Lanjak Entimau Wildlife Sanctuary Sarawak, Malaysia

A Conservation Project Supported by International Tropical Timber Organization (ITTO)

Forest Department Sarawak

International Tropical Timber Organization (ITTO)

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FOREWORD

The International Tropical Timber Organization (ITTO) is a strong supporter of sustainable forest management and nature conservation in the tropical countries. The Organization sent a Mission to Sarawak in 1989 and 1990 to assess the sustainability of the State's forest resources. On the recommendations of the Mission two pre-projects and four projects were approved by ITTO for implementation since 1992. One of the projects is the "Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area", a biodiversity conservation project. Situated in the south-western part of Sarawak, Lanjak Entimau Wildlife Sanctuary (LEWS) is the largest totally protected area covering 168,758 hectares. Its many outstanding characteristics, both physical and biological, make it a suitable candidate for in situ conservation and biological research.

The LEWS Project is now in the third phase and focuses on supporting the community development activities that relate to conservation and sustainable forest management. Both the Sarawak Government and ITTO view the LEWS Project as a very important one because of its pioneering role in encouraging and promoting rational utilization of natural resources through local participation. The Forest Department has also formed a Special Wildlife Committee as a management body of the Sanctuary to ensure continuity in development. In 1994, Sarawak Government took the lead to form the Trans-boundary Biodiversity Conservation Area (TBCA) with Betung Kerihun National Park in West Kalimantan, Indonesia, a similar project funded by ITTO. A joint ITTO Borneo Biodiversity expedition to the TBCA, was organized in 1997 to collect data for management purposes. A Task Force has been set up by the two host countries to coordinate the collaborative management of the conservation area.

This information booklet is a continuing effort by the Forest Department and ITTO to keep the general public informed of the importance of biodiversity conservation and sustainable forest management. It complements the four posters and a pamphlet published in July 2000 and May 2001 respectively. Besides describing the LEWS project this booklet also gives a brief account of other ITTO projects implemented in Sarawak. For those who are more scientifically inclined, scientific reports and individual consultant reports are available in the office of ITTO in Kuching.

I would like to thank the Director of Forests, Sarawak and the Executive Director of ITTO for their keen interest and support in the Project. My appreciation goes to Mr Kho Seng Yaw for compiling this booklet, Dr Paul Chai for his advice in preparing and editing the manuscript, Mr Braken Tisen and Mr Kueh Hong Siong for their suggestions and comments, Mr Voon Joon Hee for providing some of the photographs, Mr Jong Tze Hiong and Mr Kho Tho Leng for the maps, Miss Chiang Moi Sien for typing the manuscript, and the staff of Forest Department and ITTO Sarawak who have in one way or another contributed towards the publication of this booklet.

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ITTO Projects Coordinator
Sarawak

11 September, 2001

GLOSSARY

BANP	Batang Ai National Park
Batang	Main river
BKNP	Betung Kerihun National Park
Bukit	Hill
cm	centimetre
dbh	diameter at breast height
E, N	East, North
engkabang	illepenut
gotong royong	cooperating
ha	hectare
ITTO	International Tropical Timber Organization
IBBE (1997)	ITTO Borneo Biodiversity Expedition (1997)
LEWS	Lanjak Entimau Wildlife Sanctuary
m	metre
m a.s.l.	metres above sea level
Nanga or Ng	river mouth or confluence
Sungai	river, stream
TBCA	Trans-boundary Biodiversity Conservation Area
Ulu	up river, interior

View of the Wildlife Sanctuary from Bukit Lanjak

INTRODUCTION

General

The involvement of the International Tropical Timber Organization (ITTO) in efforts to conserve biological diversity in Borneo dates from the findings of the ITTO Mission to Sarawak in 1989 and 1990. The Mission concluded that sustainable forest management in Sarawak was being partly achieved and that the conservation of biological diversity would be best served through in situ preservation of the State's natural heritage.

The creation of Lanjak Entimau Wildlife Sanctuary to protect all forms of wildlife, in particular the orangutan and hornbills living in the area, is a step towards nature conservation.

The Role of ITTO

ITTO with its headquarters in Yokohama, Japan was formed in 1986 under the United Nations sponsored treaty, the International Tropical Timber Agreement of 1983. It is a commodity organization which provides a forum to facilitate discussion, consultation and international co-operation on issues relating to the international trade and utilization of tropical timber and sustainable management of its resource base. The 55 members of ITTO comprise the consumer and producer countries which together account for 95% of the world trade on tropical timber. The producer member countries represent 75% of the tropical forests in the world. Within the policy framework towards sustainability is the Year 2000 Objective which aims to achieve sustainable management of tropical forests and trade from sustainable managed resources by the member countries in Year 2000. ITTO also finances over 200 national and regional projects in tropical timber producing countries in Africa, Asia Pacific and Latin America/Caribbean regions worth more than US$100 million. Of the projects funded by ITTO in Sarawak, one is the Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area for nature conservation and research. ITTO encourages the use of local expertise to carry out its projects.

Forest Department, Sarawak

The Forest Department in Sarawak is the custodian of the State's forest resources. It is also responsible for the implementation of the ITTO projects and the infrastructure development associated with the projects. The Department was established in 1919 with only a handful of staff. It has progressed and developed into a scientific department and by late 1990s it has a total staff strength of over 1,900 personnel. In 1982 the Department started to computerise timber royalty

billing and other forestry applications. It is the policy of the Department to ensure the optimum use of the forest resource to the maximum benefit of the State consistent with the need to maintain essential environmental values through the protection of watersheds, prevention of erosion and maintenance of climate. In this connection, a series of national parks, wild life sanctuaries and permanent forest estates are constituted.

The national parks are aimed at protecting areas of scenic beauty, preserving sites of significant geological, biological or historical value for the benefit, education and enjoyment of the present and future generations and providing recreational opportunities for the public. Wildlife sanctuaries are developed for protecting the animals and their habitats. Entry to a wildlife sanctuary is restricted and requires a written approval from the Forest Department.

ITTO MISSION TO SARAWAK

A Case Study in Sarawak

In view of the need to assess the sustainability of our forests, the Sarawak Government invited the ITTO to undertake a study on sustainable forest management. In response to the invitation, the ITTO fielded a Mission to Sarawak in 1989 and 1990 to:

- assess the sustainable utilization and conservation of tropical forests and their genetic resources as well as the maintenance of ecological balance;
- identify actions to be taken for proper and effective conservation and development of tropical timber forests to ensure their optimum utilization, and
- recommend actions for further strengthening of sustainable forest management policies and practices, including areas of international co-operation and technical assistance.

Mission Findings and Recommendations

The Mission in its report "***The Promotion of Sustainable Forest Management : A Case Study in Sarawak, Malaysia***", concluded that sustainable management of the forest was being partly achieved. Full achievement will depend on the immediate action to:-

- comprehensively increase the staff strength of the Forest Department;
- phase down the annual rate of harvesting to correspond to the prospective sustainable yield, and
- improve the standard of catchment protection

The Mission also found that Sarawak possesses an exceptionally rich and diverse natural flora and fauna and has an impressive network of totally protected areas, but these areas are insufficient to protect the full range of habitats and biological diversity in the State. Much will be accomplished by the preservation of :

- a complete series of representatives of wide-spread habitats (e.g. the various forest types) by ensuring that a full range of variation of soils and altitudes is included;
- examples of all unusual habitats and areas where there are records of rare and endemic species;
- viable population of animals (especially those mammals and large birds) which require large home ranges, and
- those species which are naturally rare or endangered or subject to intensive cropping, e.g. orchids.

The Mission recommended that the Department shall take immediate action to ensure a complete range of ecosystem is preserved and to investigate the ecology of key plant and animal species to develop conservation strategies.

ITTO Projects in Sarawak

Manpower of Sarawak Forest Sector (completed)

To strengthen the capability of the Forest Department to fully implement sustainable forest management and to build up the capability for training the Departmental staff and industrial workforce to the standards required for a sustainable managed forest sector.

Sustainable Multiple Use of Hill Forest in Sarawak, Malaysia (completed)

To increase the sustainable aggregate benefits of the forest through the reduction of forest destruction caused by shifting cultivation and to identify feasible management options with a higher degree of compatibility.

Strategies for Sustainable Wood Industries in Sarawak (completed)

To prepare a sector plan for sustainable development of the wood industries in Sarawak, based on a reliable assessment of the forest resources and of the long-term demand and supply outlook for forest products.

Model Forest Management Area (completed Phase II in 2000)

To develop a sizeable area of the Permanent Forest Estate as a Model Forest Management Area for sustainable forest management within the acceptable environmental limits and to train the Departmental staff and industrial workforce in new methods and technologies for sustainable forest management and watershed management.

Study on the Management Standards of Hill Dipterocarp Forests in Sarawak from a Watershed Management Point of View (current)

To develop new approaches to forest operation techniques practised in the hill dipterocarp forests of Sarawak for control of erosion and reduction of adverse impacts on the watershed and to assess the overall effectiveness of the new forest operation system.

Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area (current)

To develop the Sanctuary for nature conservation and biological research, and as a model for biodiversity conservation and management of genetic resources for forestry and community development. LEWS was selected as the site for the ITTO Project in 1991.

Mixed dipterocarp forest occupies up to 70% of the Sanctuary

A giant *selangan batu* tree (*Shorea brunnescens*) in lowland dipterocarp forest

DEVELOPMENT OF LANJAK ENTIMAU WILDLIFE SANCTUARY (LEWS) AS A TOTALLY PROTECTED AREA

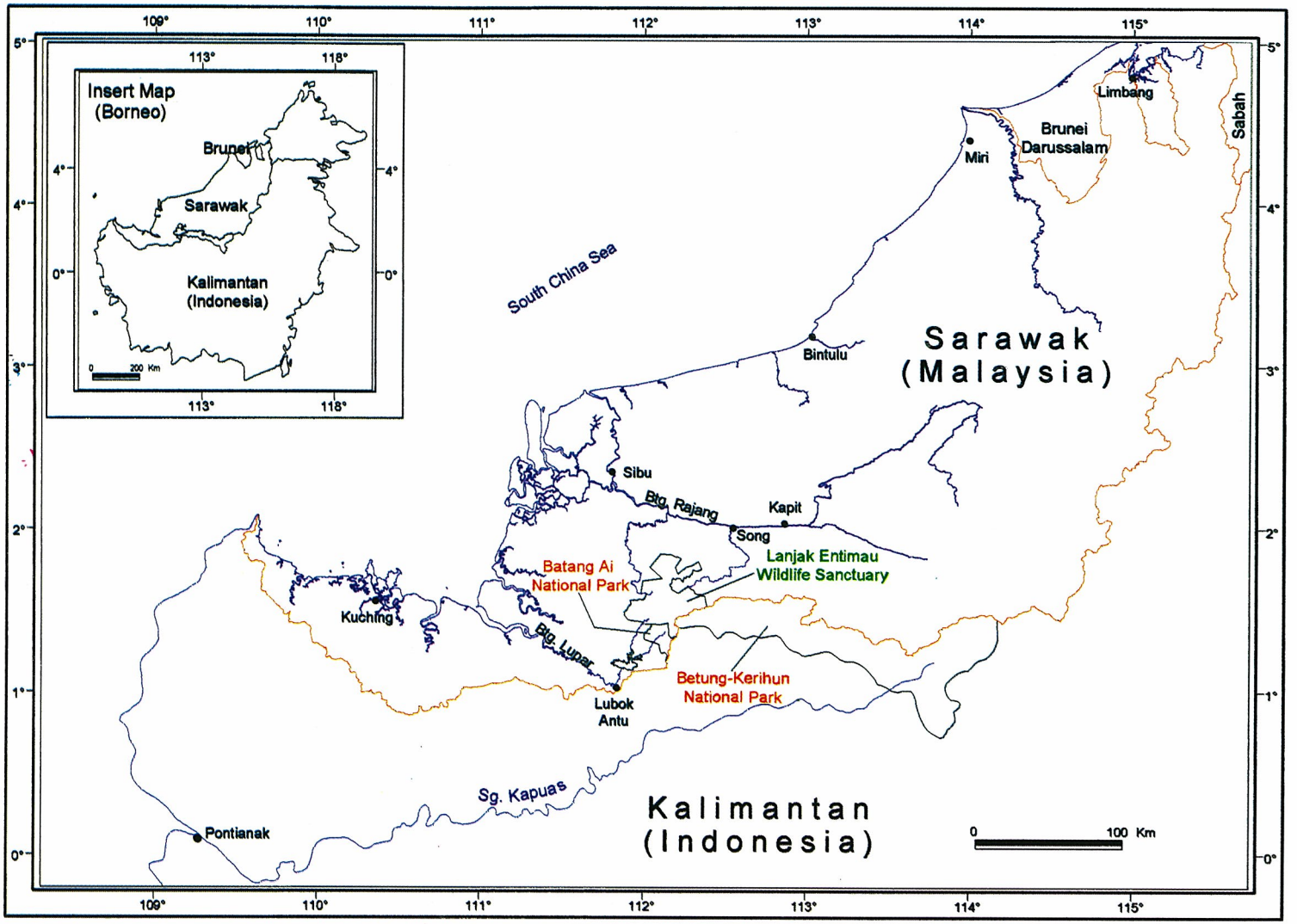
Why LEWS?

Many outstanding characteristics of Lanjak Entimau Wildlife Sanctuary make it an ideal site for in situ nature conservation and study on the sustainable utilization of the forest resources. Covering an area of 168,758 ha, it is the largest totally protected area in Sarawak. A wide range of habitats and forest types support a rich diversity of flora and fauna. For generations the local communities have been dependent on the plants and animals in the surrounding areas of the Sanctuary to provide them with food such as meat, fish, vegetables and fruits, building materials, medicine, fuel and other non-timber products. The local communities are an important component of the Sanctuary's management. LEWS is contiguous with Betung Kerihun National Park (BKNP) in Kalimantan, Indonesia, forming the largest trans-boundary nature reserve in the wet tropics for inter-regional collaboration. It also shares a common boundary with Batang Ai National Park in the south. This national park is home to about 400 individuals of orangutan.

Location

The Sanctuary is located in the south-western part of Sarawak at latitudes 1° 19' N to 1° 51' N and longitudes 111° 53' E to 112° 28' E (Map A). LEWS straddles the administrative divisions of Sri Aman, Sarikei, Sibu and Kapit and is drained by the tributaries of Batang Lupar and Batang Rajang. The terrain is a deeply dissected, rugged and hilly. The mountain ranges are marked by a series of sharp ridges with shallow soils. The highest peak of Bukit Lanjak is 1,285 m a.s.l.

Lanjak Entimau was first constituted as Protected Forest in October 1940 (southern part) and March 1941 (northern part) with a total area of 193,039 ha. Two excisions in 1948 and 1953 reduced the size to the present 168,758 ha. For the purpose of protecting all animals in particular the *maias* (orangutan) and hornbills living in the area, Lanjak Entimau Protected Forest was constituted as Wildlife Sanctuary with effect from 2nd February 1983. Except for patches of abandoned secondary forest, the Sanctuary is a relatively undisturbed primary forest. Including the adjacent areas proposed for extension the size of LEWS will increase to 191,568 ha.



MAP A :LOCATION OF LEWS AND TRANS-BOUNDARY BIODIVERSITY CONSERVATION AREA

THE AIM OF THE PROJECT

The aim of the Forest Department and ITTO is to make the Sanctuary into a model for biodiversity conservation and sustainable management of genetic resources for forestry and community development. The Project is consistent with the objectives of the International Tropical Timber Agreement, 1994 :

- To contribute to the process of sustainable development;
- To promote and support research and development with a view to improving forest management and utilization;
- To encourage and support forest management activities as well as rehabilitation of degraded forest land with due regard for the interests of local communities dependent on forest resources;
- To encourage the development of national policies aimed at sustainable utilization and conservation of tropical forests and their genetic resources, and maintain the ecological balance in the regions concerned.

The Project has completed Phase I and Phase II (1993 - 2000). The activities carried out under the period were set to :

- Survey, analyse and interpret soils and geological materials;
- Survey, identify and describe a complete series of representative forest types relative to different soil types and altitudes;
- Study the floral diversity and distribution in different forest types and identify species with economic potential;
- Establish gene bank plots for timber tree species;
- Study the population of mammals, birds, fish and insects to determine their species diversity, distribution and habitat ranges;
- Identify rare or endangered plant and animal species and their habitats for protection;
- Study the socio-economic status of the communities living in the periphery of the Sanctuary and their perception on the conservation and preservation of the natural resources;
- Encourage indigenous crop cultivation and indigenous fish rearing with direct participation of the local communities, and
- Study the management of wild game species.

A riverine habitat for many rheophytes and aquatic fauna

BIOLOGICAL DIVERSITY

FLORA

Forest Types

LEWS is one of the richest sites for flora in Borneo covering eight forest types except forests on limestone and igneous rocks. These are the alluvial and riparian forests on flat ground that are subject to periodic flash flood, and forests on higher elevations such as the old secondary forest, lowland mixed dipterocarp forest, hill mixed dipterocarp forest, summit ridge forest, submontane mossy forest and montane mossy forest. The secondary forests of some 30 to over 100 years old have evolved from shifting cultivation areas abandoned by the local communities.

Species Richness

The forests are very complex in their appearance and structure. The floristic composition of the same forest type is also highly variable between sites. These forests are home to as many as 1,996 species of vascular plant of which 1,446 are tree species and 500 non-tree species. The non-tree species include small palms, gingers, ferns, *Piper* and many other herbs. Epiphytes include numerous orchids and a giant *pandan* (*Pandanus epiphyticus*). Hemi-parasites such as *Macrosolen* (*family Loranthaceae*) are also common. The rare giant *Rafflesia* flowers are found in several localities in the old secondary forest. No less than ten species of plants including a large leaf *Ixora* may be potentially new to science and another six species are new records for Sarawak. In the course of botanical studies, three new species were described. These are two treelets, *Helicia mahmudii* P.Chai and *Symplocos leochaii* P.Chai and a rattan, *Korthalsia rostratioides* Mogea.

Species Abundance and Density of Trees (≥ 10 cm dbh)

Forest Types	Families	Genera	Species	Total No. of Trees	No. of Trees/ha
Riparian	31	62	70	-	533
Alluvial	38	111	265	779	518
Old Secondary	53	144	376	1,322	588
Lowland Mixed Dipterocarp	52	152	494	2,431	810
Hill Mixed Dipterocarp	43	123	368	1,900	838
Summit Ridge	48	110	285	1,243	1,029
Submontane	40	73	123	436	968
Montane	33	55	93	498	1,106

Species Abundance of Trees (< 10 cm dbh), Climbers, Herbs and Palms in Different Forest Types

Forest Types	Locality								
	Sengayoh (Ulu Katibas)			Entimau (Ulu Mujok)			Lanjak (Ulu Engkari)		
	Tree Species	Non-Tree Species	Total	Tree Species	Non-Tree Species	Total	Tree Species	Non-Tree Species	Total
Riparian	70	27	97	-	-	-	-	-	-
Alluvial	68	38	106	103	28	131	103	27	130
Old Secondary	120	39	159	57	18	75	123	31	154
Lowland Mixed Dipterocarp	85	13	98	147	23	170	107	33	140
Hill Mixed Dipterocarp	80	22	102	122	16	138	102	7	109
Summit ridge	99	23	122	102	42	144	56	21	77

Forest Fungi

Over 500 species of forest fungi are recorded. These include 37 species that are edible, 456 inedible, 8 species poisonous/hallucinogenic, 16 species with medicinal properties and a mycorrhizal fungus. Forty-two species of lichens have also been recorded. The forest fungi are both destructive and beneficial to humans. While they may be responsible for the damage of forest crops by causing plant diseases, they also increase the soil fertility through the decaying process and the formation of mycorrhizal association with the roots of the forest trees to promote the absorption of chemical nutrients.

Species Diversity of Macro Fungi in LEWS

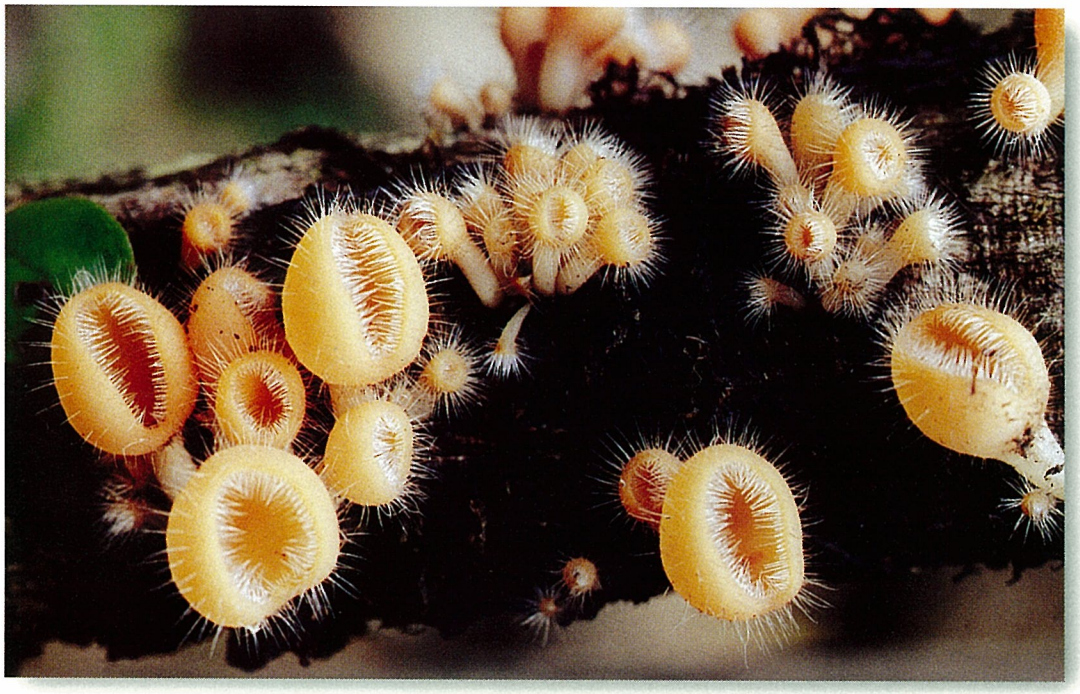
Types of Fungi	No. of species in LEWS	No of species Statewide
Edible fungi	37	75
Inedible fungi	456	4,500
Poisonous / Hallucinogenic fungi	8	21
Luminescent fungi	6	6
Mycorrhizal fungi	1	2
Fungi for medicinal and other uses	16	14

This orchid (*Coelogyne septemcostata*) is common in the alluvial forest

Nepenthes tentaculata is a rare montane forest species from Bukit Lanjak

Climbers abound in the forest. This *Entada borneensis* is over 100 m long

Begonia are useful as ornamental, food and medicine



Kulat mangkok (*Cookeina tricholoma*) is used for treating inflammed eyes

Labisia sp. is a well-known medicinal plant. This variety has unusual linear leaves.

Gene Banks

Where dipterocarp and non-dipterocarp species abound, gene banks are established to ensure a living source of seeds and genetic stock for future planted forest programme in Sarawak. Two gene banks were established under Phase II (see Map B, page 30). The 4.42 ha gene bank at Ulu Engkari recorded 602 trees comprising 14 dipterocarp and 28 non-dipterocarp species including nine species of wild fruit trees. The most predominant species is Meranti sarang punai (*Shorea parvifolia Dyer*) with 123 trees. The second gene bank at Ulu Mujok covers an area of 6.2 ha, and contains 643 trees comprising 44 dipterocarp and 18 non-dipterocarp species, the latter including six wild fruit species. The predominant species is Keruing putih (*Dipterocarpus caudiferus* Merr.) with 69 trees. These gene banks will complement other seed production areas established by the Forest Department throughout the State.

Ethnobotany

Ethnobotany is a study of the relationship between people and plants especially on the traditional use of wild plants for fuel, food, medicine, perfume, dye, etc. Ethnobotanical surveys have uncovered a wealth of information on the uses of many plants. One hundred and seven species of wild vegetables, 150 species of wild fruits and 216 species of medicinal plants are used by the local communities. Another thirteen species are used in food flavouring and production of illepenut or *engkabang* oil.

FAUNA

Mammals

The Sanctuary supports the largest single population of Sarawak's orangutan (*Pongo pygmaeus Linnaeus*) numbering about 1,000 individuals. Also found are about 24,000 Bornean gibbon (*Hylobates muelleri* Martin), 28,000 red langur (*Presbytis rubicunda* Muller) and 13,000 white-fronted langur (*Presbytis frontata* Muller). Two species of macaques (*Macaca* spp.) number about 9,000 individuals. They are attracted to the disturbed areas outside the Sanctuary where food is more easily available. Forty species of true small mammals comprising 13 bats, 10 rats, 9 squirrels, 3 porcupines and 5 tree shrews are recorded. One tree shrew (*Tupaia* sp.) is believed to be potentially new and endemic to Borneo.

Herpetofauna

LEWS also contains an extremely rich diversity of reptiles including 13 snakes, 12 lizards, 51 amphibians and one terrapin. The new species discovered are two frogs *Pelophryne rhopophilius* Inger & *Stuebing* and *Philautus refugii* Inger & *Stuebing*, an agamid lizard *Pseudocalotes saravacensis* Inger & *Stuebing*, and a snake *Cylindrophis engkariensis* Stuebing. A tree frog *Rhacaphorus reinwardti* Schlegal, first known from Sabah, is a new record for Sarawak, while a legless lizard *Ophisaurus büttikoferi* Lidth is a rare species known only from Borneo.

Birds

The occurrence of 241 species of birds comprising 45% of the Bornean avifauna makes LEWS a major repository of birds on the island. Of the eight species of hornbills found in Sarawak, seven occur in LEWS. Not only does the Sanctuary serve as a refuge for the resident birds, it also supports 19 species of passage migrants such as the Fairy Pitta. The relatively high proportion of certain sensitive groups, the trogons and flycatchers, reflect the pristine quality of the Sanctuary. In protecting the Sanctuary, the avifauna and the migration routes of the migrants are safeguarded. Birds also play an important role in pollination of flowers and dispersal of seeds.

Insects

Insects make up the biggest proportion of the biological diversity of a tropical rain forest. Out of 1,050 species of insects recorded, 787 species are moths. The moths, butterflies and dragonflies are suitable indicators for various types of forest ecosystems. Insects are the most important pollinating agents in our forest. Termites, like fungi, are important to the cycling of forest nutrients by decomposing dead organic matter. Some termite species are however noxious pests. One of the most significant findings is the abundance of the Rajah Brooke's Birdwing butterfly (*Troides brookiana brookiana* Wallace) on the alluvial forest at Nanga Joh in Ulu Katibas (see Map B, page 30). The presence of the *Aristolochia* vine, the larvae host plant, may have helped to maintain its population. This butterfly is the only insect species protected under the Sarawak Wild Life Protection Ordinance, 1998.

Fish

The Sanctuary's river systems support a rich diversity of fish. Of the 82 species documented, ten percent are endemic to Borneo while putih (*Puntius kuchingensis Banarescu & Bianco*) is the only species endemic to Sarawak. At least 12 species may be new to science. Once abundant in the inland rivers of Sarawak,

the high-value empurau (*Tor tambroides* Blecker), tengadak (*Barbodes schwanenfeldii* Blecker) and semah (*Tor tambra* Valencienes) are now less common in the rivers outside the Sanctuary. The natural breeding grounds of these and other species should be protected to ensure their survival and continuous supply of protein to the local people (see Map B, page 30).

LEWS AS AN IMPORTANT CONSERVATION AREA

The ecological studies and inventories on the flora and fauna have so far been largely confined to the Wilderness Zone around the periphery. Ecologically this is the richest zone with the presence of all the eight forest types so far known from the Sanctuary. Extending the studies into the central Core Zone will undoubtedly uncover many more species. The conservation, scientific and cultural values of the reserve made it necessary to prepare a management plan in 1996 to ensure that the natural assets are suitably managed for long-term environmental and socio-economic benefits.

To fully safe guard the resources and their habitats, the Sanctuary was re-zoned to include a complete range of all the forest types that have so far been identified. Studies have confirmed LEWS as one of the most biodiverse regions in Sarawak.

The Sanctuary was constituted primarily for the protection of the State's largest orangutan population. This role is more fully realised as it becomes a vital part of the Trans-boundary Biodiversity Conservation Area with BKNP. This neighbouring reserve is home to at least another 2,000 individuals of orangutan. It is interesting to note from the results of the surveys that the total number of 3,000 individuals are concentrated in the western region where the international boundaries of the two reserves meet. Another 400 individuals are known from the Batang Ai National Park which is also contiguous with LEWS in the south (see Map A, page 7).

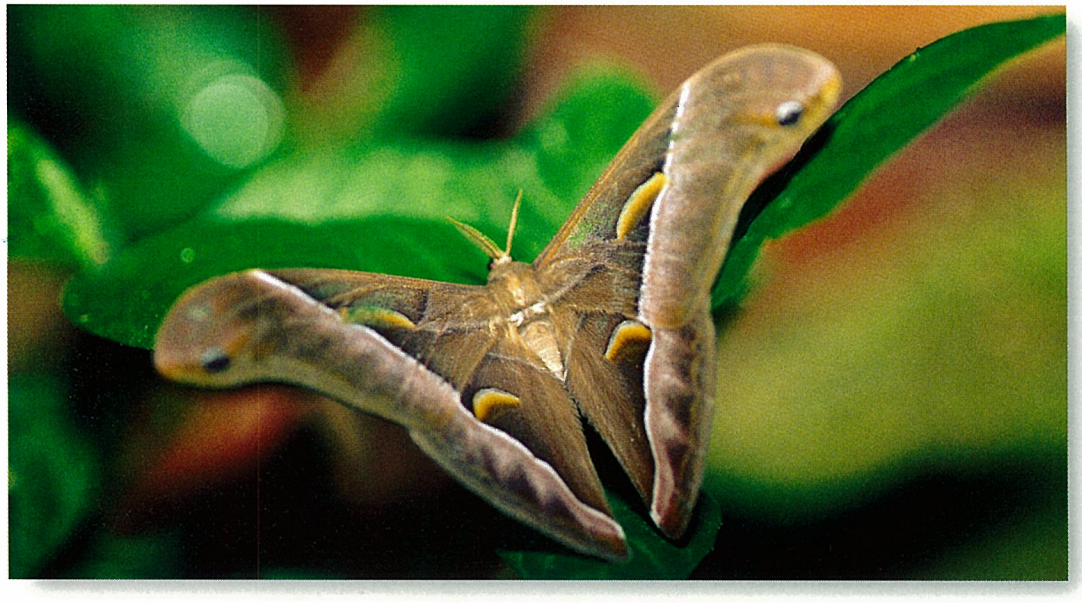
Bornean gibbons (*Hylobates muelleri*) number about 24,000 individuals in LEWS

Low's squirrel (*Sundasciurus lowii*) is one of the 40 species of small mammal

A beautiful endemic snake (*Gonyophis margaritatis*) from Ulu Engkari

This legless lizard (*Ophisaurus buttikoferi*) is a rare species

Kingfishers are colourful birds. This Rufous-collared kingfisher (*Actenoides concretus)* are common in LEWS



Thauria aliris aliris. Moths are the most abundant insects in LEWS

THE IBAN COMMUNITY IN THE BUFFER ZONE

The story of the Ibans in Sarawak began with their ancestors' first migration over the low hills from the Kapuas River system in Kalimantan, Indonesia. The Kapuas migration probably represented an expansionist tendency in search for fresh agricultural land, a general over spill into the neighbouring river system. The first of the migrants probably arrived at the Undup and Batang Ai, tributaries of Batang Lupar (Map A), in the early or mid-sixteen century. Settlement extended along the other rivers in the area such as Skrang, Saribas and Katibas making the region the home of the energetic and warlike Iban Dayaks. As the population in these areas increased, the pattern of land ownership became complex. The Ibans were compelled to move on to new territories in search of virgin forests and their settlements expanded from Batang Lupar and Batang Saribas to the watershed of the mighty Rajang. The community in Ulu Katibas claimed that their ancestors migrated to Katibas about 300 years ago.

A socio-economic study conducted in 1994 identified 102 Iban longhouses with an estimated population of 12,400 people living in the areas surrounding the Sanctuary. These longhouses are found along Sungai Engkari, Sungai Katibas, Sungai Ngemah, Ulu Sungai Kanowit and Sungai Mujok. When the Sanctuary was established in 1983, thirty-five longhouses were granted rights to collect forest produce in three designated areas within the Sanctuary (Map B, page 30). However it is the few longhouses that are close to the Sanctuary which have made an impact with their subsistence hunting of wildlife and gathering of forest produce. The study shows that about one-half of the population had formal education; many still practise shifting cultivation of hill rice. It is noted that shifting cultivation practices are decreasing because of low yield and shortage of manpower in the longhouses. The Sociologist in his study recommended strategies to improve the rural economy. Among them are integrated agro-forestry projects, domestication and rearing of wild game species, fresh water fish rearing, cultivation of indigenous fruit species and cottage industries.

The local communities view the Project very positively. They value the Sanctuary, particularly its rich natural resources, clean water and fresh air. They appreciate the great potential benefits that can be derived through a joint effort with the Government to sustainably manage the natural resources. To help protect the Sanctuary, many of the local people have been appointed Honorary Wildlife Rangers by the Government.

COMMUNITY DEVELOPMENT RELATED ACTIVITY

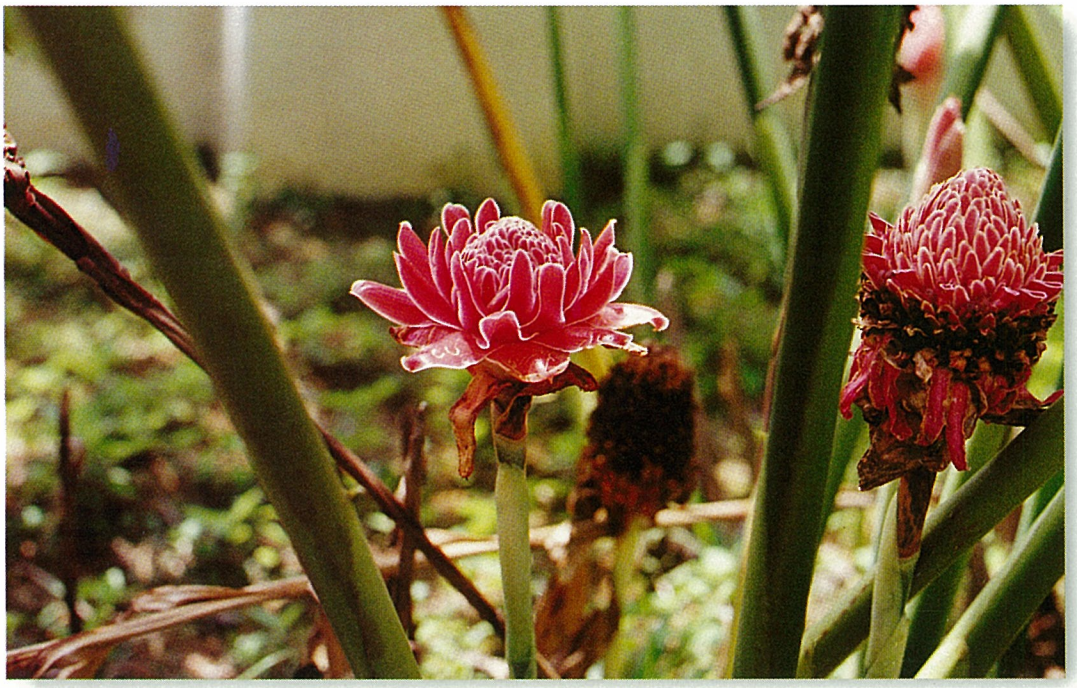
An important component of the Project is to integrate the resource use and conservation in the buffer zone outside the Sanctuary. The local Iban communities are encouraged to develop plant and animal species of economic potential to supplement their income and at the same time to reduce their dependence on the resources of the Sanctuary. Cultivation of indigenous crops and fish rearing were two community activities that were implemented through direct local participation in the Buffer Zone. These are described below:-

Rumah Api, a 21-door longhouse in Ulu Katibas

A dialogue session (*berandau*) with the longhouse residents

Hands-on training on indigenous fruit tree planting

Petai (*Parkia speciosa*) is one of the fruit crops selected for community development. The young pods are popular as a vegetable



Kecala (*Etlingera elatior*) is commonly used as a vegetable and condiment

High-value fish such as this *tengadak* (*Barbodes schwanenfeldii*) are getting rare outside the Sanctuary

Cultivation of Indigenous Crops

Farmers from four longhouses in Ulu Katibas and Ulu Mujok nearest to the Sanctuary were selected to participate in the cultivation of indigenous crops. These crops were selected based on their potential for domestication and commercialisation and in consensus with the participants. The principal crops are *dabai* (*Canarium odontophyllum* Miq.), *isau* (*Dimocarpus longan* var. *malesianus* Lour), and *petai* (*Parkia speciosa* Hassk). Two species of rattan were also planted : *sega* (*Calamus caesius* Blume) and *manau* (*Calamus manan* Miq.) In addition, the farmers were provided with commercial fruit species some of which are non-seasonal in an effort to have an integrated orchard to ensure fruit supply on a daily basis.

Monitoring of the growth performance of the indigenous crops on-station and on-farm trials continues. Crop established based on mortality rate was good at 10%. Crop performance based on plant girth showed excellent growth rate with mean values of 29.2 cm, 14.2 cm and 76.3 cm for *dabai, isau* and *petai* respectively after three years. Even though the urban drift continues unabated interest of the eleven participants remains and a high standard of maintenance is practised. Some of the petai trees were already flowering 2½ years after planting.

Indigenous Fish Rearing

A pilot project on fish rearing was implemented for three longhouses in Ulu Katibas and Ulu Mujok. Two valley ponds and a concrete tank for fish rearing were constructed by the local communities on *gotong-royong* basis with the building materials supplied by the Project. The participants were encouraged to rear the high-value indigenous fish such as *empurau, tengadak* and *semah* for own consumption and for sale to generate income.

The water quality of the valley ponds and the concrete tank was regularly monitored. A new pipe line was installed in December 2000 to improve the water supply to the concrete tank. The fish have reached an average size of 400 grams after 2 years. Some fish have been harvested for own consumption.

Training

In addition to the technical training in agro-forestry and fish culture, the participants were sponsored to attend study tours to:

- Introduce them to the concept and management of national parks and wildlife sanctuaries, ecotourism, fish rearing, cultivation of fruit trees and non-timber products, and agro-forestry projects run by the Government;
- Increase their awareness that such activities can generate additional cash income, and
- Introduce them to the facilities available for training and human resource development.

The concrete pond for fish rearing at Rumah Api. It can stock up to 400 tails of fish

Valley pond at Rumah Enggong with capacity for up to 1,100 tails of fish

Collecting fish wildings for stocking the valley pond in Ulu Mujok

Demonstration plot of indigenous fruit trees at Nanga Ju Ranger Station.

Engkilili (*Lepisanthes alata*),
a wild fruit

Ara (*Ficus* sp.). Many species are eaten by fish, birds and primates

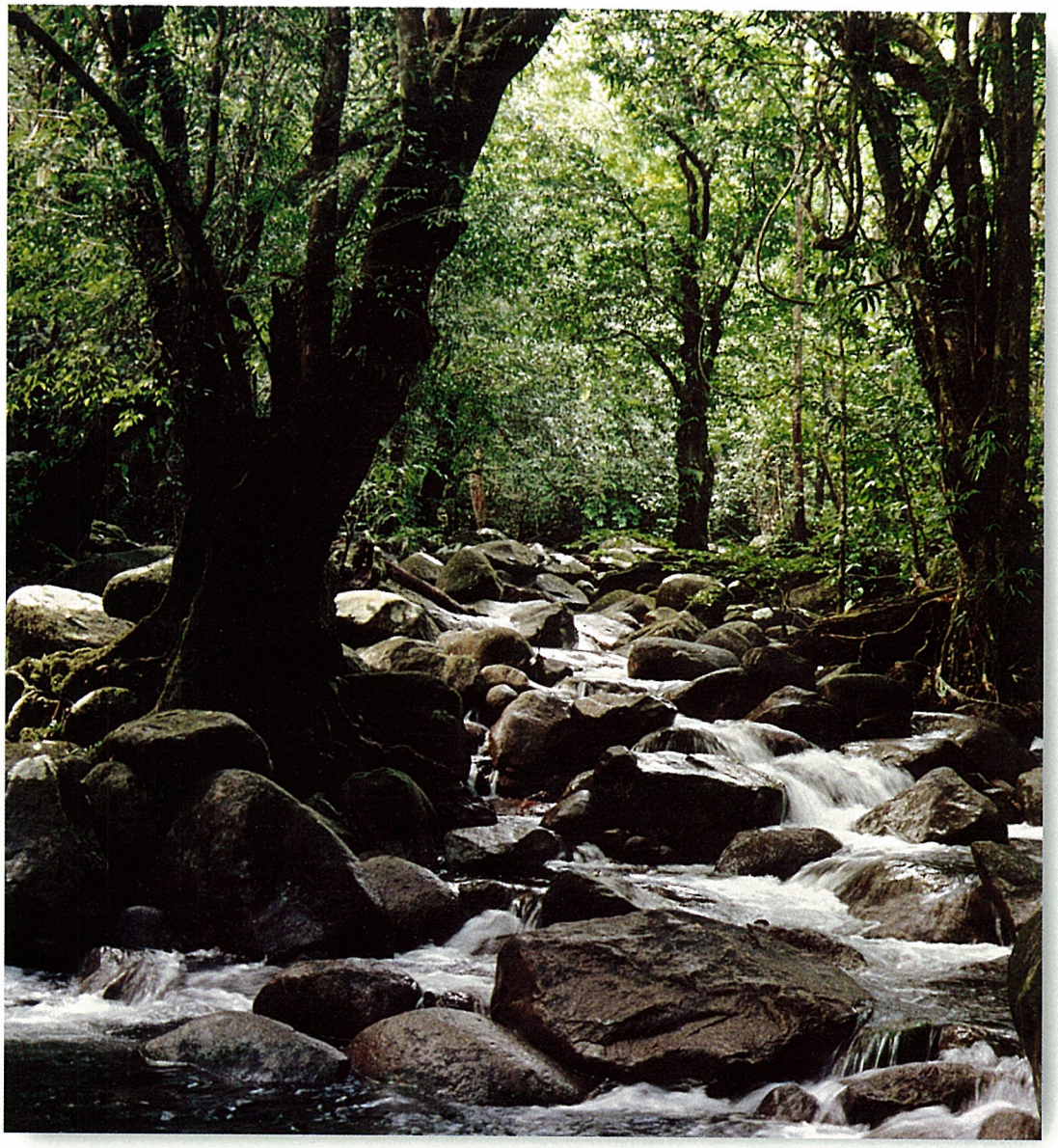
RE-ZONING OF THE SANCTUARY

Since the Sanctuary is to be managed as a totally protected area, human activities within it have to be limited. Based on the scientific evaluation, the Sanctuary was divided into several zones to ensure protection of a complete range of forest types and rare habitats. The Sanctuary was re-zoned following new scientific findings in Phase II.

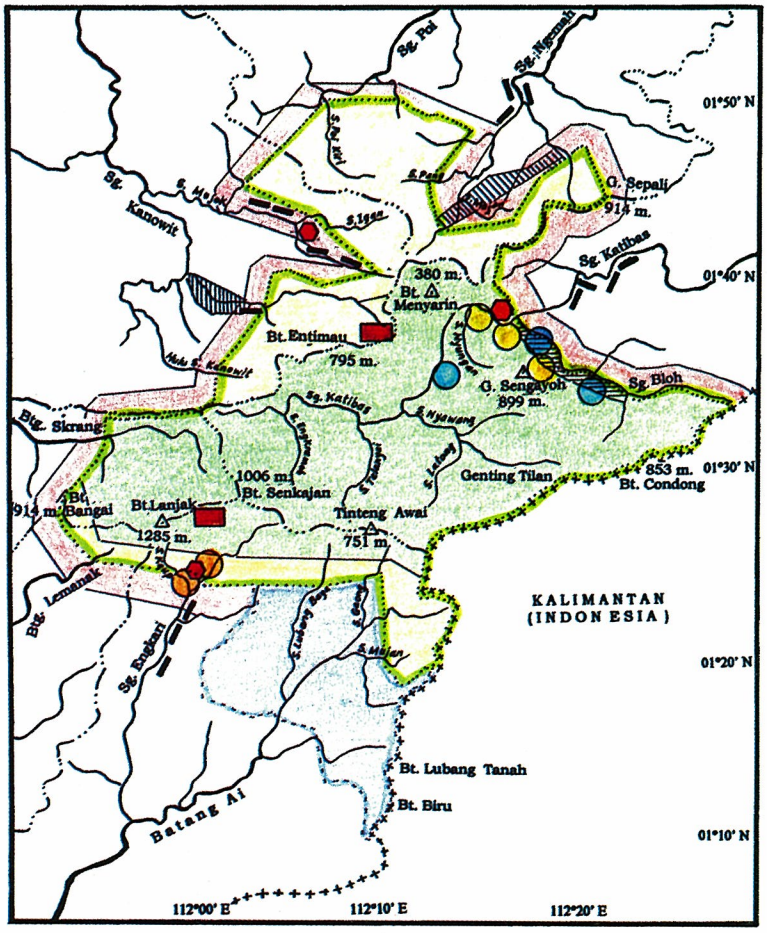
Ecological studies have shown that a complete range of all eight major forest types are concentrated in the area close to the southern boundary. Here the boundary between the Wilderness Zone and Core Zone follows the watershed running east to west. Thus a large proportion of the eight forest types fall within the Wilderness Zone. This zone, being close to the Buffer Zone, is more liable to be encroached thus inflicting damage on the forest. In order to ensure a more effective protection of all the eight forest habitats, the width of the Core Zone is increased to encompass a full range of the forest types there (Map B). This would also ensure fuller protection of the areas where the Sanctuary's only montane mossy forest is located.

TRANS-BOUNDARY BIODIVERSITY CONSERVATION AREA

Through the initiatives of ITTO, the Malaysian and Indonesian Governments took the lead to launch the Trans-boundary Biodiversity Conservation Area (TBCA) comprising Lanjak Entimau Wildlife Sanctuary and Betung Kerihun National Park in 1994. With a combined area of about one million hectares, this TBCA (Map A, page 7) is the largest totally protected area in the humid tropics. Within this rugged heartland lies the origins of three of the Borneo's greatest rivers, namely Batang Rajang and Batang Lupar in Sarawak and Kapuas River in Kalimantan. Interlaced with a network of thousands of streams and water courses, this complex topography provides livelihood and shelter for an equally complex community of plants and animals. The Area forms a crucial link in long-term conservation of Bornean biological diversity, not only for the numerous endangered species, but also for many more plants and animals yet to be discovered. Its formation highlighted a positive move towards a bilateral co-operation and collaboration in biological diversity conservation between the two countries. Trans-boundary conservation is regarded as an effective biodiversity conservation strategy and has attracted international interest and financial support. This new concept is being emulated by Ecuardo and Peru in South America, Thailand, Cambodia and Laos in South East Asia, and Cameroon, Gabon and Congo in Africa.



Into the headwater of the TBCA



Legend	
Lanjak Entimau W/S	
Batang Ai N/P	
International boundary	
LEWS headquarters	
Ranger station	
Long house	
Genebank	
Mountain peak	

Zoning	
Core Zone	
Wilderness Zone	
Buffer Zone	
Special Zone for Fish	
Special Zone for Insects	
Special Zone for Rafflesia	

0 30 KM

Scale 1 : 800,000

Gazetted areas for collection of forest produce	
Ulu Katibas (1,174 Ha.)	
Ulu Kanowit (918 Ha.)	
Ulu Ngemah (1,722 Ha.)	

MAP B :
LANJAK ENTIMAU
WILDLIFE SANCTUARY

IBBE 1997

Following the formation of the TBCA in 1994, ITTO sponsored a biodiversity expedition to BKNP and LEWS in 1997. The expedition, called the ITTO Borneo Biodiversity Expedition (IBBE) marked the beginning of research collaboration between the scientists of the two countries. The Expedition highlighted the ITTO's commitment to promote nature conservation and sustainable forest management in the tropical world. The data collected from the Expedition are invaluable for formulating long-term strategies and trans-national efforts in biological diversity conservation and sustainable utilization of natural resources.

Findings of IBBE 1997

The expedition assembled a tremendous amount of data on ecology and botany and collected many specimens including new records, rare and new species. The results are contained in the "Scientific Report, ITTO Borneo Biodiversity Expedition (1997)" published in 1999.

Botany : Both LEWS and BKNP have similar forest types and species richness. The botanists collected 1,020 specimens in BKNP and 910 specimens in LEWS. Potentially new species are found from the genera *Loxocarpus*, *Ardisia, Lepisanthes* and *Microtropis*. *Jarandersonia parviflora* Kosterm. is a new record for Kalimantan while *Crytandra mirabilis* (C.B.Cl.) is another rare plant found in BKNP. Sixty two species of palms were identified. A new rattan *Korthalsia rostratioides* Mogea was found in LEWS and a new palm, *Pinanga bifidovariegata* Mogea was recorded in BKNP. The expedition also uncovered three new palm records from LEWS and 13 from BKNP. One hundred and twenty species of orchids from 50 genera were collected including 105 living specimens from 61 species. *Dimorphorchis lowii* (Lindl.) Rolfe is one of the rarest species. The forests are also rich in mosses (Bryophytes) of which 168 species are found. LEWS recorded a lower diversity of Bryophytes with 68 species compared to BKNP with 133 species. *Himantocladium scrobiculatum* which can survive on the ground, rocks, trees and even in water is an extra-ordinary bryophyte species. Another unique bryophyte is *Frullania* sp. which is always found in association with orchids.

Ecology : Although the geology and soils of the two areas differ, both BKNP and LEWS support similar forest types that spread from the alluvial basins to the highest mountains. The study has identified eight major forest types with a number of subtypes. Within each type, ecological plots were established to study species composition and frequency of occurrence of the tree and non-tree species. The mixed dipterocarp forest is the most dominant forest type and is characterised by the presence of many species of the Dipterocarpaceae. While the forest types may differ in size and species composition, they all play an important role in the ecosystems catering for the ecological needs of all the plants and animals present.

Fish : A total of 125 fish species from 12 families are now known from the TBCA. The dominant family is the Cyprinidae with 56.6% recorded in LEWS and 51.8% in BKNP. The survey results indicated that 24 fish species were exclusively found in LEWS while 66 species were exclusively from BKNP. At least 10 species are potentially new to science. However, BNKP showed a higher concentration of endemic fish compared to LEWS.

Amphibians and Reptiles :Sixty-five species consisting of 41 amphibians and 24 reptiles representating about 15% of the known herpetofauna of Borneo were collected. Species richness in LEWS is lower compared to BKNP. Apart from the potentially new species, no rare ones were found although an Agamid lizard (*Pseudocalotes saravacensis*) and a cylindrophine snake (*Cylindrophis engkariensis*) are unique to LEWS.

Birds : The TBCA is home to 291 bird species or about 50% of the avifauna of Borneo. Among them were 20 endemic species (12 in LEWS and 16 in BKNP). All the eight species of hornbills are found in BKNP. There were 17 migrants including species from the northern hemisphere. This establishes the conservation area as an important winter range for many species of temperate zone migrants.

Primates : The primate team studied six species of primates found in both LEWS and BKNP. The population of orangutan in the TBCA is estimated at 3,000 individuals (1,000 in LEWS and 2,000 in BKNP). The most common of the six primate species is the Bornean gibbon estimated at 50,000 individuals and shows a widespread distribution. The langurs are mainly found in the riverine forest and hill slopes. Two species of macaques (long-tailed and pig-tailed) are more common in the secondary forests.

Ethnobotany : The surveys were conducted among the Iban and Tanambaloh communities in BKNP and the Iban community in the Batang Ai area south of LEWS. The information collected included 41 species of plants with medicinal value, 144 species of food plants, 58 species used for rituals and ceremonies, 30 species for building materials and 60 species for miscellaneous uses.

Ecotourism : BKNP has good prospects for nature tourism development and it has many interesting sights and unique culture. The ethnic communities living in and surrounding the Park are the Dayak Iban, Tamambaloh, Bukat Mendalam, Bukat Metelunai, the Kayan and Punan. Being a Wildlife Sanctuary, ecotourism is not encouraged in Lanjak Entimau, but joint ecotourism development between BKNP and Batang Ai National Park is being envisaged.

INTO LEWS PHASE III

LEWS Phase III (2000-2003) is focusing on supporting the community development activities relating to conservation and sustainable forest management. The Project will:

- Study the phenology of timber species in gene banks and the establishment of new gene banks to include a good diversity of non-timber species, such as plants with medicinal and ornamental values.
- Continue specific aspects of biodiversity inventory to suit the management needs of the Sanctuary and the adjacent BANP. This will be undertaken by the Forest Department;
- Encourage and support the development of economic activities by the local communities to enable them to share the benefits of the biological resources on a sustained level, and
- Promote and integrate biodiversity conservation, research and management on a collaborative base in the TBCA with BKNP in Kalimantan and other institutions involved in research on tropical rain forest biodiversity.

To support the above activities, a community based field centre will be set up by the Department at Batang Ai to provide training to the local communities in handicraft, culture and ecotourism. In addition, demonstration plots for cultivation of indigenous crops, rearing of high-value indigenous fish and farming of wild game species will also be developed.

THE MANAGEMENT PLAN

The studies have confirmed the Sanctuary to be extremely rich and diverse in plant and animal species. Some significant achievements are made towards sustainable management and utilization of forest biological resources in the Sanctuary. The Management Plan for the Sanctuary, which was drawn up after Phase I, identified specific goals for:

Conservation of biodiversity

- Research and collection of data on species and communities;
- Monitoring of threatened, endangered or "indicator" species, and
- Improvement in the understanding of interactions within the biological communities and natural forest processes.

Tree ferns (*Cyathea* sp.) are common in disturbed forest

Rhododendron durionifolium occurs in riparian and montane forests

A handsome *Pinanga* with variegated leaves

Slow loris (*Nycticebus coucang*)
is a nocturnal mammal

Tree frog (*Rhacophorus pardalis*),
a proficient forest glider

Little spiderhunter (*Arachnothera longirostra*)

Forest fungi such as this *Flammulina* sp. play an important role in soil fertility through the decaying process

Termites are important decomposing agents of the forest.

Protection of the Sanctuary

- Community involvement and support through an active programme of consultation;
- Conspicuous and consistent boundary demarcation, enhanced by patrols and enforcement of existing regulations;
- Control of entry and use via zoning, and
- Co-management of the Sanctuary by a Special Wild Life Committee involving the local
- Communities to be set up under the Sarawak Wild Life Protection Ordinance, 1998.

Research and education

- Ensuring local participation in basic biodiversity research projects, and
- Channelling research findings into staff and student training, as well as other educational and interpretative programmes.

Community involvement and promotion of socio-economy

- Regularly schedule consultative meetings with local community leaders;
- Employment of local residents in management programmes, and
- Development of beneficial or profitable ventures in the buffer zone.

Long-term goals include steps taken to:

- Conserve biological diversity;
- Ensure the maintenance of ecological integrity;
- Enhance scientific knowledge through research;
- Promote public education through interpretative programmes;
- Protect the water quality through the control of erosion;
- Preserve scenic beauty, and
- Preserve the cultural reserves and integrity.

Study Tour participants visiting the Fishmart Cage Culture, Batang Ai

Study Tour participants visiting the Forest Research Centre, Kuching

A rare visit by ITTO personnel to LEWS community project in Ulu Katibas on March 1, 2001

THE FUTURE - AFTER ITTO

The Project has laid the framework for the management of the Sanctuary. Besides the Management Plan, the establishment of a Special Wildlife Committee will assist the Controller of Wildlife in the supervision, control and management. The Special Wildlife Committee will comprise a warden, wildlife rangers, honorary wildlife rangers, ITTO consultants and relevant persons from the local community. The setting up of a field centre for training the local communities in handicraft, food cultivation and ecotourism will help raise the economic standard of the local communities. To benefit from this, the local people need to move away from their traditional livelihood as shifting cultivators and forest gatherers to devote more time and effort to the new opportunities created for them.

A human resource training programme has been developed since August 2001 for up to six young research officers from the Forest Department to be attached to the LEWS Project for a period of two years. Emphasis of the training will be on research, conservation and sustainable management of biological resources. Studies on the flora and fauna will involve project planning, field surveys, species identification, data analysis and report writing. They will be supervised and guided by ITTO consultants and senior research officers of the Forest Department. It is hoped that this programme will set the pace for more interested candidates to be trained in the important field of biodiversity conservation, research and sustainable utilization.

RANGER STATIONS AND FACILITIES

In order to carry out administration and law enforcement effectively, Ranger Stations were established in Ulu Engkari, Ulu Mujok and Ulu Katibas. Besides serving as a general office, each station provides accommodation for the staff and researchers. Sub-Ranger Stations will also be built for more extensive law enforcement wherever necessary.

The new Sanctuary headquarters complex at Nanga Bloh in Ulu Katibas, when completed at the end of 2001 will have an administrative office building, a science laboratory, a hostel to accommodate 20 persons and a generator house. All basic utilities including sanitation, water and electricity supplies, telecommunication and access by boats will be available. To maximise the use of the facilities the Forest Department is proposing to develop it into a field study centre for the promotion of nature education, research and conservation.

BIBLIOGRAPHY

Anon, 1990. *The Promotion of Sustainable Forest Management : A Case Study in Sarawak, Malaysia.* A Report submitted to the International Tropical Timber Council

Anon, 1994. *Joint Inauguration Ceremony of Lanjak Entimau/Betung Kerihun Biodiversity Conservation Area - A Souvenir Programme.* ITTO/Forest Department Sarawak

Anon, 1999. *Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area, Phase III - A Project Proposal.* ITTO/Forest Department Sarawak

ITTO, 1996. *Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area, Phase I. The Management Plan.* ITTO/Forest Department, Sarawak

ITTO, 1998. *ITTO Borneo Biodiversity Expedition 1997.* ITTO, Yokohama, Japan

ITTO, 1999. *ITTO Borneo Biodiversity Expedition 1997, Scientific Report* ITTO, Yokohama, Japan

ITTO, 2000. *Development of Lanjak Entimau Wildlife as a Totally Protected Area, Phase I and Phase II 1993-1999 Scientific Report.* ITTO/Forest Department, Sarawak

ITTO, 2000. *Development of Lanjak Entimau Wildlife as a Totally Protected Area, Phase II Final Report.* ITTO/Forest Department, Sarawak

Wreathed Hornbill