Sanctuary

correct knowledge about the goral medicinal myth. It is finally feasible to attain sustainable goral livelihood, even though the area of Doi Mhoe Ka Do and Doi Pa Ti Do is outside the legally protected area category.

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Two goral found across the peak of Doi Mhoe Ka Do in the early morning.

DISTRIBUTION AND CONSERVATION STATUS OF CHINESE PANGOLIN IN NANGKHOLANG VDC, TAPLEJUNG, EASTERN NEPAL

by Prakash Thalpa, Sushila C. Nepali, Ambika Prasad Khatiwada and Shambhu Paudel

Introduction

Pangolins (*Manis sp.*), often called "scaly anteaters," are nocturnal, shy, non-aggressive, solitary and burrowing mammals which have received low scientific attention. Among eight different pangolin species in the world, two species of pangolins, i.e., Chinese pangolin (*Manis pentadactyla*) and Indian pangolin (*Manis crassicudata*) are found in Nepal. Chinese pangolins occur in Nepal, Bhutan, northern India, northeastern Bangladesh, Myanmar, northern Lao PDR, northern Viet Nam, Thailand, China and Taiwan (Duckworth *et al.*, 2008). In Nepal, Chinese pangolins are distributed in Annapurna Conservation Area, Makalu Barun National Park, Taplejung, Illam, Panchtahar, Ramechap, Sindhulli, Pannauti (Beber area), Bhaktapur, Kavre, Soondarijal, Barabisse and Baglung (Majupuria & Majupuria, 2006; Shrestha, 1981; Kaspal, 2008; Suwal, 2011). Chinese pangolin is a vulnerable species due to its taxonomic uniqueness (monotypic order, family and genus), food specialization, very low reproductive rate (usually one cub per litter, one litter per year), strict requirements for habitat and very poor defense mechanisms (Wu *et al.*, 2004). The generic name of pangolin in Nepal is "Salak" although it has some local names that are popular in particular areas. Chinese pangolins are listed as Endangered under the IUCN category and are listed in Appendix II of CITES. In Nepal they are protected by the Government of Nepal under the National Park and Wildlife Conservation Act, 1973. Although, Chinese pangolins are ecologically beneficial they have not received much scientific attention. Their ecology, behavior, status and distribution in Nepal are relatively unknown. A few studies regarding the Chinese pangolin were made by Acharya (1993), Gurung (1996), Kaspal (2008) and Suwal (2011) in Nepal but there is no significant research about this shy and nonaggressive species. Due to illegal trade and habitat destruction, the population of Chinese pangolins is decreasing at an alarming rate and the lack of information about this animal has exacerbated the situation.

Objectives of the study

The general objective of this study was to gather baseline information about Chinese pangolin in Nangkholyang Village Development Committee (VDC), Taplejung, Nepal. The specific objectives of this study were:

- To study the distribution of Chinese pangolin in the study area
- To study the habitat type utilized by Chinese pangolin
- To explore the social beliefs about Chinese pangolins
- To identify the conservation status of Chinese pangolin.

Study site

The study site chosen was Nangkholyang Village Development Committee (VDC), Taplejung, eastern Nepal. It is situated at a distance of twelve km from Taplejung Bazar. The field visit for this study was conducted in September 2012.

This study area is rich in floral and faunal diversity. The human population is mainly composed of lower middle class farmers. People mainly practice agriculture for their livelihood. According to the

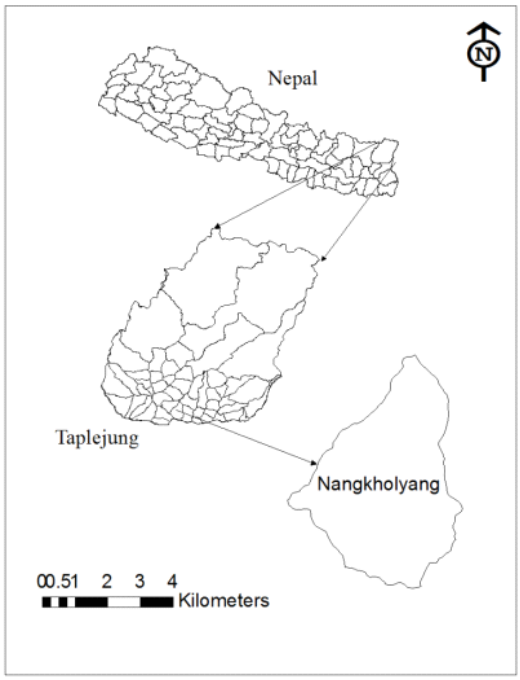


Figure 1: Map of the study area

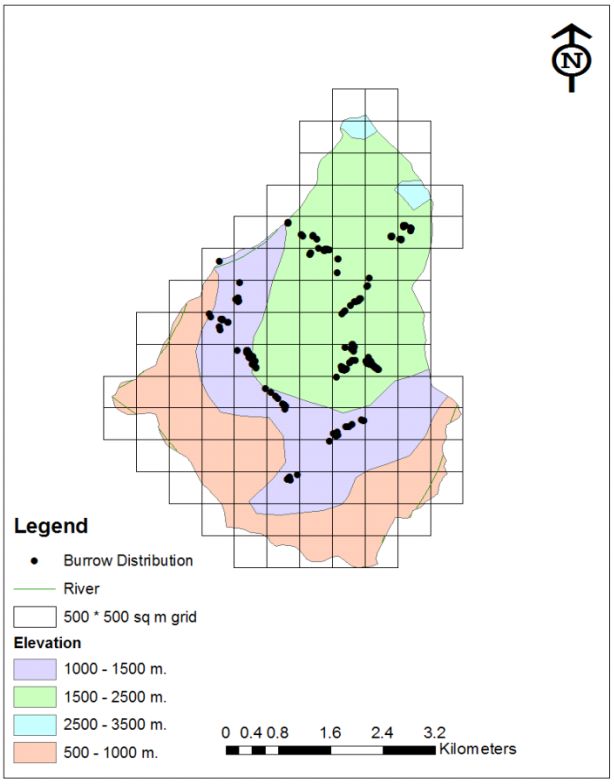


Figure 2: GIS map showing the distribution of pangolins

2001 census, there were 730 households with an average household size of 5.373. Total population was 4,015. The main castes of this VDC are Rai, Limbu, Brahmin, Sunuwar and Gurung.

Methodology

A preliminary survey was carried out initially in Nangkholyang VDC to assess the situation and identify potential sites where Chinese pangolins could be found. Discussions were held with the District Forest Office authorities and local people and a search was made of relevant literatures. Group discussions were carried out separately with school teachers, community forest users and the local community with the use of a checklist. A participatory mapping exercise was also carried out in these group discussions to determine the potential distribution of Chinese pangolin in villages. The distribution sites of Chinese pangolin as identified during the participatory mapping exercise were surveyed by diurnal walks along the available tracks for direct field observations. The random search method was also employed for field observations. Information about pangolin burrows (old and new), scats, footprints, and traces of tail movement were noted. GPS readings were taken at the burrows and other related matters of pangolins were recorded. About 52 respondents to the questionnaire survey supplied information such as hunting trends, the price of scales, and so on. Respondents were selected by using the snow-ball sampling technique. For secondary data, relevant journals, papers, books, and published and unpublished reports were consulted. Arc GIS 9.3 was used to map out the distribution of pangolin.

Result and discussion

Distribution

This study investigated the distribution of Chinese pangolin burrows in all the wards (political units of VDC). Indirect signs such as footprints, scats and tail traces were found during the field observations. The distribution map showing the distribution of Pangolin in the study area is shown in Figure 2.

Pangolin burrows were found in all the wards, with highest number found in ward four and the lowest

in ward six. Altogether, 211 burrows were found during the field study, including 16 new and 195 old burrows. The maximum number of burrows were found in the southwest aspect and the least amount in the northern aspect. Burrows were found from 1,126 m to 2,406 m elevation, with the maximum burrows at the elevation range of 1,520 m to 1,620 m. The average width and depth of pangolins burrows were found to be 18 cm and 49.630 cm.

Old Chinese pangolin burrow

New Chinese pangolin burrow

Habitat utilization

Pangolin burrows were widely distributed in forest and agricultural land. The number of burrows present in forest and agricultural land were 146 and 65 respectively. Among 146 burrows found in the forest area, the maximum number of burrows were found under a crown cover percentage of 0-25. The fewest were found under a crown cover of 50-75 percent. The burrows were mainly found near *Imperata cylindrica, Nephrolepis auriculata, Dendrocalamus, Ficus nerifolia* and *Pinus roxburghii.* Altogether 38 species of plants were found to be associated with the burrows. The study conducted by Kaspal (2008) recorded 35 species of vegetation and the distribution of burrows near different plant species is similar.

Social beliefs

It was found that the local people considered Chinese pangolins to be a sign of bad luck. This belief kept people away from pangolins in the past because it was believed that something bad would happen if a pangolin was seen. A similar belief was reported from Vietnam (www.huffingtonpost.com) and China (Patel & Chin, 2008). But nowadays due to the high market value of pangolin scales people are illegally hunting this insectivorous mammal.

Conservation status

A total of 52 respondents were interviewed regarding the conservation status, trade issues and possible threats to pangolins. Of those interviewed, 43 respondents (82.7%) had seen Chinese pangolins during their life time, whereas nine respondents (17.3%) had never seen a pangolin. However, all the respondents were aware of pangolin signs, i.e., burrows. Forty-seven respondents (90.4%) were male and five respondents (10.6%) were female.

Population trend within the last five years

Among 52 people interviewed, 44 (84.6%) believed that the pangolin population was decreasing; five respondents (9.6%) believed the population was stable. Three respondents (5.8%) had no knowledge about the population trend.

Threats to Pangolin

About 45 respondents (86.6%) thought that hunting by humans was the main threat to pangolins. Six respondents (11.5%) thought habitat degradation was the main threat. Only one respondent (1.9%) thought predation by wild animals was the main threat.

Causes of habitat degradation

Regarding the causes of habitat degradation, 19 respondents (36.5%) focused on forest fires as the main cause of habitat degradation. Twelve respondents (23.1%) focused on deforestation. Eleven respondents (21.2%) focused on road construction. Six respondents (11.5%) focused on

fodder or grass collection and four respondents (7.7%) focused on grazing for the main cause.

Hunting pangolins

About 25 of the respondents (48.1%) said that hunting of pangolin was occasional (quarterly or half yearly). Nine of the respondents (17.3%) said that it was done regularly (weekly or monthly). Eight of the respondents (15.4%) thought that hunting was rarely done (annually or biannually). Ten of the respondents (19.2%) did not know about the period of hunting of pangolins in villages.

According to the respondents' views, 42 (17.3%) said that pangolins were hunted for trade. Nine respondents (17.3%) said that the reason was for meat. Only one respondent (1.9%) answered that it was for traditional medicine.

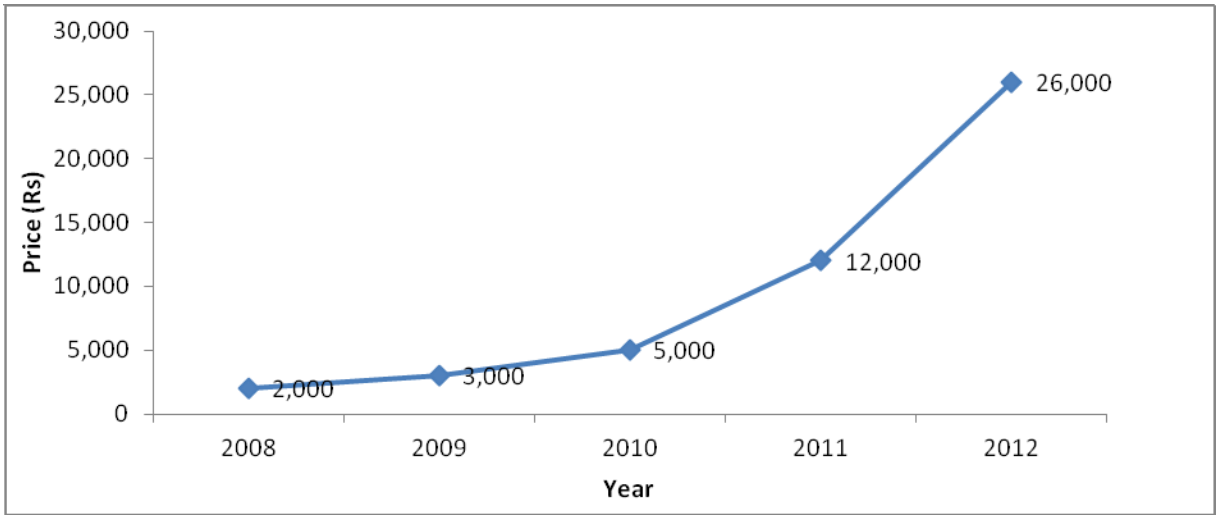
Among 52 respondents, 11 (21.2%) were involved in hunting. Five had hunted one time. Three had hunted twice. Two had hunted 3 times and one respondent had hunted 4 times.

Methods used to catch pangolin

Thirty-five respondents (67.3%) answered that pangolins were caught by finding their burrows (wait, dig, fire). Nine respondents (17.3%) answered that pangolins were caught by trapping. Four respondents said that dogs were used to catch pangolins. Four respondents did not know about the methods used to catch pangolins.

Price dynamics

About 15 respondents (28.8%) knew about the illegal trade in Chinese pangolin in that area. According to their response, the price dynamics of scales within last five years is as follows:



Pangolin scales were seen in two houses during questionnaire survey. The local price of pangolin scale was very high (Rs. 26,000). Special skills are not needed to kill this animal so anyone from school children to old people can be involved in the search for pangolin. The price of pangolin scales varies from seller to seller and the place of the sale. Respondents stated that the price of pangolin scales depends upon the seller and his bargaining power with the purchaser. The price of a pangolin scale is higher if it is sold in the market (Taplejung bazar, Birtamod), but when it is sold in the village the price is comparatively low. The price of pangolin scales also depends upon the quality of the scales. The scales are of a mature animal will bring a higher price than those of an immature one. The trend seems to indicate a rapidly increasing price for scales. Five hunting tunnels were found during the field observation.

Pangolin scales found in village

Bag of pangolin scales

Hunting tunnel dug by hunters to catch pangolins

Conclusion

Chinese pangolins were distributed in all the wards of Nangkholyang VDC, Taplejung. Indirect signs of pangolin found in the study area included 211 burrows (16 new, 195 old), scats, footprints and traces of tail scrapes. The burrows were distributed from sub-tropical to temperate regions, i.e., 1,126 to 2,406 m altitude, with the highest location found at 1,520 – 1,620 m. The most preferred aspect was the southwest. The habitat utilized was in agricultural land and forest. In forest, the maximum number of burrows were found in open forest with crown cover of 0-25%. Thirty-eight types of plant species were found around the burrows.

Social belief about Chinese pangolin was found to be negative, but due to the profit motive people were hunting this creature.

The conservation status of Chinese pangolin was found to be worsening. Hunting and trapping for illegal trade was found to be the major threat for pangolins. Habitat degradation was also a threat. The population trend within the last five years was found to be decreasing.

Acknowledgements

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STATUS OF SEAGRASSES IN MARINE NATIONAL PARK, GULF OF KACHCHH, INDIA

by R.D. Kamboj

Introduction

The lesser known but vibrant coastal ecosys tem of seagrass meadows are very important for coastal communities as they provide various goods and services and are critical components of a vital, interdependent and interconnected series of coastal ecosystems. Along coastlines, mangroves, coral reefs, seagrasses and sand dunes are often found together and form a mosaic of micro-organisms, algal, fungal, floral and faunal communities. Each of these form integral parts of interdependent coastal ecosystems (KallesØe *et al.*, 2008).

Seagrasses are seed-bearing, flowering, rooted plants, which grow submerged, exclusively in marine coastal waters and coastal wetlands. Like grasses in terrestrial habitats, they form meadows on the bed of coastal seas. They are dependent on light penetration for photosynthesis; therefore, they generally grow only in clear, shallow waters, in estuaries and coastal seas. They cannot survive out of water; therefore, they often grow where there is shelter from a sand bar or coral reefs. Seagrasses are different from the seaweeds which are also found in a marine environment comprising mostly algae or kelp. These seaweeds lack the vascular systems for the transport of food and water which are found in seagrasses. Similarly, seaweeds also lack flowers and fruits that are specialized for reproduction, as well as roots.

Seagrasses are the only flowering plants that have adapted to a completely submerged life in the sea. In order to thrive in tidal and subtidal marine environments, these grasses have special adaptations to withstand the wave energy of the sea and sub-marine pollination. Air-filled tissues in the leaves facilitate gas exchange with the environment and the plants have salt tolerance up to 36 parts per thousand. Seagrasses grow underwater rooted to the sea floor. The underground rhizomes and roots are in black sediments with no oxygen and therefore the plants need the sugars and oxygen produced during photosynthesis in the above-ground parts for their survival. Seagrasses need more sunlight than algae, which do not have underground parts. This limits the depth to which seagrasses can grow (Orth *et al.*, 2006). They need more than 10% of the light falling at the water surface compared to algae, which only need 1% (Bjork *et al.*, 2008).

Importance of seagrass

Seagrass meadows constitute ecologically and economically important habitats as they provide many goods and services to our ecosystem which also benefit human beings such as the many edible fish found living in seagrass; they are nurseries for many commercial fin and shellfish species; they provide for the aquaculture and aquarium trades; and the plants themselves are used as insulation and thatching material for housing and packaging. They also offer regulating services such as prevention of erosion, prevention of pollution and sedimentation in coastal waters, stabilizing the floor of coastal seas, giving supporting services like primary production in the ecosystem, supporting coastal biodiversity, enriching nutrients in coastal waters and acting as indicators of health of the coastal ecosystem. They also offer cultural and recreational services and in many countries also support traditional fishing practices. They act as filters for coastal waters as they slow down water currents, trapping particles, nutrient organic matter and pollutants washed from inland waters to coastal areas.

There are only about 60 species of seagrasses recorded all over the world (Phillips and Menez, 1988). From India, 15 species of seagrasses belonging to seven genera have been reported, which accounts for about 30% of the total seagrasses reported in the world (Jagtap, 1991).

In Marine National Park, Gulf of Kachchh, six species of seagrass are reported from the regions having mudflats and sand from the lower intertidal zone to a depth of 10-15 m along the islands in most cases.

Distribution of seagrass in Marine National Park

The Marine National Park and Sanctuary (MNP&S) is situated along the southern coast of the Gulf of Kachchh in Jamnagar and Rajkot district between 20° 15' N to 23° 40' N latitudes and 68° 20' to 70° 40' E longitudes. An area of 620 km^2 was declared as the Marine National Park and Sanctuary by the Government of Gujarat in 1980 and 1982. There are 42 islands, each ranging from only a few hectares to as large as 7,000 hectares in area. It encompasses a variety of habitats, viz., coral reefs, mangrove forests, sandy beaches, mudflats, rocky coast, seagrass beds, wide intertidal areas, etc. This diversity of habitats caters to the needs of thousands of flora and fauna and provides them suitable shelter.

Attempts to study the seagrass ecosystem exclusively in Marine National Park, Gulf of Kachchh, are not encountered through a review of literature. However, information on the occurrence of seagrass has been recorded by various agencies/organizations studying the mangroves, coral reefs and related aspects of Marine National Park. Jagtap (1991) reported the occurrence of four species of seagrass from the Gulf of Kachchh. *Halophila beccarii* was reported to have common occurrence whereas three other species, viz., *Halodule uninervis*, *Halophila ovalis* and *H. ovata* were very rare. The status of seagrass was reported to be degraded. Nair (2002) reported three species viz., *Halodule univervis*, *Halophila ovate* and *H. beccari* on sandy regions of Narara reef and Kalubhar reef. A comprehensive study on the biodiversity and management issues of Marine National Park carried out by Singh *et al.* (2004) shows the locality-wise status of seagrass. The localities with maximum abundance were observed at Paga reef, Chandri reef, Noru reef, Bhural chank reef, Kalubhar reef, Narara reef, Boria, Mangunda, Goose and Pirotan. The locations without seagrass were Bet Dwarka, Sonemiar, Khara chusna, Dedeka, Mundeka, Okha and Arambhda. The localities with the minimum abundance of seagrasses were Meetha Chusna, Bhaidar, Chank, Ajad, Jindra, Chhad and Poshitra. This study recorded only three species from the intertidal reef areas of Marine National Park as against the six species reported by SAC in 2010. The scientific investigations carried out by the Space Application Centre (Indian Space Research Organization) Ahmedabad, during the period from 2004 to 2007, revealed the presence of seagrass on different islands in Marine National Park. The results of these investigations indicated the presence of six species of seagrass from the Gulf of Kachchh. Seagrass (*Thalassia hermprichii*) has been mapped along with algae on the inward side of the reef flats of Bural Chank and Paga reefs, Kalubhar, Narara reef and Pirotan. The common seagrasses found growing on the muddy substrate are *Halophila ovalis*, *H. beccarii* and *Zostrea marina* (SAC, 2010).

The Gujarat Ecology Commission and Bhaskaracharya Institute for Space Application and GEO-Informatics, Gandhinagar, jointly published the "Coral Atlas of Gujarat State" in 2011, in which an attempt has been made to compile the area-wise distribution of seagrasses in different areas of Marine National Park. The results of the compilation are reproduced in Table 1.

During an inspection of various areas/islands of Marine National Park during last two years, the author has observed seagrass patches on various localities which have been photographed and reproduced as figures A to D.

It is interesting to observe that the area under seagrass in Marine National Park may be more than 2,500 ha, as some of the islands having presence of seagrass as per SAC (2010) have been not included in Table 1. The largest extent of the area has been reported from Bhural reef, comprising Chank, Noru, Bhaidar, Khara chusna and Meetha chusna islands.

Seagrass associated fauna

Due to the occurrence of a large area of seagrass habitat, the Marine National Park supports a large

Table 1: Extent of Seagrass in Marine National Park

Sr. No.	Name of Reef/Islands	Area (ha)
1	Bhural reef (Chank, Noru, Bhaider and Chusna both)	1,321.72
2	Ajad Tapu	8.94
3	Gandhio kado	3.01
4	Goose reef	15.65
5	Sikka reef	198.81
6	Dedika-Mundika reef	354.62
7	Pirotan	504.18
8	Chhad and Jindra	25.38
	Total :	**2,432.31**

array of marine fauna including vulnerable species like green sea turtles and dugongs. A researcher from the GEER Foundation, Mr. Yashpal Anand, detected and photographed watery, trail-like configurations amidst the seagrass beds dominated by *Halophila spp.* at a place adjoining Pirotan Island in Marine National Park (22° 34' 40.4" N; 69° 59' 07.3"E) in May 2009. Subsequently, the photographs of these trails were sent to Professor Helene Marsh (Australia), who confirmed these to be likely feeding trails of dugong, indicating indirect evidence of the occurrence of dugong in Marine National Park. The study also recorded for the first time large seagrass beds dominated by *Halophila spp.* near Pirotan Island, Gulf of Kachchh (Pandey *et al.*, 2010). Similarly, the author, along with staff, during inspection of Bhaider Island in first week of January 2012, came across patches of seagrass near this island and also found four carcasses of sea turtles on the island confirming its presence in the area.

Threats to seagrass meadows

Like all coastal ecosystems, seagrasses are also subjected to multiple impacts that are often from inland sources at local, national and global levels. Many anthropogenic activities impact the seagrass ecosystem and it is estimated that to date 65% of the seagrass meadows has been lost as a result of coastal development and alteration (Bjork *et al.*, 2008). In Marine National Park, there are both natural and anthropogenic threats to seagrass described as follows.

Pollution

One of the major threats to the seagrass meadows in Marine National Park is pollution due to various industries and sedimentation affecting the water quality. Because sea grass meadows are dependent on sunlight for photosynthesis, water clarity and quality are important for the health of this ecosystem. When there is excessive sedimentation and the turbidity of the water increases, then seagrass meadows are affected. Dredging and coastal development also causes water turbidity affecting seagrass.

Eutrophication

Industrial and domestic pollution and runoff from inland areas carrying with it excessive nitrogen and phosphorus from fertilizers, animal and domestic waste leads to an extreme burst of growth of algae which blocks light and oxygen from reaching the waters below the surface. The water then turns cloudy and green, further blocking light penetration and thus adversely affecting the seagrasses.

Other sources of pollution such as oil spillage from tankers, ships, sub-sea pipelines and hot water discharge from industries also affect the condition of seagrasses.

Port, harbor and jetty development facilities on the coastline are leading to the increase of

sedimentation, solid waste and marine pollution affecting the seagrass.

Irresponsible fishing is another threat to seagrasses in Marine National Park. Fishing activity, in particular trawlers, shore seine operations, gill net operations and boat anchorage are adversely affecting the seagrasses. When fishing boats enter into areas where there are seagrass meadows, their propellers can slash leaves as well as the rhizomes of seagrass, leading to fragmentation of the habitat, which, in turn, adversely affects the seagrass.

Climate change

Seagrass meadows are much more at risk from climate change as it will cause many changes in the oceans. Water temperature will be higher, acidity will increase (as a result of increased dissolved CO_2), the sea level will rise, storms and extreme weather events will increase in intensity and frequency, the amount of falling rain will change, wave climates will be altered, and sea water will intrude into fresh water (IUCN, 2007).

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Fig. 1 Seagrass patch on Bhaidar Island

Fig. 2 Seagrass patches on Goose Island

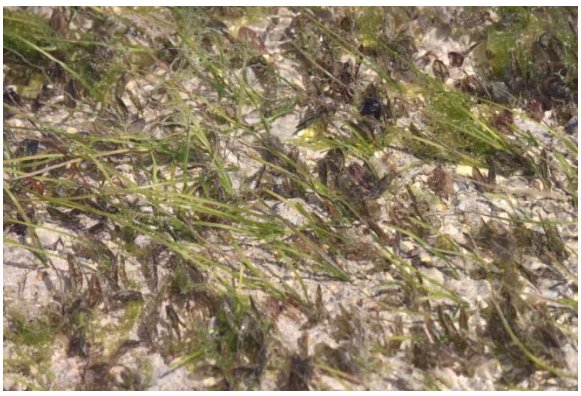


Fig. 3 Seagrass on Narara Reef

Fig. 4 Seagrass on Noru Island

FOREST NEWS

Vol. 27: No. 3 2013

FAO'S WORK ON COMBATING CLIMATE CHANGE RECEIVES RECOGNITION AT THAILAND'S CLIMATE CHANGE ADAPTATION EXPO

The Climate Change Adaptation Expo, organized by the Office of Natural Resources and Environmental Policy and Planning (ONEP) under MoNRE, was aimed at promoting greater awareness on climate change adaptation among the general public. FAO was one of around 30 organizations (UN, bilateral, Thai government agencies, and the private sector) that participated in the expo held 26-28 September at Central World Square in Bangkok.

Mr. Vili A. Fuavao, FAO Deputy Regional Representative, received a "Friends of Thailand's Climate" award on behalf of the Organization. The award cited FAO's efforts in combating climate change, with its role in formulating a climate change strategy and action plan.

The FAO booth highlighted the approach of FAO in mitigation and adaptation to climate change across all sectors. The organization has made climate change mitigation and adaptation a major program by mainstreaming climate change into the development planning of countries. The program's objective is to build resilient communities and capable government agencies able to handle the challenges of climate change. The booths displayed posters depicting the impact of climate change on vulnerable communities, how one can mitigate climate change through simple lifestyle measures, and FAO's work on adaptation, entitled "FAO in Action". This poster captured the entire gamut of work that FAO is undertaking, which includes climate-smart agriculture, climate-smart livestock, invasive species, drought management, gender and climate change, indigenous knowledge, forests and climate change, water cycles and climate change, etc.

Vili Fuavao, FAO Deputy Regional Representative for Asia and the Pacific, receiving the "Friends of Thailand Climate trophy on behalf of FAO from Vichet Kasem-thongsri, Minister of Natural Resources and Environment.

Besides information on climate change, FAO's booth adopted a participatory approach where visitors were invited to undertake a computer-based quiz on climate change, and also participate in the "FAO Hero" contest, which required them to post their ideas on how to address climate change. The successful participants received certificates and a chance to pose for a photograph with the "FAO Hero".

We would like to thank a number of individuals who contributed to FAO's booth. They include: Patrick Durst, Matthew Leete and Leyla Arpac for ideas on poster designs; Gerard Sylvester and Kevin McKeen for designing the computer-based quiz; Ms Kanyapat Seneewong Na Ayudhaya and Sakchai McDonough for poster design work; and Simmathiri Appanah for pulling the entire scheme together.

By Kallaya Meechantra & Sarinna Sunkphayung
October 2013

FAO's booth and staff at the Expo with the "FAO Hero."

Children taking the climate change quiz.

After successfully completing the quiz, certificates were issued.

The "My Action, My Idea" board drew many people to post their ideas about climate change.

WORLD TEAK EXPERTS, PRODUCERS AND TRADERS CONVENE IN THAILAND

"Sharing our planet: Teak model development towards the improvement of mankind"

Her Royal Highness Princess Maha Chakri Sirindorn graciously presided over the Opening Ceremony of the World Teak Conference.

The World Teak Conference 2013 convened in Bangkok, Thailand, 25-30 March 2013. The Conference was jointly hosted by TEAKNET, The Plant Genetic Conservation Project under the Royal Initiative of Her Royal Highness Princess Maha Chakri Sirindhorn of Thailand (RSPG), Plant Genetic Conservation Foundation, FAO, ITTO and the IUFRO Teakwood Working Party D5.06.02 and co-hosted by a total of 31 agencies.

Teak grows naturally in India, Myanmar, Thailand and Lao PDR, covering over 29 million hectares. Planted teak is raised in 38 tropical countries and covers 4.3 million hectares. The estimated market share of teak logs in the total tropical roundwood production is less than 2%; however, teak is part of the high-value hardwood market, and is a major component of the forest economies of many tropical countries. The superior qualities of teak wood make it a preferred species for ship building, construction, furniture making and other multiple end-uses. Substantial experience has been gained in the management of teak resources for sustainable teak wood production from tropical plantations worldwide.

Objectives

The major objective of the programme was to examine the multiple aspects of teak cultivation and management in the context of sustainable development with social, ecological and economic implications.

Opening Ceremony

In his opening remarks Mr. Hiroyuki Konuma, Assistant Director-General, FAO Regional Office for Asia and the Pacific, highlighted the importance and support given to the management and utilization of this high-value species in plantations and farm lands in the Asia-Pacific region. He pointed out that teak is an excellent crop for timber production in small farms, agroforestry, and with rehabilitation of degraded lands. These developments can potentially lead to small and medium industries in rural settings. However, in most instances, the policies, regulations and institutional setups are not adequately developed to foster such positive changes. FAO has been actively seeking countries to implement these prerequisites, so rural communities can benefit from forestry, their livelihoods are raised, and urban migration can be stemmed. Simultaneously, FAO is also exploring other win-win strategies whereby farm and agro-forestry developments can also address climate change mitigation while contributing to sustainable development. Teak can be an anchor species in all such initiatives.

Technical Sessions

Symposium I: Genetics, Silviculture, and Utilization

Conclusions:

- Under the present situation, a strategy for the genetic improvement of teak should be formulated with more consideration given to conservation of the existing gene pool.
- Mutual cooperation among international, regional and national agencies under the auspices of TEAKNET and IUFRO needs to be strengthened.
- For practical application, the delineation of provenance zones is suggested.
- Seed production of clonal seed orchards requires more urgent research to overcome the existing problems.
- Biotechnological tools in conjunction with intensive breeding programs need to be developed.
- Risk assessment should be taken into consideration in conjunction with an insurance package.

Symposium II: Environment, Climate Change and Carbon Trading

Key issues:

- Sustainable carbon sinks of teak plantations for sustainable forest management, as a tool to maintain or increase carbon stocks and to meet eligibility for sustainable forest management standards (e.g., Forest Stewardship Certification: FSC and ISO) and as a screen for forestry mitigation projects.
- Low carbon teak products can be developed through reducing emission from wood products of teak, carbon capture and storage (CCS) in teakwood products and assessment of the carbon profile and carbon footprint of teakwood products.
- The potential of teak plantations in carbon trading includes new facilities or crediting opportunities under the UNFCCC (e.g., REDD+, Nationally Appropriate Mitigation Activities (NAMAs) and sectoral crediting opportunities); incentives for teak plantations in carbon markets (e.g., government subsidies or tax incentives to stimulate carbon markets in the forestry sector); voluntary carbon market (VCM) and CSR with high quality standards and other sustainable forest management standards (e.g., FSC).
- Recognition of the co-benefits of teak plantations refers to benefits from trading carbon other than carbon benefits, such as biodiversity conservation, environmental services and their significance for local livelihoods in REDD+, VCM and other forestry projects.

Symposium III: Economics and Investments

Major issues in teak investments:

- Based on the wood's aesthetic qualities, strength and durability, teak has been utilized for centuries in high-end furniture and ship building and the mindset of the consumers was based on tradition and the preference for natural forest teak that has matured with age. One significant difference between natural teak and plantation teak is the relatively lower levels of tectoquinone (anti-termite) or lapachol (antifungal), which contributes to

decay resistance in the latter. However, there are some ways to improve plantation teak to make its qualities closer to that of natural teak.

- The prices of natural teak and plantation teak differ greatly at the moment. This will definitely affect the ROI depending on which prices are in use. A number of investors got into the investment by looking at the high prices of natural teak in the market.
- Teak is excellent for carbon trading. Compared to other investments, wood is becoming important as it is renewable and considered very eco-friendly. The investment in plantations means they are also investing in carbon trading, which shows the organization's Corporate Social Responsibility (CSR) to the world.
- Based on the investment criteria, there is no evidence of successful cases among the small holders. Investing in the forest is long-term and involves fringe benefits. Studies have to focus on successful options for the small scale investments in order for the small holders to profit from the teak plantation as well.
- Extensive research has gone into genetic improvement, raising tissue culture plantations and manipulation of nature to improve the dimensions, straightness, and percentage of heartwood and to reduce the rotation years to 20 years, focusing on the yield.
- Research on teak has been done extensively on silvicultural aspects, but is very limited regarding the production and improvement of plantation teak; in particular, the aesthetic attributes were not covered as driven by market demands in the high-end categories.

Symposium IV: Rural Development

The highlights were:

- Awareness of intercropping methods among farmers and small holders is needed due to the long-term returns from teak cultivation. Ownership of land is also essential if teak is to make significant contributions to the livelihood of rural communities.
- Make available quality teak germplasm to avoid planting of poor quality seedlings by the farmers.
- The important role of Government, support agencies and policy makers for adopting improved silvicultural and marketing management systems for the smallholders.
- There is need for collaborative research and partnership with teak-growing countries to enhance the livelihood of small holders through sustainable forestry.
- Establishment of a Community Tree Bank as a model of self-sufficiency for rural people to encourage them to plant trees which have great potential for mitigating greenhouse gas emissions which lead to global warming, and also creating investment opportunities.

Source: Teaknet Bulletin Volume 6 Issue 2&3 April & July 2013

Source: Facebook meme

GLOBAL MEETING IN PREPARATION FOR FRA 2015

Prepared by Örjan Jonsson, Forestry Officer, FAO

Introduction

The "Global Meeting in Preparation for FRA 2015" and the "Collaborative Forest Resources Questionnaire Reporting" took place 6-10 May 2013, in Chiang Mai, Thailand. It was jointly organized by the Royal Forest Department of Thailand and FAO. More than 120 participants from 96 countries, including the National Correspondents to FRA 2015, representatives of partner organizations, FAO Headquarters and the FAO Regional office for Asia and the Pacific (RAPA) attended the event.

The programme included plenary presentations and small group sessions organized according to languages, plus a computer room for interactive work. An open knowledge fair and small group sessions allowed participants to clarify any issues related to the FRA 2015 reporting.

Background to FRA 2015

Global forest resources assessments have been carried out by FAO since 1946. The mandate to carry out these assessments stems both from the basic statutes of FAO and the Committee on Forestry (COFO). Global forest resources assessment reports have been published at periodic intervals of five to ten years. The latest of these reports, *FRA 2010*, was published in 2010. The *Global Forest Resources Assessment 2015*, or *FRA 2015*, was mandated by the twentieth session of COFO.

The key milestones of FRA 2015 are outlined below to give an overview of the process and the deadlines.

Activity	Tentative date	Comment/output
Global meeting, Regional, sub-regional and national workshops	March 2013 – November 2013	Country reporting process, technical assistance including regional workshops and review of draft country reports.
Deadline for submission of draft country reports	15 July 2013	Countries are strongly encouraged to submit draft reports well in advance of the deadline.
Deadline for completion of final country reports	15 October 2013	Country reports reviewed and completed.
Confirmation of final country reports	15 December 2013	Official request for validation of the final country reports will be sent to countries.
Public release of FRA 2015 report(s), public access to FRIMS	September 2015	Several publications are planned for FRA 2015 release at the World Forestry Congress, Durban South Africa

Key outcomes

- All National Correspondents were informed about the FRA 2015 country reporting process and the CFRQ working modalities;
- All aspects of FRA 2015 were clarified and country reporting capacity was improved;
- National Correspondents are familiar with the use and functionalities of the Forest Resources Information Management System (FRIMS);
- National Correspondents were informed about the FRA 2015 remote sensing activities;
- National Correspondents were informed about the Forest Futures study and scenario formulation is improved;
- National Correspondents are informed about the national capacity building plan activities and benefits derived from its implementation;
- Improved plan for the analysis and publications of FRA 2015 results; and
- Networking and exchange of experiences among national experts in forest monitoring assessment and reporting was fostered.

For more details regarding the Global Forest Resources Assessment Programme, please visit the FRA website at: www.fao.org/forestry/fra.

THE ILLEGAL TIMBER TRAIL

How global timber demand is causing the destruction or degradation of carbon-rich forests and vital wildlife habitats around the world, and what consumer countries are doing about it.

By Robert Simpson, Bruno Cammaert and Giulia Muir[1]

The challenge

In a carbon-rich forest in Madagascar, a CITES-protected rosewood *(Dalbergia* spp.*)* tree is being felled illicitly. This tree will very likely follow a complex and illegal timber trail thousands of kilometers long into a private home or business around the world. Malagasy rosewood fetches around US$45-50,000/ton in China and a set of furniture made from rare rosewoods has been found to reach an asking price of US$1,000,000, making the trade fuel for illegal crime and corruption. This insatiable appetite for rosewood is having an equally devastating impact in the greater Mekong region – including Myanmar, Cambodia, Lao PDR, Thailand and Vietnam – also home to a number of rosewood species of the *Dalbergia* and *Pterocarpus* genera. Demand for rosewood is just one example of the effects consumer choices are having on forests in the region and around the globe.

Compounding the problem is that many tropical timber-producing countries are plagued by weak governance and corruption in the forest sector. Together with rising consumer demand, these trends are fuelling widespread forest loss and degradation throughout Asia, with repercussions being felt far beyond the region. In contrast to sales of elephant ivory, rhino horn and tiger parts worth an estimated US$75 million[2] which have quickly and legitimately captured the public imagination, the illegal timber trade between South-East Asia and the European Union (EU) and other areas in Asia is estimated to be worth US$3.5 *billion*, with global estimates of trade in illegal timber reaching as high as US$30-100 billion[3]. Asian and European consumption of illicit timber now makes up **more than half of the global market.**

So what?

The trade in illegal timber and associated illicit practices in the forest sector – such as illegal logging, corruption, unlawful concession allocation, illicit conversion of forests to agricultural use and so on – can have a series of devastating impacts. In addition to destroying carbon-rich forests, devastating biodiversity hotspots, exacerbating poverty, fuelling conflicts with local communities, creating market distortions and political instability and contributing to growing greenhouse gas emissions, illegal forest practices exacerbate revenue loss from the forest sector (forests are degraded and the citizens of those countries reap no benefits). At the peak of Indonesia's illegal logging problem, when 80 percent of the timber being exported was illegal or considered suspect,

[1] Robert Simpson, EU FAO FLEGT Programme Manager; Bruno Cammaert, Forestry Officer & FAO FLEGT Focal Point, Asia; Giulia Muir, information consultant

[2] UNODC. Environmental Crime, The Trafficking of Wildlife and Timber.

[3] INTERPOL/ UNEP. 2012. Green Carbon, Black Trade: Illegal Logging, Tax Fraud and Laundering in the Worlds Tropical Forests.

[4] EIA. 2012. *Apetite for Destruction: China's trade in Illegal Timber.*

[5] EU Timber Regulation (EUTR), Lacey Act Amendment (USA), Illegal Logging Prohibition Bill (Australia) and Green Purchasing Law (Japan).

the Indonesian Government estimated that this trade was costing them US$4 billion annually from failed collection of royalties and tax evasion, five times more than the country's 2004 health budget[4]. What's more, recent years have seen a shift in mentality among a number of consumer countries around the world, including the European Union, the United States, Australia and Japan, to adopt sustainable procurement policies[5]. If this trend in consumer mentality continues, failure to demonstrate legality and improve governance in the forest sector will increasingly limit access to international markets in the years to come.

What is the European Union doing to counter the illegal timber trade?

The illegal timber trade and associated organized and criminal activity thrives on weak forest governance, unrealistic and unenforced laws and corruption in the forest sector. In light of this, and in part swayed by growing public concern about the environmental, social and legal credentials of timber, the EU adopted an Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT) in 2003. The FLEGT Action Plan involves a series of supply- and demand-side measures that aim to improve forest governance and in turn, legality in the sector. One of the main tools of the Action Plan is the negotiation and conclusion of Voluntary Partnership Agreements (VPAs), bilateral accords between the European Union and timber-producing partner countries that work to support measures and technologies that can distinguish between illegally and legally produced forest products and that strengthen forest governance altogether. The Action Plan also contains many options for countries interested in addressing forest governance without engaging in the VPA process.

What is the EU FAO FLEGT Programme?

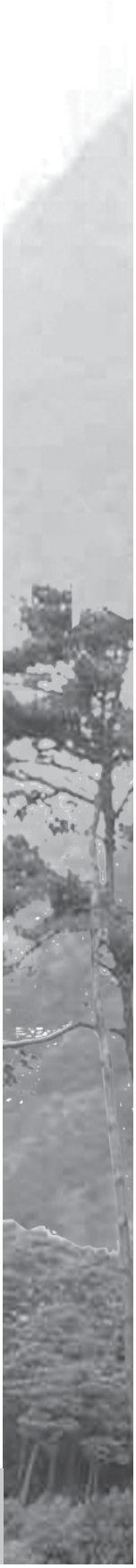
The EU Food and Agriculture Organization (FAO) FLEGT Programme is a demand-driven Programme which provides grants of up to €100, 000 to local stakeholder groups including government institutions, private sector organizations and civil society in timber-producing developing countries to help put the FLEGT Action Plan into practice. In addition to working in Africa and Latin America, the Programme is building a presence in the Asia-Pacific region, working with local stakeholders in countries negotiating or implementing a VPA and other eligible timber producing countries. For example, the Programme is supporting implementing partners in: 1) **Viet Nam** to effectively address stakeholder consultation and legality of imported timber in the context of a VPA; 2) **Myanmar** to develop sustainable Community Forestry (CF) initiatives by enhancing the legality of timber production and trade and improving CF and smallholder timber revenues; and 3) **Nepal** to promote good governance and increase transparency of production and trade of *Shorea robusta* by developing independent monitoring of timber traceability, verification and control systems and building necessary capacities of different stakeholders**.** The Programme will also be operating in Indonesia, Lao PDR and Malaysia in 2013 and is currently soliciting proposals from other eligible timber-producing countries in the region.

For more information, please see: www.fao.org/forestry/eu-flegt/en/

REGIONAL WORKSHOP ON CAPACITY BUILDING NEEDS, 16–17 October, Bangkok, Thailand

This workshop provides an opportunity for government, civil society and private sector representatives to learn more about existing and emerging international timber market requirements and the available forest governance support programmes in the region. Participants will be invited to identify key regional FLEGT support and capacity building priorities, in particular in the areas of stakeholder engagement in forest governance improvement processes, compliance to market requirements, especially for SMEs, and the development and local implementation of systems that help governments assure the legality of their timber production. The event is co-organized by the EU FAO FLEGT Programme, the EU FLEGT Facility, RAFT, UK-DFID and GIZ under the auspices of the Thai Royal Forest Department.

For more information, please contact: Bruno.Cammaert@fao.org



FLEGT IN ASIA: SUPPORTING GOOD GOVERNANCE AND RESPONSIBLE TRADE FOR ASIA'S FORESTS

A Regional Workshop on Capacity Building Needs to Support FLEGT in Asia is being organized by FAO and the Royal Thai Forest Department in Bangkok, Thailand, 16-17 October 2013. Participants will include government, civil society and private sector representatives from regional VPA countries (Indonesia, Lao PDR, Malaysia, Thailand and Vietnam), plus Cambodia, Myanmar, Papua New Guinea, Philippines, Solomon Islands; representatives of EU delegations of concerned countries; and representatives and resource persons from FLEGT-related support programmes (EFI, RAFT, DFID, FAO, GIZ)

Background

In 2003, the European Union (EU) adopted its Action Plan on Forest Law Enforcement, Governance and Trade (FLEGT) with the aim to halt illegal logging and promote better governance. The negotiation and conclusion of a Voluntary Partnership Agreement (VPA) between the EU and a Partner Country has been the predominant tool, but there are many measures in the Action Plan to support improved governance. The ultimate objective of a VPA is to ensure, through a licensing scheme, that only legal timber is imported into the EU. Each VPA is dependent on the development and implementation of a Legality Assurance System (LAS), which includes a definition of legal timber, a verification system, a licensing system and an independent audit. Five countries in Asia have initiated actions to develop a VPA: Indonesia, Malaysia, Vietnam, the Lao People's Democratic Republic, and most recently Thailand. Indonesia, which concluded negotiations in May 2011, is due to sign its VPA soon, and is making significant progress towards implementation of the VPA requirements.

The EU Timber Regulation became applicable in March 2013 and prohibits the placing of illegal timber and timber products on the EU market. The United States and Australia have both adopted similar legislations, completing a significant demand-side incentive to address illegal logging in supplier and processing countries. China, Japan and South Korea are contemplating the further development of policy instruments to curb the trade in illegal timber and timber products.

A number of programmes support regional and country-level action to address illegal logging and to facilitate the implementation of these new trade-related legal instruments. The executing agency of the EU FLEGT Action Plan is the European Forest Institute's (EFI) EU FLEGT Facility. Since 2007, EFI has been providing technical and financial support to VPA processes and other elements of the EU FLEGT Action Plan. Since May 2012, the EU has further strengthened its support with the EU-FAO FLEGT Programme, implemented by FAO. The programme supports local stakeholder groups in developing countries to put the FLEGT Action Plan into practice. In addition, the European Commission has thematic programmes such as the EU-ENRTP (Thematic Programme for Environment and Sustainable Management of Natural Resources) and country programmes that can support FLEGT-related activities. Concurrently, substantial support is also provided by the UK Forest Governance, Markets and Climate (FGMC) Programme, ITTO's Thematic Programme on Tropical Forest Law Enforcement, Governance and Trade (TFLET), the GIZ Forest Governance Programme and the Responsible Asia Forestry and Trade (RAFT) Partnership and the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet), funded through the Australian and US governments.

APEC FORESTRY MINISTERS COMMIT TO INCREASED COOPERATION ON SFM

Asia-Pacific Economic Cooperation (APEC) Forestry Ministers have released the Cusco Ministerial Statement, which sets out their aspirations for future cooperation in the area of forestry. The Statement was released at the close of the Second APEC Meeting of Ministers Responsible for Forestry, held in Cusco, Peru from 14–16 August.

Ministers and senior officials attending the meeting discussed the importance and potential of forest resources in the APEC region, conditions for sustainable forest management (SFM), as well as threats and challenges to SFM. APEC notes that its economies produce 60 percent of the global forest products and account for 80 percent of the global trade in such goods, with annual revenue from trade valued at over US$150 billion.

The key outcome of the meeting was the Cusco Ministerial Statement, in which APEC forestry ministers aspire to, *inter alia*: advance the important contributions of forests to the emerging green economy through research on, innovation in and demonstration of new wood-based and non-timber forest products, services and applications; strengthen private sector investment in SFM across the APEC region, along with access to better technology and markets, by promoting, among other things, market-based instruments such as certification, and social and environmental safeguards; recognize, where applicable, the key role of indigenous people and local communities and traditional knowledge in SFM; promote technical cooperation among APEC economies to share best practices, lessons learned and experiences in governance, especially institutional and legal frameworks, regulation and public policies; encourage the development of local forest industries that generate employment and value-added products from sustainable sources; maintain and strengthen the efforts of APEC economies to combat illegal logging and associated trade including through education programs; promote trade in legally harvested forest products; and consider establishing mutually agreed policy partnership dialogues to address the implementation of APEC forest objectives.

The Cusco Statement reaffirms and strengthens previous commitments and declarations made by APEC Leaders in Sydney (2007), Yokohama (2010), Honolulu (2011) and Vladivostok (2012). The full text of the Cusco Statement is available at: http://www.apec.org/Meeting-Papers/Ministerial-Statements/Forestry/2013_forestry.aspx.

APEC member economies include: Australia; Brunei Darussalam; Canada; Chile; China; Hong Kong; Indonesia; Japan; the Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; the Philippines; the Russian Federation; Singapore; Chinese Taipei; Thailand; US; and Vietnam.

Source: Forests Policy & Practice – iisd Reporting Services
http://forests-l.iisd.org/news/apec-forestry-ministers-commit-to-increased-cooperation-on-sfm/

VIETNAM LAUNCHES NATIONAL UN-REDD PHASE II

Signing ceremony

Vietnam is the first of the 47 UN-REDD partner countries to move into the second phase with an additional US$30 million investment to reduce greenhouse gas emissions through improved forest and land-use management. The start of Phase II of the UN-REDD Programme, will significantly expand national efforts to reduce deforestation, enhance forest quality, and increase overall forest cover in Vietnam.

Financed by the Government of Norway, the National UN-REDD Programme to Reduce Emissions from Deforestation and forest Degradation (REDD+) will be a major pillar of Vietnam's efforts to reduce greenhouse gas emissions from the agriculture and rural development sector by 20 percent by 2020. By developing and implementing improved policies that address the drivers of deforestation and forest degradation, the aim is to increase Vietnam's overall forest cover to 45 percent by 2020.

As one of the original pilot countries of the UN-REDD Programme, Vietnam has been on the frontline of global REDD+ activities for the past four years. The country has successfully piloted REDD+ readiness work in a number of key areas including supporting strong coordination among national stakeholders, developing a framework for Measurement, Reporting and Verification, and testing approaches for the free, prior and informed consent of ethnic minorities and other forest-dependent communities.

Phase II will build on the REDD+ readiness work of Phase I, and start implementing Vietnam's National REDD+ Action Programme in six provinces across the country, namely Lao Cai, Bac Kan, Ha Tinh, Binh Thuan, Lam Dong, and Ca Mau. Over the next 3 years the Programme will help identify, negotiate, plan and implement land-use practices that are sustainable, climate-smart and adapted to local needs. Additional financial incentives will be made available by the Government of Norway and other international partners for transparently measured and verified greenhouse gas emissions reductions achieved through the Programme.

UN-REDD is a key UN joint programme, which harnesses the complementary global expertise of FAO, UNDP and UNEP. FAO is supporting national forest resource monitoring and assessment; UNDP supports democratic governance and stakeholder engagement; and UNEP will help secure multiple ecosystem benefits.

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UN-REDD PROGRAMME TRAINS SOLOMON ISLANDS FORESTRY OFFICERS IN FOREST INVENTORY

Chris Heider (Watershed Professionals Network, USA) explains to a team of trainees how to establish permanent carbon inventory plots for assessing in a lowland primary forest, southern Choiseul Province, Solomon Islands. (Photo: Fred Pattison, UN-REDD Programme)

Prepared by Joel Scriven, Forestry Officer, UN-REDD Programme

The Solomon Islands Ministry of Forest and Research, in collaboration with the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) and other partners, successfully completed a two-week forestry field training course that was conducted 9-23 August 2013. The course focused on methodologies for forest inventory and was delivered to 35 government forestry officers. It took place in South Choiseul in the northern Solomon Islands, with logistical support from the Boeboe Community.

The training course followed a very practical approach, and over the course of the two weeks the teams of trainees established 18 forest inventory plots in a variety of forest types, including mangroves and low-, mid- and high-elevation forests. One focus of the inventory activities was to measure the carbon content of different forest types and forests that had been subject to disturbances. To this end, the total ecosystem carbon contents of natural, secondary and logged forests were measured during the training course. In addition to field measurements, training included intensified team building and leadership skills to best allocate personnel capacity and resources to successfully meet the project goals. Following the completion of the training course, the MECCDMM hosted a closing dinner, during which participants were given certificates, and the Ministry reiterated its commitment to ongoing forest inventory capacity-building activities.

The course was organized and delivered by the Solomon Islands UN-REDD National Programme and received additional technical and financial support from the SPC-GIZ Pacific Regional Project on Climate Protection through Forest Conservation, which funded the participation of

four officers from the Fijian Government's Department of Forest and Fisheries. The Fijian participants were able to share their knowledge and experience of carrying out forest inventory in similar forest types in Fiji. The Government of the Solomon Islands also contributed substantially to the training by purchasing all the necessary equipment and funding the majority expedition. In this respect, the training course was a model outcome of national commitment and regional and international support for forestry.

The knowledge gained through this training course will feed into the formulation of the national forest inventory (NFI) methodology of the Government of the Solomon Islands, which will eventually be rolled out across the entire country. The added value of increased regional collaboration with Fiji strengthens the role of standardized methodologies for the Pacific region in inventory design, management and qualified personnel capacity. The NFI will aim to capture information on the condition of the country's forests and forest carbon stocks, as well as other useful forest information such as levels of biodiversity and social uses of the forest by local communities. The NFI will play a key role in tracking changes in forest carbon stocks, and carbon emissions from the Solomon Islands' forests, as part of the country's National Forest Monitoring System (NFMS) for REDD+. REDD+ is the country's effort to reduce emissions from deforestation and forest degradation (plus conserve forest carbon, sustainably manage forests and enhance forest carbon stocks).

The UN-REDD Programme is a capacity-building project to raise awareness and technical capacities on REDD+ of all relevant stakeholders in the Solomon Islands. To achieve this, the UN-REDD National Programme is working closely with various ministries of the government, national and international NGOs and the private sector. The work on the Solomon Islands NFI and NFMS represents one of the work areas of the Programme, with other work areas and activities including stakeholder engagement, analyses of the drivers of deforestation and forest degradation, and the formulation of a National REDD+ Readiness Roadmap document.

Further information on the UN-REDD Programme can be found at: http://www.un-redd.org/.

(Left to right) Terence Titiulu and Gusgrandy Mua (Ministry of Forests and Research) conduct downed wood sampling and data recording while Jimmy Kereseka (The Nature Conservancy) measures trees in a permanent plot located in a primary Bruguiera mangrove forest in southern Choiseul Province, Solomon Islands. (Photo: Chris Heider, Watershed Professionals Network)

STAFF MOVEMENT

Mr. Kenichi Shono, a Japanese national, joined the RAP NRE group as Forest Resources Officer, effective 20 September 2013, for an initial assignment duration of two years.

Mr. Shono holds a Master's degree in Forest Science and Management from the Yale School of Forestry and Environmental Studies.

Mr. Shono has 10 years of broad experience in forest management and conservation, including project coordination, research and policy analysis. Mr. Shono first gained experience as a field researcher for the Center for International Forestry Research (CIFOR). Subsequently, he coordinated a research project on forest restoration in Singapore for the Smithsonian Tropical Research Institute. From 2005 to 2008, Mr. Shono worked as Associate Professional Officer at FAO RAP, where he was involved in various programmes and projects related to promoting sustainable forest management in Asia-Pacific. Prior to rejoining FAO, Mr. Shono served as Technical & Operations Director for a Canadian environmental consulting firm based in Indonesia.

Mr. Shono has also been active in forest management and land use carbon project certification in the region as an accredited lead auditor for the Forest Stewardship Council (FSC) Forest Management Standard, as well as voluntary carbon standards including the Verified Carbon Standard (VCS) and the Climate, Community and Biodiversity (CCB) Standards.

Mr. Yurdi Yasmi, an Indonesia national, has joined the RAP NRE group as Forestry Officer (Policy), effective 10 October 2013, for an initial assignment of two years.

Mr. Yasmi holds a PhD degree (Forest and Nature Conservation Policies) and MSc (Tropical Forestry) from Wageningen University, the Netherlands and a BSc in Forest Management from Bogor Agriculture University, Indonesia.

Mr. Yasmi has over 15 years working experience in the forestry sector in the areas of forest policy and governance, participatory forest management, decentralization, conflict management and community forestry. He started his professional career in 1997 as a researcher at the Center for International Forestry Research (CIFOR) in Bogor. From 2003 to 2007 he worked for Wageningen University in the Netherlands. He moved to RECOFTC, the Center for People and Forests, in Bangkok in 2007, where he became the Head of Capacity Building and Research until early 2013. Before joining FAO, Mr Yasmi worked as Coordinator of Mekong Action Area at the World Agroforestry Centre (ICRAF) in Hanoi, Vietnam.

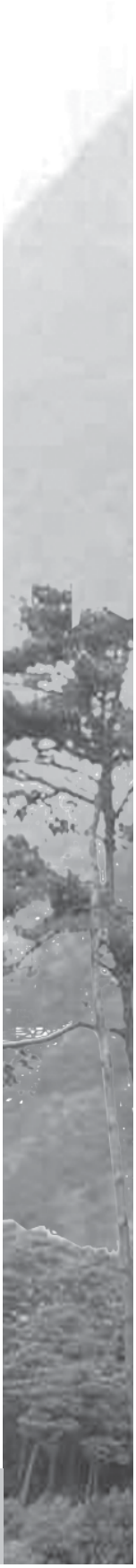
Mr. Yasmi serves on a number of international expert panels for organizations such as the World Bank, the International Union of Forest Research Organizations (IUFRO), the International Tropical Timber Organization (ITTO) and ASEAN.

Ms. Wirya Khim, a Cambodian national, has joined the RAP NRE group as a Junior Professional Officer – Natural Resources Management (Asia-Pacific), effective 31 August 2013, for an initial assignment of two years.

Ms. Khim holds a post-graduate degree in Natural Resource Management from Massey University in New Zealand and an undergraduate degree in Environmental Management from Royal University of Phnom Penh, Cambodia.

Ms. Khim has been working with various community-based natural resource management (CBNRM) initiatives since 2003. She spent two years working for an ADB-funded initiative – Skills and Awareness Building for the Tonle Sap, Cambodia. Most recently, Ms. Khim worked for FAO Cambodia as a Monitoring and Evaluation Officer for the Regional Fisheries Livelihoods Programme for South and Southeast Asia (GCP/RAS/237/SPA) for three years.

Bruno Cammaert, a Belgian national, has joined RAP as Forestry Officer of Project GCP/GLO/395/EC (EU FAO Forest Law Enforcement, Governance (FLEGT) and Trade Support, II), effective 31 August 2013, for an initial assignment



duration of one year. He will be responsible for the implementation of programme activities in the Asia-Pacific Region.

Mr. Cammaert holds an Engineering degree from the Faculty of Agronomy and Forestry of the University of Ghent (Belgium) and a Diploma in Business Administration from the University of Louvain (Belgium).

He has some 20 years of experience in Agro-forestry, Participatory Forestry and Forest Governance and some of his main assignments include East-Africa/ Kenya (ICRAF), Cambodia (FAO, UNDP and World Bank), Afghanistan (FAO), Nepal (SNV), Cameroon (EU), Lao PDR (UNDP and FAO) and Myanmar (UN-REDD Programme). The development of Participatory Forest Management has been the main focus of his work, but his involvement in FLEGT and REDD+ projects allowed him to gain experience in a much wider range of forest governance issues.

Leyla Arpac, a national of Turkey, joined the RAP NRE group in May 2013 as a consultant for the EU-FAO Forest Law Enforcement in Governance and Trade (FLEGT) Support Programme. Ms. Arpac is a graduate in International Relations from Bilkent University and holds an MA in European Studies from Sabanci University.

Prior to her assignment at FAO, Ms. Arpac worked as a technical officer at the Carbon Business Office of the Thailand Greenhouse Gas Management Organization. She has substantive experience in climate change mitigation, event management and environmental issues.

FAO ASIA-PACIFIC FORESTRY CALENDAR

29-30 January 2014. ***Regional Consultation and Publication on "Forests and climate change after COP19 (Warsaw): An Asia-Pacific perspective***. Kathmandu, Nepal. Contact: Patrick Durst, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

1st quarter 2014 (dates to be announced). ***Inception Workshop for TCP/RAS/3408 - Control and management of destructive forest invasive species in South Asian natural and planted forests***." Kerala, India. Contact: Patrick Durst, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Patrick.Durst@fao.org

10-14 March 2014. ***32nd Session of the Regional Conference for Asia and the Pacific***. Ulaanbaatar, Mongolia. Contact: Joachim Ottee, Secretary APRC, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Joachim.Ottee@fao.org

Late March (dates to be announced). ***Regional Seminar on the impacts of climate change in natural resources management***. Bangkok, Thailand. Contact: Simmathiri Appanah or Wirya Khim, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand; E-mail: Simmathiri.Appanah@fao.org;/Wirya.Khim@fao.org

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

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- Forests beneath the grass: Proceedings of the regional workshop on advancing the application of assisted natural regeneration for effective low-cost forest restoration (RAP Publication 2010/11)
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