

ITTO PROJECT PD 106/90 REV.1 (F)

**DEVELOPMENT OF THE LANJAK-ENTIMAU
WILDLIFE SANCTUARY AS A TOTALLY
PROTECTED AREA, PHASE I:**

THE MANAGEMENT PLAN



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EXECUTIVE SUMMARY

I. NATIONAL AND REGIONAL CONTEXT

Historical Background

Conservation of natural habitats has a long history both in Malaysia and in Sarawak. Approximately 10% of Sarawak's land area has been gazetted or proposed for nature conservation, totalling over one million hectares.

Lanjak-Entimau Wildlife Sanctuary was initially gazetted in 1983. Hunting and collection of forest products was banned under this Order, though exceptions to this general prohibition were made in specific cases, where such rights were assigned at the time of original gazettment. In the case of Lanjak-Entimau, the Sarawak Government granted special rights to several communities in residence adjacent to the Sanctuary, to collect jungle produce from specified areas for their own consumption.

Following further reference to the Sanctuary in the report of the ITTO Commission in 1990, a proposal was submitted by the Sarawak Government for development of Lanjak-Entimau as a Totally Protected Area.

Ecological and Cultural aspects

Tropical forests on the island of Borneo possess some of the richest biological diversity in the world, which contains ten thousand plant species and several million kinds of animals. As many as one-third of these species are endemic, *i.e.* not found outside Borneo.

Approximately two thirds of Sarawak is still under forest cover. A majority of these forests are dominated by species of the Dipterocarpaceae, trees valuable for timber as well as jungle produce such as oil-rich illipe nuts. There are also many endemic or rare animals such as the orangutan, Bulwer's pheasant and an abundance of wild game.

A great diversity of ethnic groups are found in Sarawak including Bidayuh, Iban, Malay, Melanau and the Orang Ulu. Forested areas of western Sarawak are mostly inhabited by the Iban people.

II ASSESSMENT OF LANJAK-ENTIMAU AS A TOTALLY PROTECTED AREA

Climate, Topography, Geology and Soils

Lanjak-Entimau is composed principally of rugged, hilly terrain ranging from about 60-1200 metres above sea level, and forms the origin of the watersheds of the Batang Lupar and Rejang rivers. Annual rainfall ranges from 2000-4000 millimetres per year.

Rocks in the Sanctuary are roughly between 40-60 million years old (Cretaceous to Upper Eocene), consisting mainly of sandstone, shales and slates. Soils are generally poor, and the majority (86%) are unsuitable for agriculture.

Flora

Seven basic forest types exist in Lanjak-Entimau : alluvial, lowland dipterocarp, hill dipterocarp, summit ridge, submontane mossy, montane mossy and old secondary forest. These forests are potentially the richest in Sarawak with well over one thousand tree species. Tree densities are higher than in other sites in Sarawak and Peninsular Malaysia.

The Sanctuary also contains secondary forest from eighty to one hundred and thirty years old. The rare, giant *Rafflesia* flower has been reported from several of these old secondary forest areas.

Numerous other plant species abound on the forest floor, particularly in mossy forest, rich in palms, ginger, ferns, pandans, pitcher plants and orchids. Three potentially new species of plants have been discovered during recent surveys.

Also, at least 140 different kinds of medicinal plants have been identified. More than one hundred types of wild fruits and thirty-six varieties of jungle vegetables from the Sanctuary are used by local people.

Fauna

Lanjak-Entimau's primate fauna includes the only viable population of the threatened orangutan in Sarawak, approximately 1,000 individuals. Among other primate species include the rare white-fronted langur, and the Bornean gibbon. Gibbon densities are higher in Lanjak-Entimau than anywhere else in Borneo.

There are at least 203 species of birds in Lanjak-Entimau, with approximately half (13 of 29) of Borneo's known endemics. Seven of the State's eight hornbill species breed there, as well as the spectacular Great Argus and rare Bulwer's pheasants.

A total of 75 species of herpetofauna are now known from Lanjak-Entimau. Four are new to science, while the other has been reported for the first time in Sarawak or are extremely rare. The potential total of herpetofaunal species exceeds three hundred, forming one of the richest areas of the Asian tropics.

Fish diversity is also high, and two new species were discovered among the 26 species collected incidental to herpetofaunal collections.

Socio-Economic Aspects

An estimated 12,400 people of the Iban community reside in the periphery of the Lanjak-Entimau Sanctuary.

A socio-economic study has shown that only about half of the population has formal education, and virtually all are involved in shifting agriculture. Most households are still without electricity and can experience a shortfall of rice, which must be purchased from towns.

Cash crops are not popular because of expensive maintenance (fertilizers, etc.) and poor infrastructure, resulting in high transportation costs.

Income for individuals living on the periphery of Lanjak-Entimau averages well below the State Government's official poverty line. Local communities still depend on the Sanctuary for supplies of forest produce, fish and wild game.

A majority of local residents, however, approve of the existence of the Sanctuary, and its status as a Totally Protected Area.

CONCLUSIONS

Lanjak Entimau Wildlife Sanctuary is one of Sarawak's richest reserves with great potential for the conservation of biodiversity (taxonomic, ecological and cultural), and an important area for acquiring further understanding of forest processes applicable to sustainable forest management.

Furthermore, Lanjak-Entimau and the Bentuang-Karimun Conservation Area together form an important natural biological heritage for Sarawak, Malaysia and the region.

III MANAGEMENT AND DEVELOPMENT OBJECTIVES

Rationale

The combined Lanjak-Entimau Wildlife Sanctuary - Gunung Bentuang and Karimun Conservation Area forms a single ecological unit so that management strategy for one must be appropriate to both.

Management should focus on the protection of diversity at all levels, and the advancement of monitoring and research activities.

Local input should be emphasised in order to realise the Sanctuary's full intellectual and scientific potential.

The principal goals of management will be to maintain ecological integrity, conserve biological diversity, enhance scientific knowledge, promote public education, protect the water quality of the Batang Ai Reservoir and preserve cultural resources and scenic beauty.

Management Zones

The Sanctuary will be divided into concentric management zones based on perceived needs for protection, research and community development.

The proposed Buffer Zone outside the Sanctuary boundary will provide an area for the practice of community forestry or small scale agriculture.

Hunting, fishing, farming and collection of natural forest products is permitted in the Buffer Zone outside the Sanctuary. Conversion of any part of this Buffer Zone area for plantation agriculture or industrial projects should not be permitted.

The Wilderness Zone of the Sanctuary is set aside for scientific monitoring and research. No removal of forest products from this area is permitted except for the collection of scientific specimens.

Low impact ecotourism may be allowed at the periphery of this zone, while access into the zone will be limited to Forest Department staff and authorised local or visiting scientists.

Access into the interior of Lanjak-Entimau, the Core Area, will be actively restricted for the protection of endangered wildlife and the prevention of human disturbance to this pristine area.

Entry into the Core Area will require a written permission of the Director of Forests.

Several other areas of the Sanctuary may be designated as recovery zones (for natural regeneration of forests) or historical sites (forts or burial grounds).

Scientific Research and Interpretive Programme

Scientific research will focus on biodiversity-related areas, encouraging active local participation combined with international collaboration.

The research programme will include floral and faunal inventories, monitoring of rare or sensitive species, elucidation of ecological processes, development of gene banks and identification of bioactive compounds. Data will be entered into a Geographical Information System (GIS) to enhance its utility.

Ethnobiological research will include traditional medicine and the interaction of local residents with the forest. Local stakeholders should benefit from these studies as much as possible.

Research findings will also be used in interpretive programmes about the Sanctuary for the general public. Audiovisual documentation of the Lanjak-Entimau biodiversity will be an important point of these programmes.

Development-oriented research for local communities should concentrate on economic and health care needs, and how local residents can best benefit from conservation of the Sanctuary.

International collaboration will be pursued where appropriate, targeting overseas institutions which already possess a database on Bornean or southeast Asian biodiversity.

Management areas involving policy and funding, and other aspects of the research programme will be administered by the Forest Department.

Education

Existing programmes of the National Parks and Wildlife Office of the Sarawak Forest Department will be augmented to include activities involving Lanjak-Entimau. Programmes will be implemented to educate local communities concerning the purpose of the Sanctuary and the benefits to be derived from their participation in its conservation and protection.

Use of the Sanctuary as a "living museum" for secondary and tertiary education is a student opportunity unique to Sarawak.

Community Relations

Existing agriculture extension programmes of the Sarawak Government must be enhanced, such as small scale fish culture and livestock improvement programmes.

Cottage industries such as traditional crafts must be encouraged through government assistance in marketing and infrastructure.

Forested lands surrounding the Sanctuary must be maintained for use by local communities, such as silviculture projects for rattan or other economically viable non-timber forest products requiring low financial input.

Infrastructure

Infrastructure of the Lanjak-Entimau Sanctuary will include the headquarters (Ng Bloh, ulu Katibas), a Field Centre (Ng Segerak, ulu Engkari) one Ranger Stations for the Central regional (Jemarang, ulu Ensirieng and Ng Serembuang, ulu Skrang). The Headquarters, Field Centre and Ranger Station at Jemarang will be equipped with a climatology cum hydrology equipment, quarters for Forest Department staff and visitors quarters.

The Headquarters will be the main command post for the Sanctuary.

The Field Station will provide laboratory facilities for scientists working in the Sanctuary, as well as accommodation.

Ranger stations at all sites will serve both protection and administrative functions.

An initial staff of approximately twenty Forest Department personnel will be required to operate these facilities, with daily-paid labour drawn from local communities.

International consultants may be needed in the initial management of the Sanctuary, particularly in the conducting of scientific inventories.

Malaysian expertise should however be drawn into these research programmes whenever such local experts are available.

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PART I

NATIONAL AND REGIONAL CONTEXT

PART I : NATIONAL AND REGIONAL CONTEXT

1.0 CONSERVATION IN MALAYSIA

1.1 National aspects

Malaysia has a long history of concern for wildlife protection and the conservation of natural habitats, beginning with the establishment of the Chemor Game Reserve in 1903, and regulations for licensing the hunting of game animals. More recently, Malaysia became an early signatory to the Convention on Trade in Endangered Species (CITES), and has a well established system of parks and protected areas, the most famous of which is Taman Negara (the National Park) in the State of Pahang. Other large and well known parks have been set up in the eastern states of Sabah and Sarawak, including Kinabalu Park and the Gunung Mulu National Park. These large natural areas have been critical in the preservation of regional biodiversity, as well as the protection of a number of species which are threatened or endangered.

1.2 Policy and legislation in Sarawak

Protection of wildlife under the law has been reviewed regularly by the Sarawak Government, and current regulations have been gazetted in the Wildlife Protection Ordinance (1990) and National Parks and Nature Reserves (Amendments) Ordinance (1990). Protection has also been extended to wildlife within Forest Reserves under the recently enacted Forest Ordinance (including all amendments), 1994.

The Forest Policy of Sarawak was first formulated and adopted in 1954. Among its stated goals were to “reserve permanently for the benefit of the present and future inhabitants of the country forest land sufficient ... for the assurance of the sound climatic and physical condition of the country...” and to “foster by education and publicity the value of forest among the public...”

Apart from Sarawak's Permanent Forest Estate, which comprises more than 50% of the State's land area, another 10% (1,037,788 ha) has been either gazetted or proposed as National Parks, Wildlife Sanctuaries, Nature Reserves and Totally Protected Areas. These areas have been set aside for the purpose of preserving in perpetuity representative examples of most types of natural habitats found in Sarawak. A summary of the above gazetted and proposed conservation areas in Sarawak is given in **Appendix I**.

1.3 History of Lanjak-Entimau's protected status

1.3.1 The NPWO-WWF Malaysia expedition

Prior to the establishment of the ITTO Commission, the National Parks and Wildlife Section of the Sarawak Forest Department with cooperation and support from World Wildlife Fund (WWF) Malaysia, organised the first systematic survey of Lanjak-Entimau during a three-month expedition based primarily in Tebellian, ulu Katibas, in late 1981. A preliminary management plan (World Wildlife Fund, 1982) was later produced which provided a basis for gazettelement of the area by the Government of Sarawak as a Wildlife Sanctuary in 1983. (Appendix II)

1.3.2 The role of the ITTO Mission

Nearly a decade later, in its report to the International Tropical Timber Council (Anon., 1990b), the ITTO Commission concluded that the conservation of the biological diversity of Sarawak was best served through the *in situ* preservation of the State's natural heritage. Measures recommended towards the accomplishment of this goal included preservation of :

- i) A complete series of representative widespread habitats (various forest types, for example) to be accomplished by insuring that a full range of soil types and altitudes is included;
- ii) Examples of all unusual habitats or areas with rare or endemic species;
- iii) Viable populations of animals (especially large mammals and birds) which require large home ranges;
- iv) Species which are naturally rare or endangered, or subject to intensive cropping, such as orchids.

These recommendations are consistent with the policy of the National Parks and Wildlife Section, whose central goal is “to preserve areas of significant geological, biological or historical value for the benefit, education and enjoyment of present and future generations”.

2.0 BIOGEOGRAPHICAL FEATURES OF BORNEO

2.1 Topography and geology

Borneo, the world's third largest island with a land area of 451,865 km², is located at the eastern edge of the Sunda shelf and part of the Sundaic sub-Region of the Old World Tropics. The South China Sea separates it from Peninsular Malaysia and Sumatra at mostly shallow depths rarely exceeding 200 m. Fluctuations of sea levels of up to 90 m during the Pleistocene have alternately exposed and drowned several major river valleys in the Sunda shelf area, and occasionally rendered Borneo accessible to the dispersal of floral and faunal elements from Sumatra or even mainland Asia.

The Malaysian portion of the island is formed primarily of Tertiary to recent alluvial deposits in its coastal areas, and a mixture of early to late Tertiary sandstones and shales with some metamorphic content in the Belaga Formation in the interior (Sia, 1995)

2.2 Climate, rainfall and drainages

The Bornean climate is equatorial, with constant high temperatures and heavy, well-distributed rainfall, conditions which are thought to have existed for several million years. Rain is more concentrated during two monsoonal periods, the first of which (the Southwest Monsoon) is weak and occurs from May to early July. The heaviest rainfall for the northern and western portions of Borneo occurs during the northeast monsoon period from December through February, usually causing localised flash floods in the interior, and major flooding in coastal areas every few years.

In most parts of the island, rainfall ranges from 2500 - 4000 mm per year, though areas of lower (< 800 mm) or much higher (> 5000 mm) exist in specific areas (Anon., 1980a). In the extreme northeastern (7 ° N) or southern (4 ° S) portions of the island, variations in

the usually stable climate can occur in the form of moderate to severe droughts which have been reported to occur at least as far back as the mid 19th Century (Bock, 1879). In modern times, these droughts have occurred in conjunction with the Southern Oscillation phenomenon and have resulted in some serious forest fires (Beaman *et al.*, 1985).

Major drainages in Borneo include the Kapuas, Barito and Mahakam Rivers in Kalimantan, the Kinabatangan and Padas in Sabah and the Baram, Rejang and Batang Lupar in Sarawak. The largest of these are the Rejang and Kapuas, the hinterland of which includes much of the central portion of the island.

All these rivers originate as swift rocky streams in the interior at altitudes above 1000 m asl., carrying large quantities of silt as they cut a meandering course through the lowlands, forming broad mangrove covered deltas at their seaward boundaries.

2.3 Flora

Until the 20th century, approximately 90% of Borneo was under natural forest cover. Forests still cover more than 60% of the land area, though most have incurred disturbance from human activities.

Coastal mangrove forests dominate the deltas of major rivers, while other coastal areas have patches of heath or *kerangas* vegetation on elevated sandy substrate, with peat swamp forests growing inland in poorly drained areas. On lowland podzolic soils are mixed forests dominated by the family Dipterocarpaceae, which extend into hilly areas forming dipterocarp forest of a different species composition on slopes from 300-900 m asl. Above 1000 m, the forest canopy is lower and a submontane (oak-dominated) forest type is increasingly common above 1300 m. Stunted gnarled trees of *Dacrydium* and *Leptospermum* become the dominant trees above 1500 m. Truly alpine vegetation is found only on Mt. Kinabalu above 3000 m.

Borneo forms the richest portion of the Sundaic sub-Region from the standpoint of floral diversity, equaling the numbers of species recorded in other extremely species rich areas such as New Guinea or parts of the Neotropics (South America). Borneo is the centre of distribution for the paleotropical Dipterocarpaceae, a family of trees with 262 known species (34% of which are endemic) and 59 genera unique to the island. Dipterocarps

dominate Borneo's lowland and hill forests and form the bulk of the valuable timber species.

Besides trees, Borneo possesses a wealth of other unique plants including at least two thousand species of orchids, and numerous other rare endemics including seven or more species of the bizarre parasitic giant flower, *Rafflesia*.

2.4 Fauna

The greatest diversity of the Bornean fauna lies overwhelmingly with the invertebrates, the majority of which remains little studied. Research on individual taxa, such as the beetle family Chrysomelidae, indicate that this single group is likely to contain over 400 species, of which 70% are probably endemic (Mohamed Said *et al.*, 1990).

The vertebrate fauna of Borneo, is also extremely diverse. It bears close resemblance to the Sundaic fauna and probably shares a common origin on the Asian mainland. Strangely, faunal similarities between Borneo and its near neighbours, Sulawesi and the Philippines, are few (Medway, 1977).

There are 119 indigenous species of mammals, excluding bats and marine mammals, of which approximately one-third are endemic, compared to 4.5% for Peninsular Malaysia and 10% for Sumatra (Groves, 1990).

Borneo is also a natural centre of diversity for birds, about 36 endemics representing about 5% of the approximately 600 known resident and migrant species. The Bornean avifauna is an integral part of the Indo-Malayan realm, which is mostly Asian in character, with a few groups (*e.g.*, hornbills, pheasants and sunbirds) shared with tropical regions of Africa. Affinities with Australian regions to the south are weak.

For herpetofauna (amphibians and reptiles), Borneo possesses the highest individual and species diversity in Southeast Asia (Inger, 1978). Endemism runs high, and about 40% of amphibians and more than one quarter of all snakes and lizards are not known outside the island.

The fish fauna is by far the most diverse among the vertebrate animals of Borneo, with 99 families possessing a total of 394 species of which nearly 40% are endemic (Kottelat, *et al.*, 1993). New species of freshwater fish are still discovered with every new scientific survey from the lesser known rivers of the Bornean interior.

3.0 GEOLOGY AND BIODIVERSITY OF SARAWAK

3.1 Climate

Sarawak experiences a prominent Northeast Monsoon from approximately December to March. The dry season for most of the State occurs between June and August. Year to year variation is, nevertheless, high. Rainfall totals between about 2000 - 5000 mm annually, with coastal areas generally receiving less, and the interior regions (particularly the Marudi Division) the heaviest. Much of west-central Sarawak is sheltered from the more extreme effects of the Northeast monsoon, and experiences comparatively lower rainfall than the eastern interior or extreme western regions. Unlike in Sabah or Kalimantan, truly rainless periods in Sarawak rarely last more than one month.

3.2 Topography, Geology and Soils

Coastal areas and the adjacent flat alluvial plains of north-western Borneo are derived from relatively young sediments laid down from the mid-tertiary to the Pleistocene and Recent. Towards the interior, most of central Sarawak is formed by the Belaga Formation of the late Cretaceous to late Eocene periods, approximately 50-60 million years before the present. Most of this interior area consists of intensely folded dense shales and slates, marine sandstones (*e.g.*, graywacke and subgraywacke) with occasional veins of quartz, or small exposed limestone outcrops. Some of eastern Sarawak exhibits granitic lava flows of late Tertiary or early Quaternary origin.

Many of the soils derived from coastal areas or (occasionally) on some high mountain plateaus are Podzols. These soils of low fertility are usually associated with stunted "kerangas" forests. In river valleys where drainage is poor, are Gley soils. In more well-drained lowland and hilly areas are found somewhat more fertile red and yellow podzolics.

Most Sarawak soils tend to be acidic, particularly where drainage is poor. All are thin in steep areas or on ridge tops, where poorly differentiated horizons are effected by persistent erosion (Sia, 1995)

3.3 Flora

Forested areas of the coast and interior cover about 8,500,000 ha, or just under 70% of Sarawak's total land area (Map 1). The dominant forest type is Mixed Dipterocarp Forest (about 7,000,000 ha), followed by Peat Swamp Forests (1,300,000 ha) and Mangrove Forests of coastal and riverine areas (200,000 ha).

Dipterocarp forests occur on several different types of terrain, including alluvial, lowlands, hills and ridges, and differ accordingly in physical structure and species composition. Dipterocarp forests are generally dominated by the genera *Shorea*, *Dipterocarpus* and *Dryobalanops*.

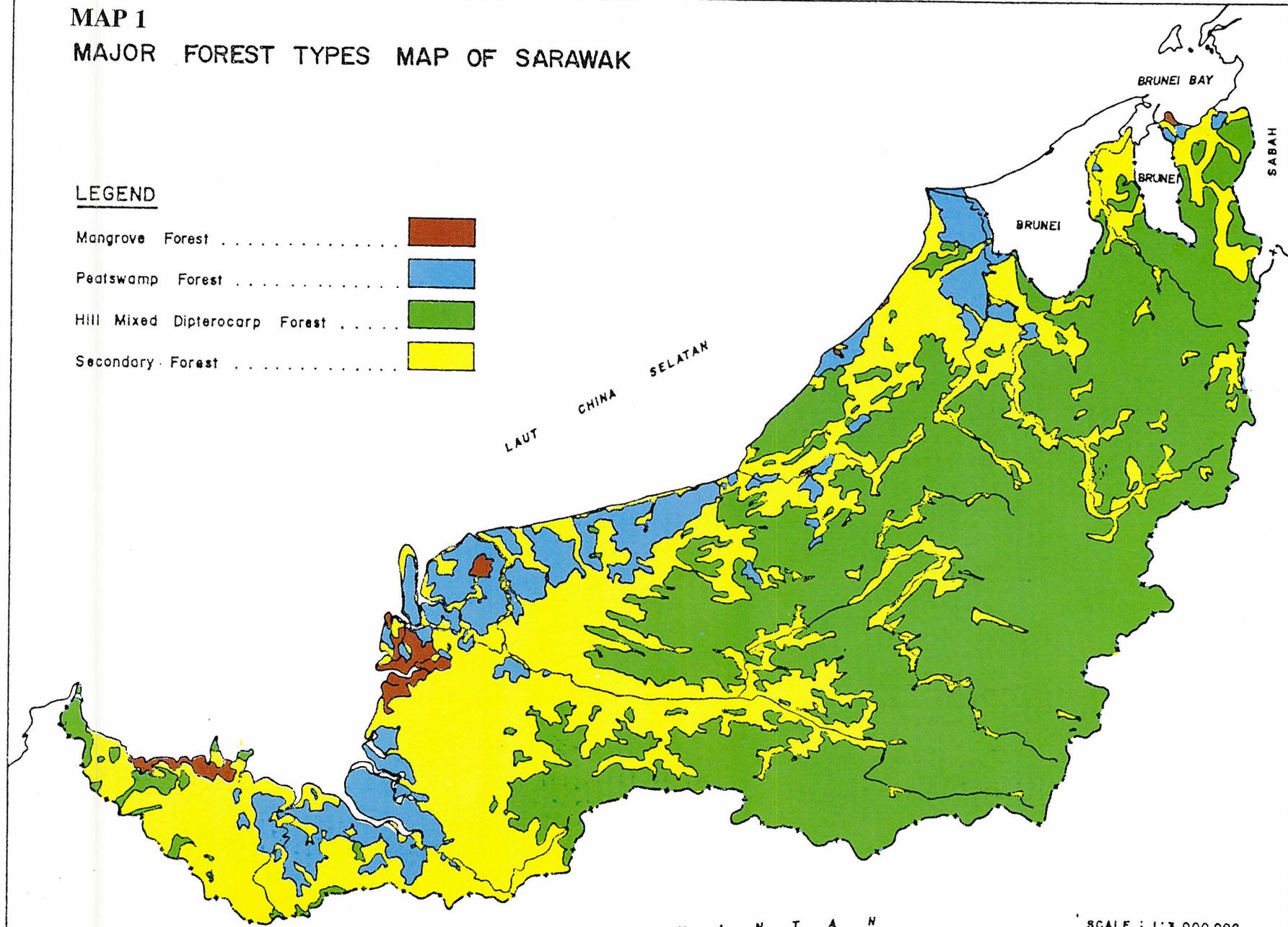
One hectare can support from 10-30 large (>70 cm diameter) trees, which frequently are of different species. Among the Dipterocarpaceae several important fruiting species exist, including *engkabang* trees, which are producers of oil-rich illipe nuts normally harvest by interior peoples and an important food for some wild herbivores. Besides tree species, the dipterocarp forest supports a complex community of lianas, orchids and other epiphytes.

Above 1000 m asl., dipterocarps decrease in abundance, and are gradually replaced by montane forest of smaller trees with a lower canopy. The highest forests are mossy and wet, with a rich diversity of understorey plants (Chai, 1995).

MAP 1 MAJOR FOREST TYPES MAP OF SARAWAK

LEGEND

- Mangrove Forest 
- Peatswamp Forest 
- Hill Mixed Dipterocarp Forest 
- Secondary Forest 



DRAUGHTED BY : COBBY SAYOB

K A L I M A N T A N

SCALE : 1:3,000,000

3.4 Fauna

3.4.1 Mammals

Where vertebrates are concerned, most of the mammals unique to Borneo are not endemic to Sarawak except for a number of small species such as tree shrews and squirrels. For rare species, both the Sumatran rhinoceros (*Dicerorhinus sumatrensis*) and the Bornean Orangutan (*Pongo pygmaeus pygmaeus*) exist, but their range is now severely limited. The rhinoceros is now thought to survive only in a small interior area of Limbang, while the orangutan survives in two widely separated areas, one in the lower Batang Lupar near Sebuyau, and a more substantial number in the Batang Ai National Park and the Lanjak-Entimau area. The Banteng (*Bos javanicus*) was plentiful in the earlier part of this century, though limited to areas east and north of the Baleh River. It now survives only in the interior of Sarawak near the Kalimantan border.

3.4.2 Birds

The avifauna of Sarawak consists of 54 families containing 534 species, of which 380 are resident, and the rest migrants or vagrants. Only a few are introductions, and 28 of 29 Borneo endemics are present in the State. All eight species of hornbills known from Borneo are also found in Sarawak (Grubh, 1994).

3.4.3 Herpetofauna

Since most terrestrial and freshwater habitats in Sarawak have been available for colonisation since the beginning of the Tertiary, some 60 million years ago, amphibian and reptile diversity is high. Sarawak possesses more than 350 herpetofaunal species, of which about 30% are amphibians and the rest are reptiles. More than one-third of this fauna is endemic, with the highest rate of endemism existing among frogs and lizards (Stuebing, 1994).

3.4.4 Fish

The fish fauna of Sarawak is even less documented than of the terrestrial vertebrates. With each new scientific collection new names are routinely added to the faunal list, which now stands at well over one hundred species.

3.4.5 Insects

Sarawak contains a major component of the biodiversity existing in Borneo. Undoubtedly most of the lowland invertebrates that occur on the island are also found in Sarawak. Great gaps remain in the knowledge of their distribution and abundance, however.

For example, one of the best known group of insects in Malaysia is the Lepidoptera, butterflies and moths. There are more than 1,000 known species so far. Nevertheless, the biology of relatively few, probably less than 10%, has actually been studied.

The largest order of insects is the beetles, with literally millions of tropical species, with perhaps several hundred thousand species in Borneo. Only a fraction of these have actually been named.

4.0 SOCIOCULTURAL FEATURES

4.1 History and demographical aspects

Seven major groups have been distinguished in Sarawak : Malay, Melanau, Iban, Bidayuh, other indigenous (the *Orang Ulu*), Chinese and other non-indigenous (such as Indian, European, etc.). Except for Malay, Melanau and Iban, most of the others possess a number of subgroups after living in different locations and speaking different dialects.

Sarawak may be broadly divided into three different regions: coastal, inland (either flat or having ranges of low hills), and interior (including riverine, upriver and mountainous areas). Each of these three has its own socioeconomic characteristics and different levels of development.

Most Malay and Melanau populations have historically been concentrated either near the coast or in the coastal sections of rivers, while Bidayuh communities have traditionally been situated in inland areas of western Sarawak. Chinese populations have been primarily urban in this century, though a small but significant percentage previously entered interior areas either to trade or to work in the extraction of raw materials such as gold from the mines near Bau.

The Iban (Sea Dayak) migrated into Sarawak's interior region, the rugged Batang Ai watershed from the Kapuas region of West Kalimantan, about 500 years ago. Further migrations occurred after 1840 into the Skrang, Lemanak and Katibas regions. Subsequent movements in recent times (since 1947), were to Simanggang (Sri Aman), Sibu and to Miri, principally for economic reasons e.g. work in the Petroleum industry (Sidu, 1995).

4.2 Community structure and cultural practices

4.2.1 Cultural background

The large scale migrations of the Iban people over the last one hundred and fifty years were often the result of their continuous search for new forests for shifting agriculture and for new supplies of fish and game.

Iban farmers grow hill rice predominantly through "slash and burn" method, a process which replaces the original forest with secondary growth. Recently, cash crops such as rubber, pepper, cocoa and oil palm have been introduced.

4.2.2 The longhouse

Communal life is centred around the longhouse made of timber, where families live in adjoining compartments, or *bilek*, with sleeping facilities and kitchen. All of the *bilek* open onto a common verandah where work is done, longhouse business is transacted and socialising takes place. Leadership of the longhouse is embodied in a communally chosen *Tuai rumah*, or Headman.

Most longhouses consist of ten or more families, though in the periphery of Lanjak-Entimau, longhouse communities can possess as few as five (ulu Engkari) and as many as fifty (ulu Kanowit). Longhouse inhabitants near the Sanctuary were reported to have resided in their respective areas for an average of fifty years. Some reported their longhouses having existed for much longer (more than 150 years), while a few mentioned a brief period of only five years (Sidu, 1995). The latter phenomenon occurs when communities taking advantage of logging roads to move into new areas.

The basic socio-economic unit of the longhouse is the "bilek-family". Each has its own apartment (bilek) and is economically self-sufficient, possessing land, farms and household property. Common property is primarily (though not exclusively) restricted to burial grounds and an area of communal forest, or *Pulau kampong*, mutually left intact by the shifting cultivators, but surrounded by secondary forest (*temuda*). This communal area is maintained in order to supply timber and other forest products.

Despite their individualistic views on property ownership, a high degree of cooperation prevails within the longhouse community, usually consolidated by kinship. Cohesion and cooperation are held in high regard, and in fact much daily as well as seasonal activity is undertaken as *gotong-royong*, i.e. on a cooperative basis.

4.2.3 *Bejalai*

Some household members, particularly young males, are absent for long periods while earning income outside. This traditional practice is still called *bejalai*, in which young men formerly left the longhouse before marriage in search of new land or trophies, prior to settling down with their own families. It has now been extended to working away from the longhouse to obtain much-needed cash income.

4.2.4 Social structure and leadership

In terms of social structure, the Iban are principally an egalitarian society without any traditional stratification. Leaders acquire influence more through achievement rather than via inherited status. Their role is to maintain cooperation and stability among the longhouse families, as well as to serve as mediator with outsiders, including Government agencies.

A formalised leadership structure exists under the Government's administrative machinery, with the *Tuai Rumah* or village Headman in charge of a particular longhouse, a *Penghulu* or leader of a group of longhouses, followed by a *Pemanca* at the District level, who coordinates with several *Penghulu* and the highest authority vested in the *Temenggong*, who is at the Divisional level. All community leaders are appointed by the Government and receive a monthly allowance. At the village level, most longhouses have a Development and Security Committee chaired by the *Tuai Rumah*, in charge of

agricultural development, maintenance of water and electricity, safety and other matters directly related to the welfare of the longhouse community.

4.3 Land use and rural economy

In Sarawak the rural economy is still dependent on the development of agriculture. The latter still makes a steady contribution to the State's internal economy, although it remains but a tiny fraction (3%) of the value of Sarawak's exports. Even though the percentage of the labour force involved in agriculture has been declining steadily since 1960, it remains the largest single sector of the economy (**Table 1**). These workers are predominantly involved in smallholdings, 90% of which are scattered in about 5,000 villages in rural areas.

Most smallholders are subsistence growers of rice (*padi*) as their staple food crop, and rubber, pepper, coconut and sago as their cash crops. The majority still practice shifting cultivation, formerly based on the felling of primary forest, but now involving secondary forest in much of the periodic cycle. The shortage of land for rotation for padi planting has increased the acceptance of cash crops.

4.4 Regional infrastructure and development

Until the last decade, travel to many parts of Sarawak was primarily by river. To reach many interior settlements required an arduous, difficult and usually costly journey, with the additional hazards of dangerous rapids or unpredictable weather. However, great improvements have taken place, so that many important destinations in the western half of Sarawak are now linked by road.

Table 1 : Percentage distribution of labour force by major industry-Sarawak

Major Industry	Percentage of Labour Force			
	1960	1970	1980	1990
Agric. Forestry, hunting & fishing	81.4	68.0	60.6	47.1
Manufacturing & Construction	5.5	6.5	9.5	15.1
Services	5.5	11.0	17.5	19.4
Others	7.6	14.5	12.4	18.4

**Source: Yearbook of Statistics 1992, Sarawak
Department of Statistics Malaysia (Sarawak Branch)**

PART II

**ASSESSMENT OF LANJAK-ENTIMAU
AS A TOTALLY PROTECTED AREA**

PART II : ASSESSMENT OF LANJAK-ENTIMAU AS A TOTALLY PROTECTED AREA

1.0 CURRENT STATUS

1.1 Location

Lanjak-Entimau Wildlife Sanctuary is located in an area of rugged topography in southwestern Sarawak between 1°19' N to 1° 51' N and 111° 53'E to 112° 281/2' E, in portions of the Kapit, Sarikei, Sibuluan and Sri Aman Divisions. Administratively, it lies within the Districts of Song, Kanowit, Julau, Lubok Antu and Sri Aman. The total area of the Reserve is approximately 187,172 ha, including proposed extensions of 18,414 ha (**Anon, 1980b; Maps 2 and 3, Appendices II A-C**).

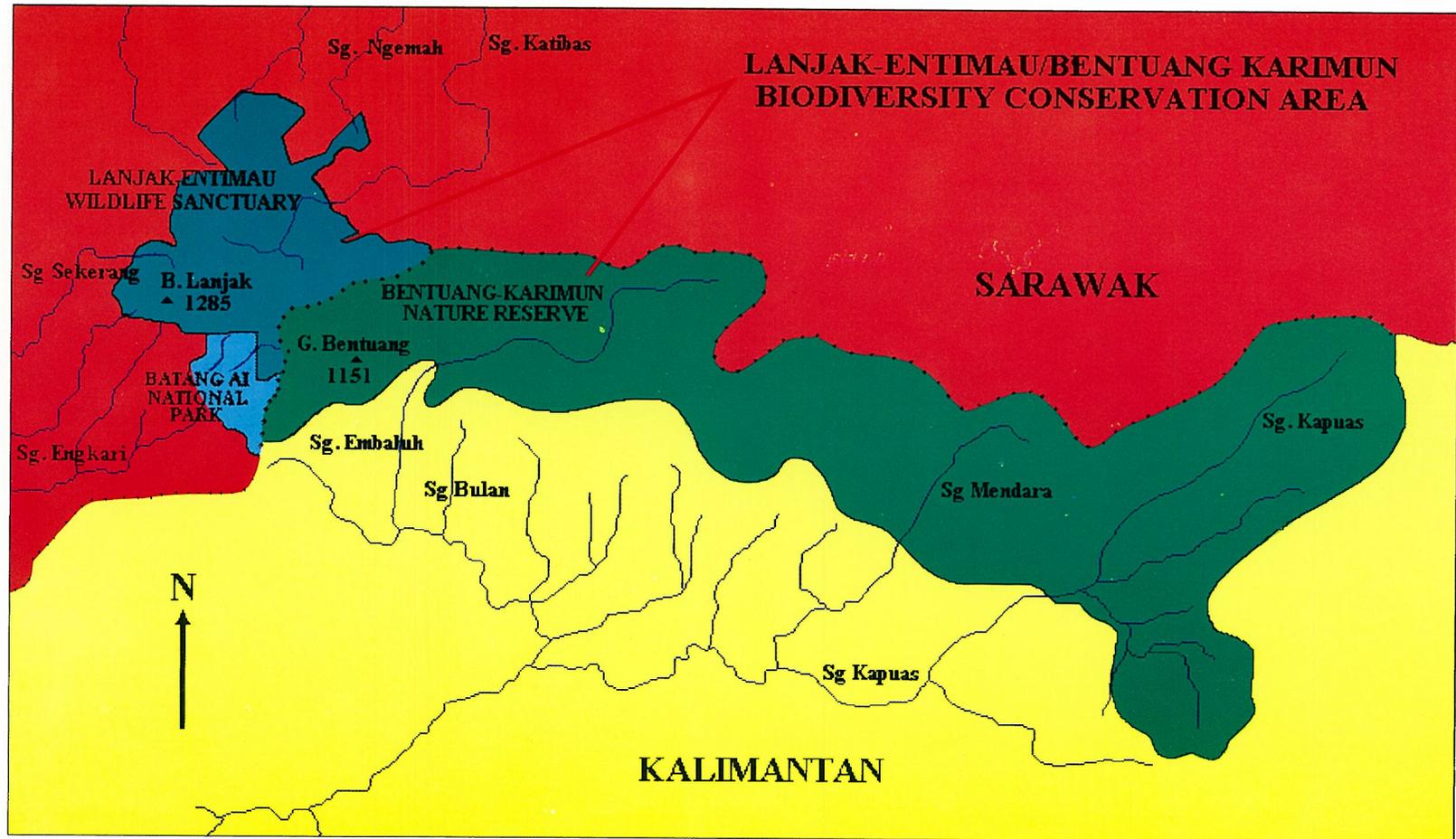
A re-survey and check of the boundary in 1990-91 revealed some minor anomalies, the suggested solutions to which are given in **Appendix III**. The Sanctuary is contiguous with the approximately 800,000 ha Bentuang-Karimun Nature Reserve (now National Park) in West Kalimantan, Indonesia in the southeast, and is continuous with the 24,000 ha Batang Ai National Park along its south central boundary (**Map 2**).

1.2 Legal Status

Lanjak-Entimau Wildlife Sanctuary was first proposed as a Wildlife Sanctuary in 1982 following the publication of the findings of a six-month expedition by the Sarawak Forest Department in cooperation with World Wildlife Fund, Malaysia (World Wildlife Fund Malaysia, 1982). The initial gazette notice was published the following year (**Appendix II**). In 1993, the Initial Proclamation was made for extensions to Lanjak-Entimau for areas not included in the original 1983 gazette of the area.

Under Sarawak's National Parks Ordinance (1956) and Wildlife Protection Ordinance (1990), as a designated Wildlife Sanctuary, Lanjak-Entimau is classified as a Totally Protected Area. All persons are prohibited from taking any form of forest produce and from hunting and fishing in such TPA's.

MAP 2



Note: Boundaries of Bentuang Karimun are only approximate

Exceptions to this general prohibition were made in specific cases, where such rights were assigned at the time of original gazettelement. In the case of Lanjak-Entimau, the Sarawak Government granted special rights to several communities in residence adjacent to the Sanctuary, to collect jungle produce from specified areas for their own consumption. These rights include portions along the boundaries of the Sanctuary, including parts of the watersheds of the Sg Ngemah, Sg Ensirieng and Sg Beloh. (Article 3, Second Schedule, **Appendix II**).

2.0 TOPOGRAPHY, WATERSHED AND DRAINAGE PATTERNS

2.1 General topography

Lanjak-Entimau is rugged throughout, with its most strongly dissected terrain in the south (**Map 4**). Elevations range from about 60 m asl. in the flood plains of the north to a maximum of 1284 m asl., at the summit of Bukit Lanjak in the Sanctuary's southwestern quadrant. The hills of the north are generally of more modest altitudes, usually less than 700 m.

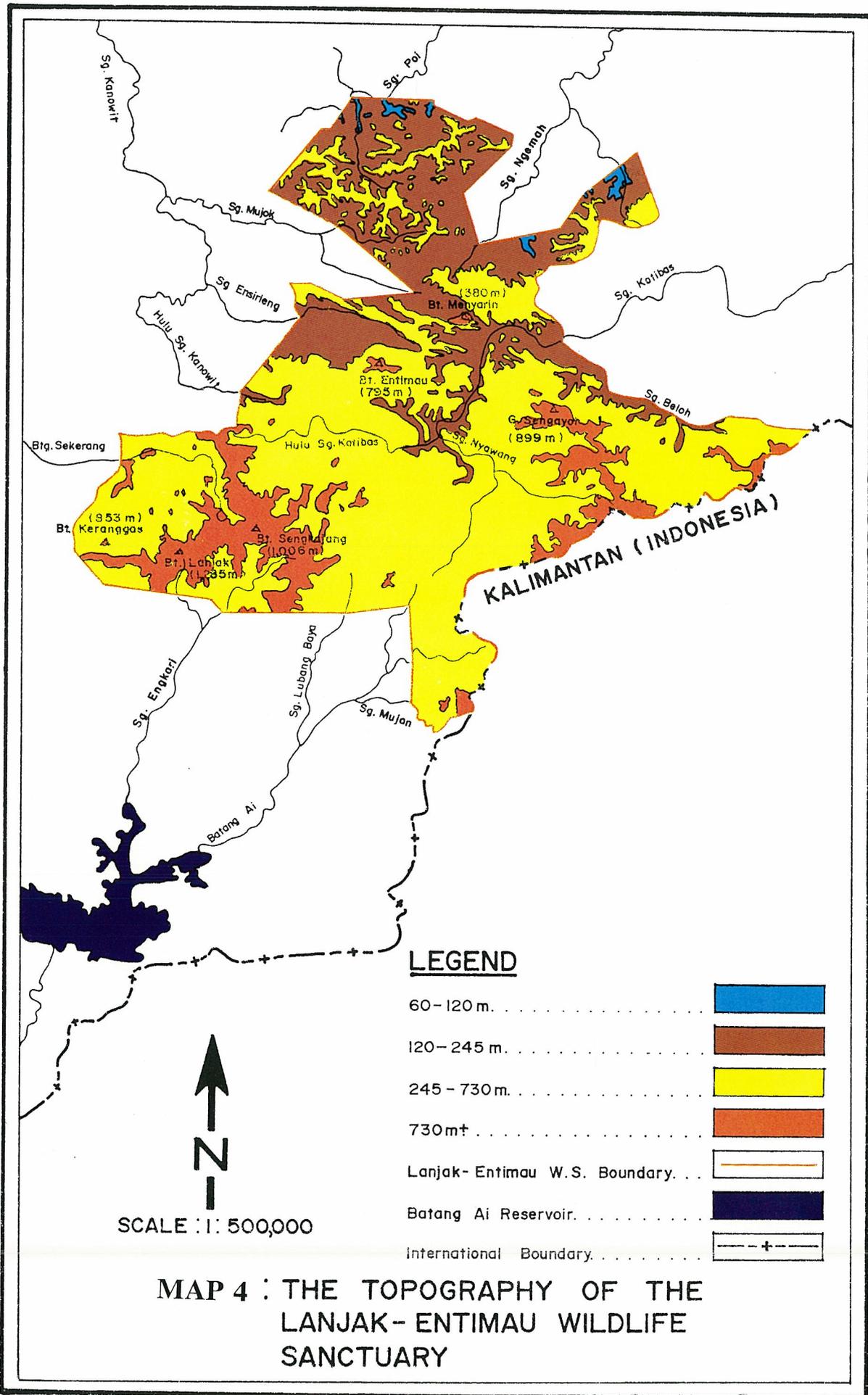
Most of the southern two-thirds of the Sanctuary, bounded approximately by a line running between Bukit Entimau (988 m) and Bukit Sengayoh (875 m) possesses elevations greater than 300 m. and hills above 700 m asl. Nevertheless, there are no areas at or above 1300 m. in elevation except for Bukit Lanjak itself.

Major river valleys navigable by longboats range from 60-120 m. asl. in the north to approximately 120-180 m. in elevation in southern waterways (**Plate 1**).

2.2 Watersheds

Lanjak-Entimau occupies two main watersheds, composed of three major and four minor drainage blocks (**Map 5**). The entire Sanctuary is located within the headwaters of the Batang Lupar and Rejang Rivers.

The Rejang drainage (77%) includes the north and northeast of the Sanctuary, while Batang Lupar tributaries (23%) are restricted to its southwestern corner.



Subdrainages of the Rejang system include Sg Kanowit in the west; the Sg Ngemah-Sg Mujan, Sg Poi and Sg Mujok in the north; and Sg Katibas with its numerous tributaries in the northeast and central parts of Lanjak-Entimau .

The Lupar tributaries drain the southwestern and southern portions of Lanjak-Entimau, comprising the Sg Skrang and Sg Lemanak in the southwest and the tributaries of Batang Ai in the south. (Table 2).

Table 2 : Drainage Pattern of the Rivers in the Sanctuary

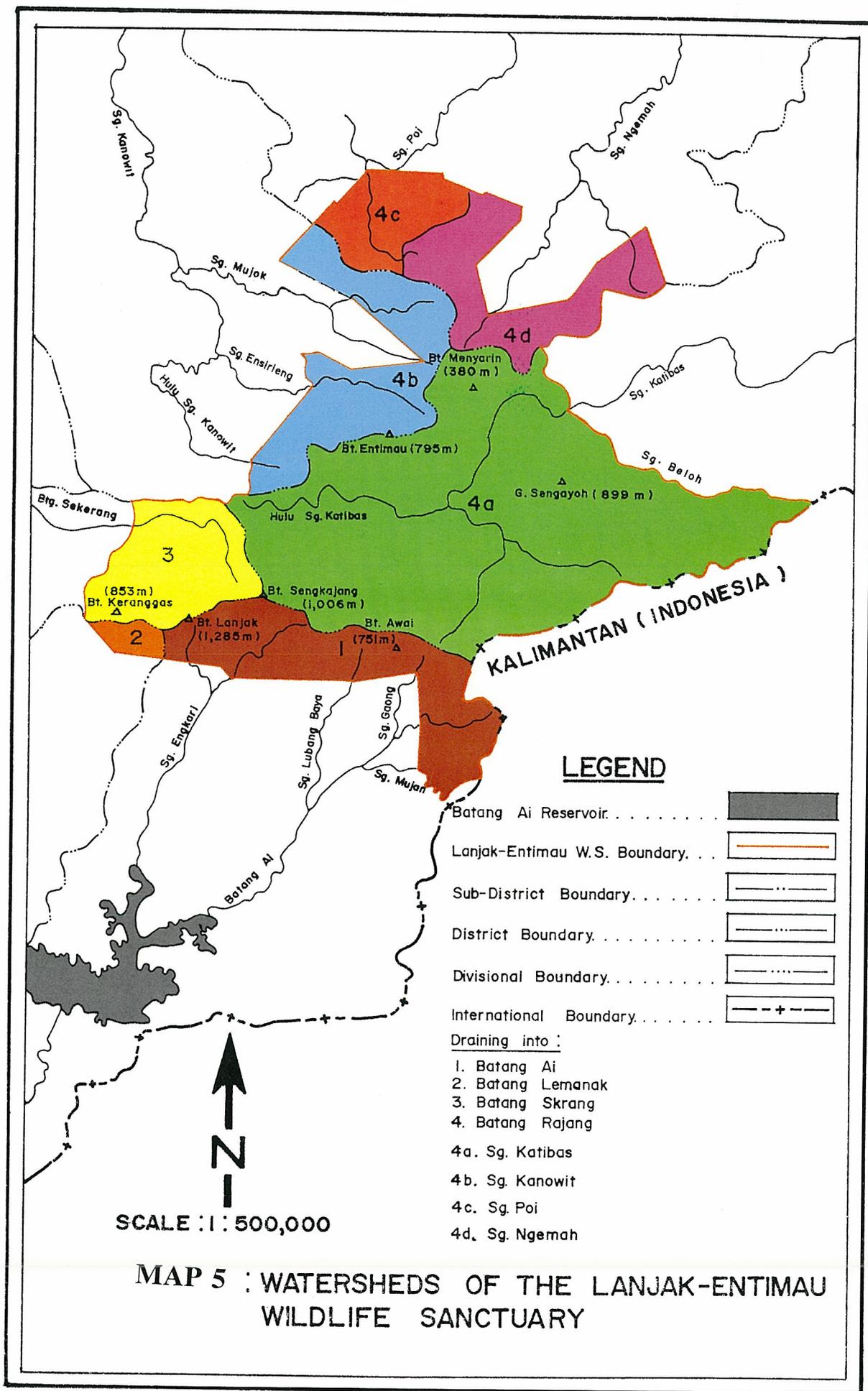
Major Rivers	Major Tributaries	Areas of Watershed as % of Total	
Batang Lupar	Ai	13	23
	Lemanak	1	
	Skrang	9	
Batang Rejang	Katibas	42	77
	Kanowit	19	
	Poi	7	
	Ngemah	9	

2.3 Drainage

The rivers of the Sanctuary cut mostly across the regional strike (the direction in which the folding of most layers has occurred) traversing deeply eroded valleys through a complex of highly dissected steep ridges with little flood plain development within the Sanctuary. Rapids are formed in the many areas where the rivers encounter resistant strata. An exception occurs in the northern tributaries such as the upper Kanowit and Katibas. These flow parallel to the regional strike through thick beds of resistant sandstone along the strike of softer shales.

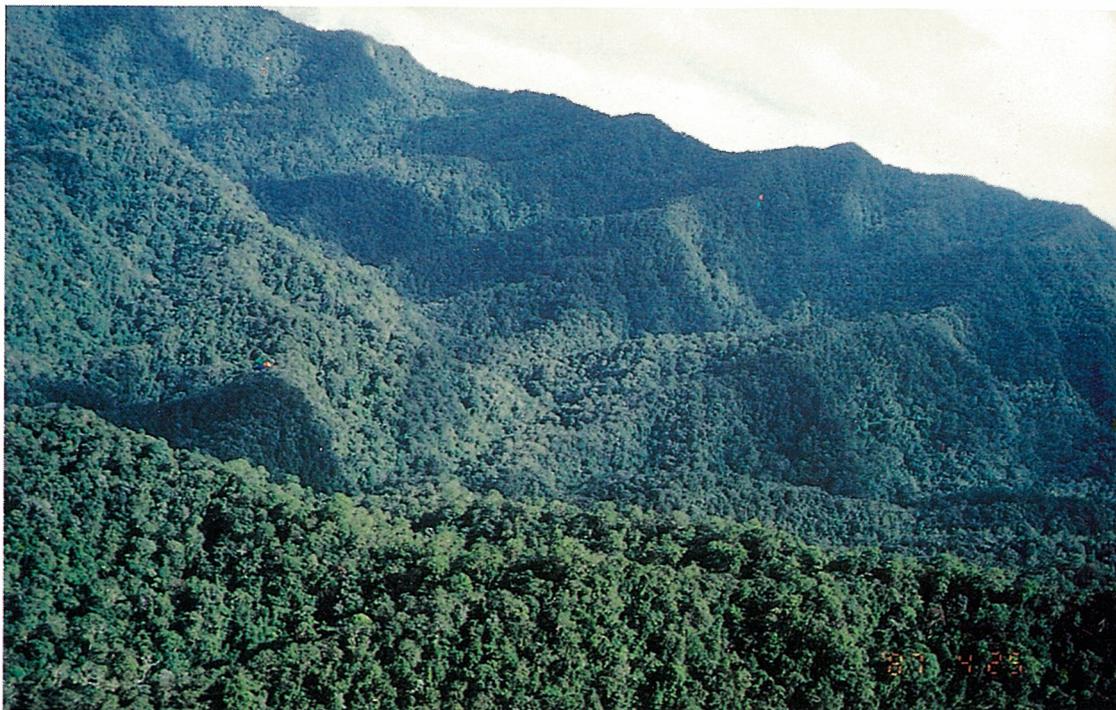
Several tributaries of the Kanowit, Poi, Ngemah and Katibas also have water courses flowing through more easily eroded rock along existing faults in a generally northwesterly orientation. Despite the existence of rapids, many of these rivers have broad channels with relatively laminar flow and substantial volume year round.

In contrast, the upriver areas of the Engkari, ulu Ai and Lubang Baya cut across the strike, flowing southwest, creating channels which are narrow and deeply incised, with tortuous channels that become shallow during the dry season. Upriver terrain is





P1 : River travel to Lanjak Entimau via the Engkari River



P2 : The forest canopy and rugged terrain near Bukit Lanjak

extremely rugged with steeply sloping hills rising directly from the river beds. Numerous large and small tributaries exist, though many are intermittent since runoff is rapid because of the largely ungraded basins (**Plates 1, 2 & 3**).

Only a small percentage of precipitation is likely to infiltrate the soil profile. Flash floods are common and can be severe (as much as a six meter rise for example) affecting the alluvial lands along the rivers and limiting agricultural potential (**Sia, 1994**)

2.4 Rainfall

No meteorological stations are located within the Sanctuary. However, data obtained from stations at Ng Tutong and Lubok Antu in the South, and at Sg Ngemah in the north between 1966 and 1985 indicate that the mean annual rainfall for the area is approximately 3,500 mm.

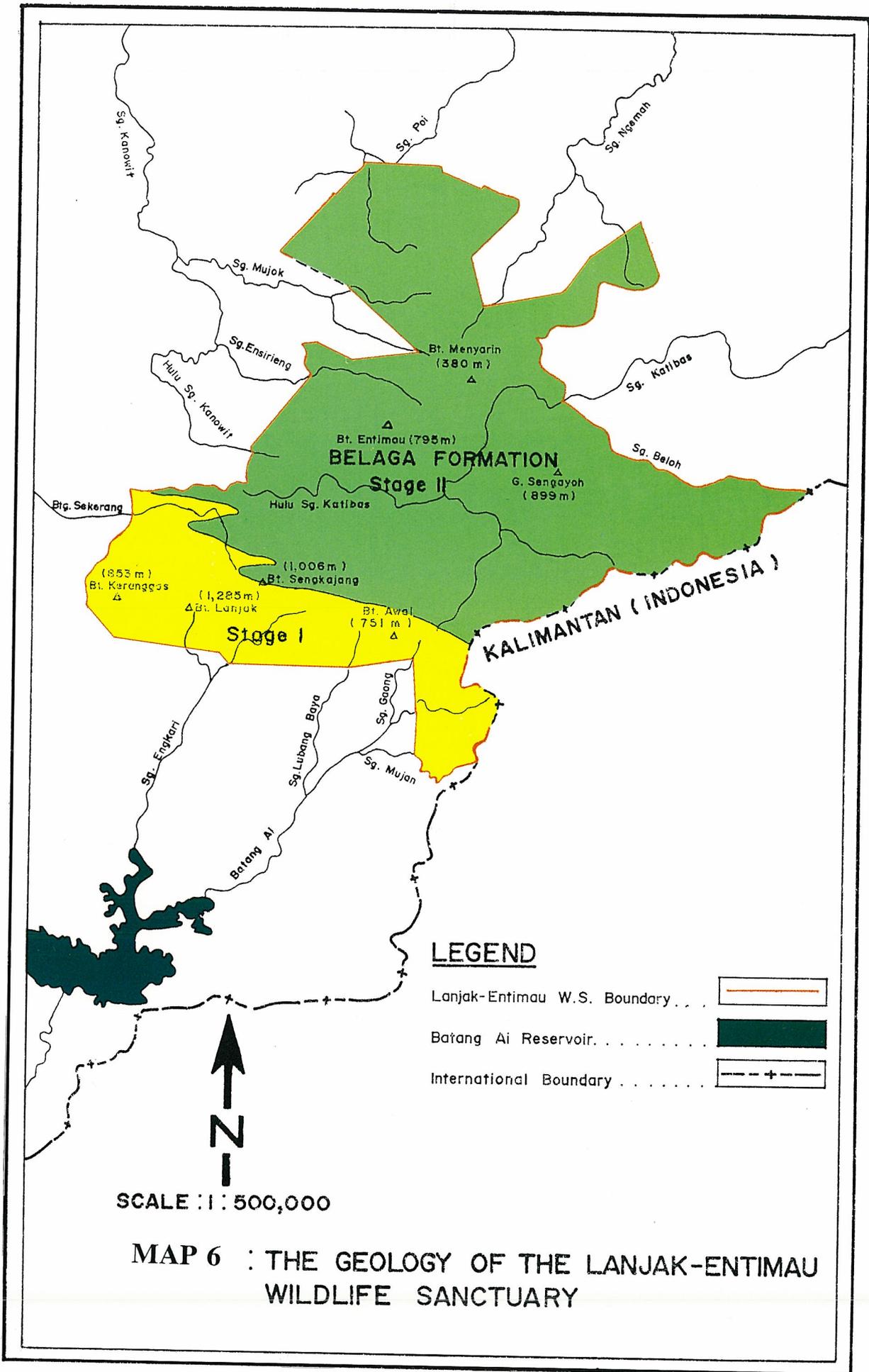
The wettest months (October-January) receive about 300-350 mm, while the driest months, about 200 mm. Nevertheless, rainfall levels can fluctuate substantially from month to month. Also, the higher terrain of the Sanctuary probably receives higher amounts of rainfall than have been recorded at peripheral stations such as Lubok Antu and Ngemah.

3.0 GEOLOGY

Geologically, the Lanjak-Entimau Sanctuary is composed entirely of sedimentary rocks associated with Stages I (Upper Cretaceous) and II (Paleocene to Upper Eocene) of the Belaga Formation. In the Sanctuary, the boundary between Stages I and II of this formation lies approximately between the headwaters of the Rejang and Lupar Basins, running roughly northwest to southeast (**Map 6**).

Much of the southern areas (Stage I) consist of hard, greenish or grey, shiny phyllite rocks, produced from shales in low grade metamorphism (heat and pressure from folding). Fine-grained greyish sandstones are exposed at many of the rapids and strikingly contrasting veins of milky white quartz are occasionally visible.

In the northern areas of Stage II, slaty shales are common, with occurrence of calcareous greywacke (a dark green to black, hard sandstone containing unidentifiable remains of



marine organisms). Impure limestone concretions were found in calcareous shale along Sg Nyawang, containing fossilised tube-like tracks of some marine organism (Haile, 1957).

3.1 Soils

The soil types of Lanjak-Entimau fall into three main taxonomic categories, namely Alluvial, Red -Yellow Podzolic and Skeletal (Tables 3 & 4, Map 7). These have the following general characteristics:

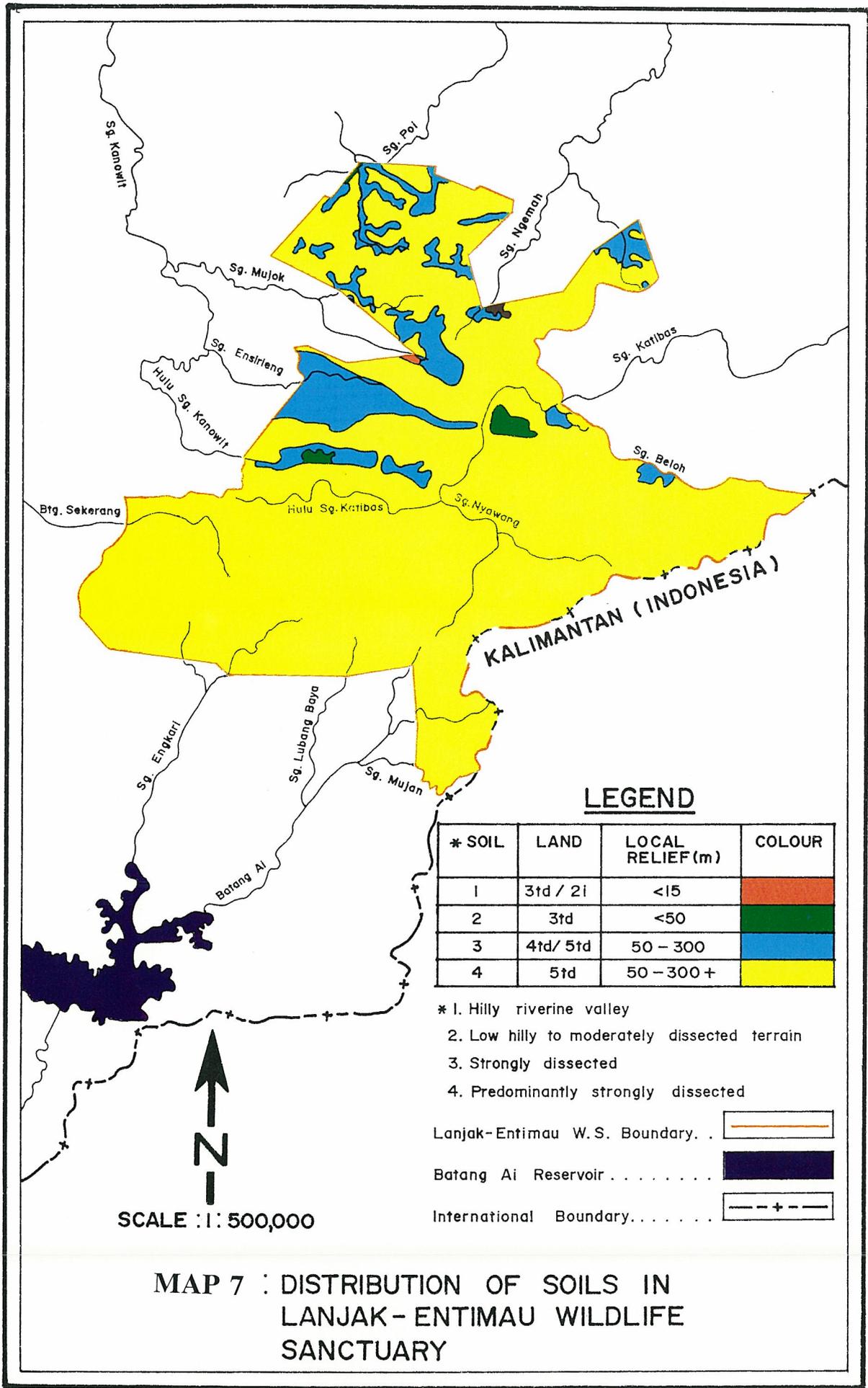
Table 3 : Soil classification from Lanjak-Entimau *

Great Group	Criteria	Family	Criteria	Series
Alluvial	Accreting alluvium, not gleyed	Seduan	Clayey	Seduan
				Malang
		Bemang	Fine loamy	Bemang
Red Yellow Podzolic	Red Yellow matrix colours, increase in clay with depth	Merit	Clayey	Merit
				Jakar
		Bekenu	Fine loamy	Bekenu
				Sarikei
Skeletal	Less than 50 cm in depth	Meluan	Lithic contact	Meluan
		Kapit	Paralithic contact	Kapit

Table 4 : Soils and land capability of the Lanjak Entimau area

Soil Unit	Agricultural capability class	Soil Great Group
hilly riverine valley	3td/2i : minor to moderate limitation	Alluvial
		Red-Yellow Podzolic
		Skeletal
low hills or moderately dissected terrain	3td: moderate to serious limitation	Red-Yellow Podzolic
		Skeletal
strongly dissected terrain	4td/5td: serious limitations	Skeletal
		Red-Yellow Podzolic
predominantly strongly dissected terrain	5td: unsuitable	Skeletal
		Red-Yellow Podzolic

* Based on Tan (1979), Teng (1979) and Sia (1994)



Alluvial soils are derived from the accreting alluvium of rivers, and possess a homogeneous or uniform profile, with little differentiation except for the top horizons. These soils occur in valleys and levees in Lanjak-Entimau, though their diverse properties are derived from parent material of varying origins. Alluvial soils formed from sandstone are light-textured (sandy and sandy-clay loams), while those derived from shales and mudstones possess heavier textures (clay and clay loams).

Agriculturally, alluvial soils are classed as category 3, excellent for a wide range of crops with little or no management. Only 0.4 % of Lanjak-Entimau's soils fall into this category, occurring sparsely along the Sg Ngemah, Sg Mujok, ulu Sg Mujok and in small areas near the junction of the Sg Joh and Sg Beloh. These areas are nevertheless limited by their susceptibility to severe flash flooding.

Red-yellow podzolic soils of the Sanctuary have originated from sedimentary rocks, specifically coarse-grained sandstones and shales. They are often fairly uniform in chemical and mineral content because of intense weathering and relative maturity. Fine, crumbly structure exists only in the uppermost layer combined with the dense root mat of a mature forest. Gravel or stones are abundant in subsoils, and clay content increases with depth, which in the Sanctuary is usually less than 100 cm. The reddish yellow colour of these podzols is caused by the presence of oxidised iron. The Merit and Bekenu families of red-yellow podzolics are common in the Lanjak-Entimau .

Red-yellow podzolic soils are classed 3-4 agriculturally (i.e. good but restricted by steep slopes and used preferably only for perennial crops). They occur principally in low hilly areas, and are considered suitable for agriculture only when they are found on gently sloping terrain. They account for only about 0.5 % of the Sanctuary's land area.

Skeletal soils are found on the steep slopes of ridges and crests. They are a complex group with a variety of texture, structure and chemical content, and their soil profiles are constantly renewed by erosion. Typically shallow (< 50 cm depth) with a rocky surface and steep gradient, skeletal soils have little to no agricultural potential (classed 4 - 5) because of an almost total absence of chemical fertility.

The first category of skeletal soils is widespread in Lanjak-Entimau though comprising only about 13% of the land area and distributed in a patch from Sg Ensirieng south to Bukit Entimau. These soils are considered marginal for agricultural purposes because they occur on strongly dissected and often steep terrain, with high potential for erosion.

A second category of skeletal soils occurring on predominantly strongly dissected terrain is found where slopes are so steep that gravity continuously disrupts the formation of a soil profile. They include the Kapit-Merit soils of steep mountain slopes. These skeletal soils occupy 86% of the Lanjak-Entimau land area, have no agricultural potential and are best left under primary forest cover, as removal would greatly accelerate the process of soil movement (Sia, 1994).

4.0 FLORA

4.1 Background and methods

Lanjak-Entimau is sufficiently large in area to contain a highly significant component of Sarawak's total biological diversity. Virtually all of the Sanctuary is under forest cover, and although the appearance and structure of the forest might appear similar, the communities and ages of the vegetation vary considerably. Distribution of forest types in Lanjak-Entimau is given in **Map 8**.

Trees of the lowland and hill dipterocarp forests are generally small with a pole-like appearance, and large trees (DBH > 70 cm) comparatively fewer than in other parts of Sarawak. The forest is highly complex both between and within sites. There are altogether seven distinct vegetation formations in the Reserve (**Table 5**).

Mixed dipterocarp forest covers about 80% of the Sanctuary area, while montane forest occurs only on Bukit Lanjak. A detailed description of forest types and their composition is given in Chai (1995).

Table 5: Forest types of the Lanjak-Entimau Wildlife Sanctuary at three sites and their respective altitudes

Forest Type	Sengayoh	Entimau	Lanjak
1 Alluvial	150 m	165 m	-
2 Lowland Dipterocarp	250-400 m	310-410 m	600-700 m
3 Lowland Dipterocarp (poles)	-	200-250 m	-
4 Hill Dipterocarp	600-750 m	530-700 m	800-900 m
5 Summit Ridge	800-900 m	780-800 m	-
6 Submontane Mossy	-	-	1150 m
7 Montane Mossy	-	-	1250 m
8 Old Secondary	160 m	165 m	400-550 m

4.2 Floral diversity and abundance

4.2.1 General aspects

Numerous differences in species composition between sites leads to a high level of floral diversity for the Sanctuary as a whole. The richest flora occurs in lowland dipterocarp forest, followed by old secondary forest and hill dipterocarp forest. Submontane and montane habitats are much poorer in species.

From the study of these sites, the total number of tree species greater than 10 cm diameter identified from Lanjak-Entimau was 1075, while trees less than 10 cm diameter and non-trees totaled 786 and 179 respectively. Total number of species per habitat and other details are given in **Table 6**.

Table 6 : Total nos. of families, genera & species, densities and basal areas recorded from different forest types

Forest Types	Families	Genera	Species	Total No. Trees Recorded	Av. No. Trees/Ha	Mean Basal Area m ² ha ⁻¹
Alluvial	38	111	265	779	518	30.98
Lowland Dipterocarp	52	152	494	2,406	810	51.45
Old Secondary	53	144	376	1,324	588	35.65
Hill Dipterocarp	43	123	368	1,900	844	36.32
Summit Ridge	48	110	285	1,243	1,029	45.29
Submontane	40	73	123	436	968	53.65
Montane	33	55	93	498	1,106	40.79

Overall, Lanjak-Entimau has about 12% more genera and 30% more species than the forests of Mulu National Park. Hill dipterocarp forests in Lanjak-Entimau are almost 50% richer in species and approximately 50% higher in tree density than in Mulu (Chai, *et. al*, 1994).

The total number of species identified from Lambir Hills National Park (1086) is higher than that found in Lanjak-Entimau (Chai, *et. al*, 1994), since researchers in Lambir measured trees down to 1 cm in diameter. In Lanjak-Entimau, measurements of only trees greater than 10 cm in diameter were made, implying that there are potentially more species yet to be recorded.

Lanjak-Entimau, though admittedly larger in area, is also much richer in species and higher in tree densities compared to Sg Menyala and Pasoh Forest Reserve in Peninsular Malaysia.

The Dipterocarpaceae and Euphorbiaceae are dominant in the lowlands, while the Myrtaceae and Guttiferae increase in dominance with altitude. Myrtaceae become most abundant in summit ridge forest. The highest tree densities occurred in montane mossy forest and the lowest in alluvial forest. The main forest types are given below:-

4.2.2 Alluvial Forest (60 - 120 m asl.)

Alluvial forest (AF) occurs in low-lying areas and flood plains, ordinarily where the terrain is gentle. It is confined mostly to the northern areas of Lanjak-Entimau, and rather rare in ulu Engkari and ulu Batang Ai in the south. The canopy is from 22-26 m. high, and while structure and morphology may appear similar, species composition is usually different. The Dipterocarpaceae is the most common family of this habitat type, with an unusually high concentration of species from this family at the ulu Ensirieng site (27 species from four genera, with 18 species of *Shorea*). Emergent *tapang* trees (*Koompassia excelsa*) are relatively common. Distinct differences were evident between sites, as only four dipterocarp species were found at Sg Joh, even though the elevations are similar and the distance between sites not great.

The total number of species was 265 for all sites, with only 33 species from 18 families common to both Sg Ensirieng and Sg Joh. More than 50% of the total trees belonged to five families (Euphorbiaceae, Myrtaceae, Myristicaceae, Guttiferae and Lauraceae), while tree density in the two alluvial plots sampled ranged from 500-539 per ha. More than 90% of Sg Joh trees were less than 40 cm in diameter (Details are given in Tables 7 and 8)

Table 7 : The most common families in the Alluvial Forest

SG JOH				SG ENSIRIENG			
Family	Genus	Species	Trees	Family	Genus	Species	Trees per plot
Euphorbiaceae	10	23	58	Dipterocarpaceae	4	27	53
Lauraceae	6	10	28	Euphorbiaceae	11	23	64
Rubiaceae	6	7	24	Myrtaceae	1	14	27
Leguminosae	4	6	12	Myristicaceae	5	12	27
Sapindaceae	1	5	31	Lauraceae	5	10	30
Sapotaceae	1	5	23	Guttiferae	3	10	13
Elaeocarpaceae	1	5	13	Burseraceae	4	9	20
Moraceae	1	5	12				
Total	30	66	201	Total	33	105	264

Table 8 : Total nos. of taxa, trees and basal area from Alluvial Forest plots.

Figures in brackets show density/ha

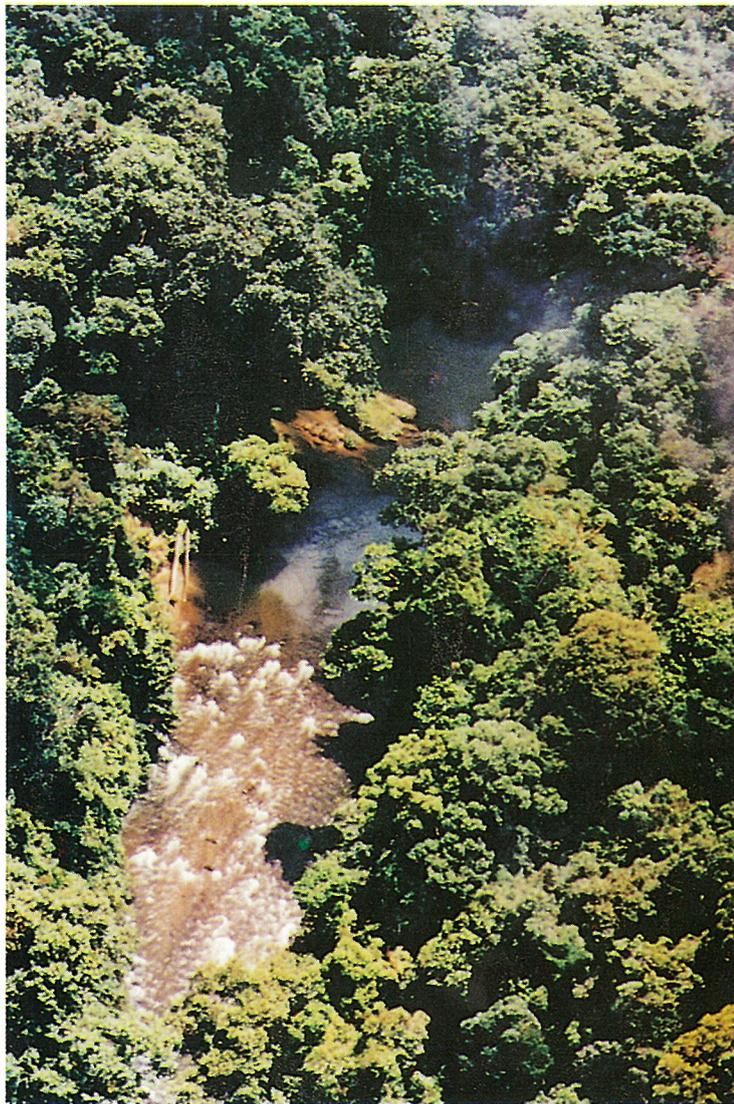
Locality	Sg Joh	Sg Ensirieng	Mean
No.			
Families	38	38	38
Genera	79	85	82
Species	132	161	147
Trees	375 (500)	404 (539)	389 (518)
Basal Area (m ² ha ⁻¹)	25.91	36.06	30.98

4.2.3 Lowland Dipterocarp Forest (200 - 410 m asl.)

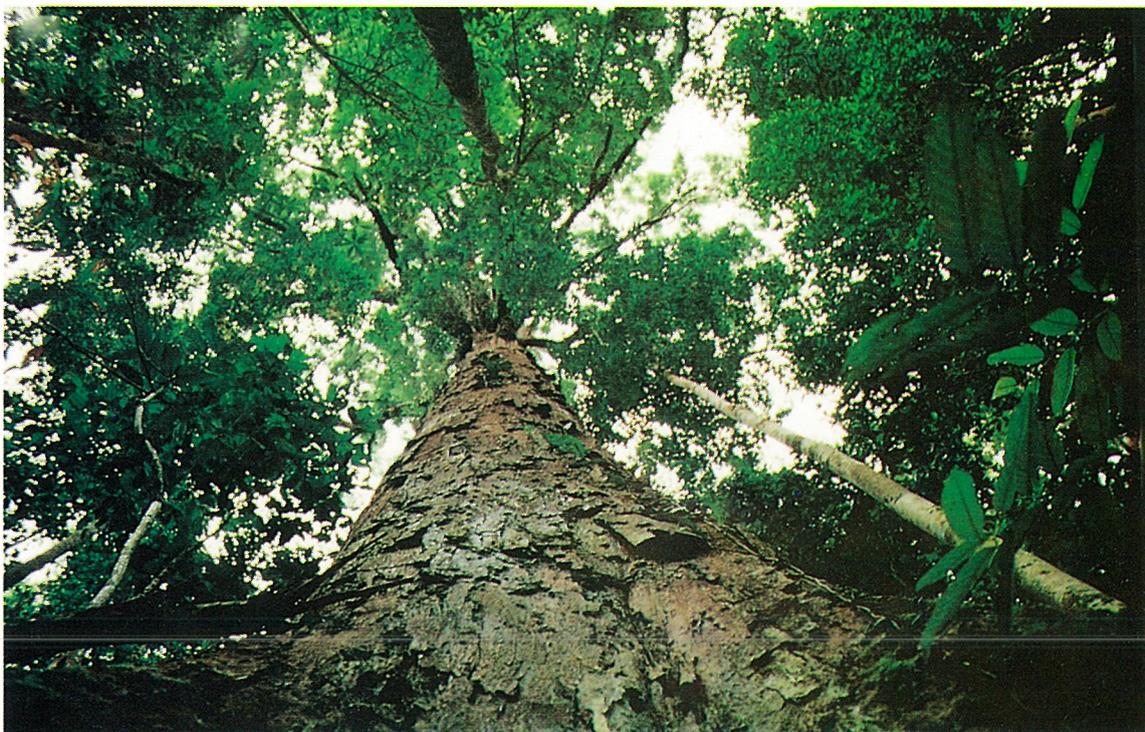
Lowland dipterocarp forest (LDF) is the most extensive forest formation in the Lanjak-Entimau Sanctuary, though rarely found below 200 m asl., since the forests of these lower elevations are almost entirely secondary (MAP 8). The LDF reaches its maximum elevation at approx. 700 m asl. on Bukit Lanjak, the site with the lowest number of genera and species.

Overall, dipterocarp species constitute at least 43% of the forest of the lower elevations (200-300 m), forming a major element of the second canopy layer at about 30 m from the ground (with an upper canopy height between 35-40 m). The largest trees though relatively few in number, exceed 100 cm in diameter. In fact, trees attaining breast-height diameters of 60 cm or greater comprise only about 3% of all LDF trees measured.

The most common trees include genera such as *Dipterocarpus*, *Shorea* (Plate 4), *Koompassia*, *Scaphium* and *Hydnocarpus*. The five most abundant families are the Euphorbiaceae, Dipterocarpaceae, Myristicaceae, Myrtaceae and Lauraceae. Altogether, a total of 52 families, 152 genera and 494 species were found, with the Euphorbiaceae and Dipterocarpaceae as the two dominant families, with a combined total of 119 species between them. Tree density (trees > 10cm dbh) at three lowland sites (Sengayoh, Entimau and Lanjak) range from 777-811 per ha. Only 17 tree species were common to all LDF plots. **Details are given in Table 9 and 10)**



P3 : The Latong River, interior of Lanjak-Entimau



P4 : A giant *Shorea* sp. in lowland dipterocarp forest near Bukit Entimau

Table 9 : Total nos. of taxa, tree populations and basal area in Lowland Dipterocarp Forest plots. Figures in brackets show density/ha.

Locality		Sengayoh	Entimau		Lanjak	Mean
			240 m	400 m		
No.						
Families		40	44	44	36	41
Genera		98	96	96	69	90
Species		197	215	192	147	188
Trees		604 (805)	608 (811)	583 (777)	636 (848)	608 (810)
Basal Area (m ² ha ⁻¹)	Total	51.20	42.94	64.23	47.44	51.45
	Dipts	16.39	16.12	20.65	28.65	20.49

Table 10 : Most common families from Lowland Dipterocarp Forest

Family	No. of Genera	No. of Species	Trees per plot
Euphorbiaceae	21	63	251
Dipterocarpaceae	6	56	587
Myristicaceae	5	30	169
Myrtaceae	1	26	134
Lauraceae	10	24	83
Burseraceae	3	24	140
Total no. of families = 52			
Total no. of genera = 152			
Total no. of species = 494			

4.2.4 Old Secondary Forest (120 - 200 m asl.)

Most of the dipterocarp forest at low elevations in Lanjak-Entimau has been affected by agricultural activities occurring over the past 100-150 years. Many longhouse communities, especially in the Katibas area, claimed to have resided in and around the Sanctuary for up to 180 years. The Lanjak Entimau old secondary forests (OSF) are estimated to be from 80-130 years in age, and are similar in appearance to mature natural forest. However, canopy height varies considerably (25-38 m) and the ten most common families are all non-dipterocarps.

The Euphorbiaceae are dominant, while only 4-9 species of the Dipterocarpaceae can be found at any one site. Tree diameters are small, and 95% of trees are less than 40 cm in diameter. Less than 3% exceed 60 cm. The species total is 376, with from 528-625 trees at any one site. Only 20 species are common to all three secondary forest sites. Also, the

undergrowth in this habitat type is dense and floristically rich, with many palms and climbers. Details for this forest type are summarised in **Tables 11 & 12**.

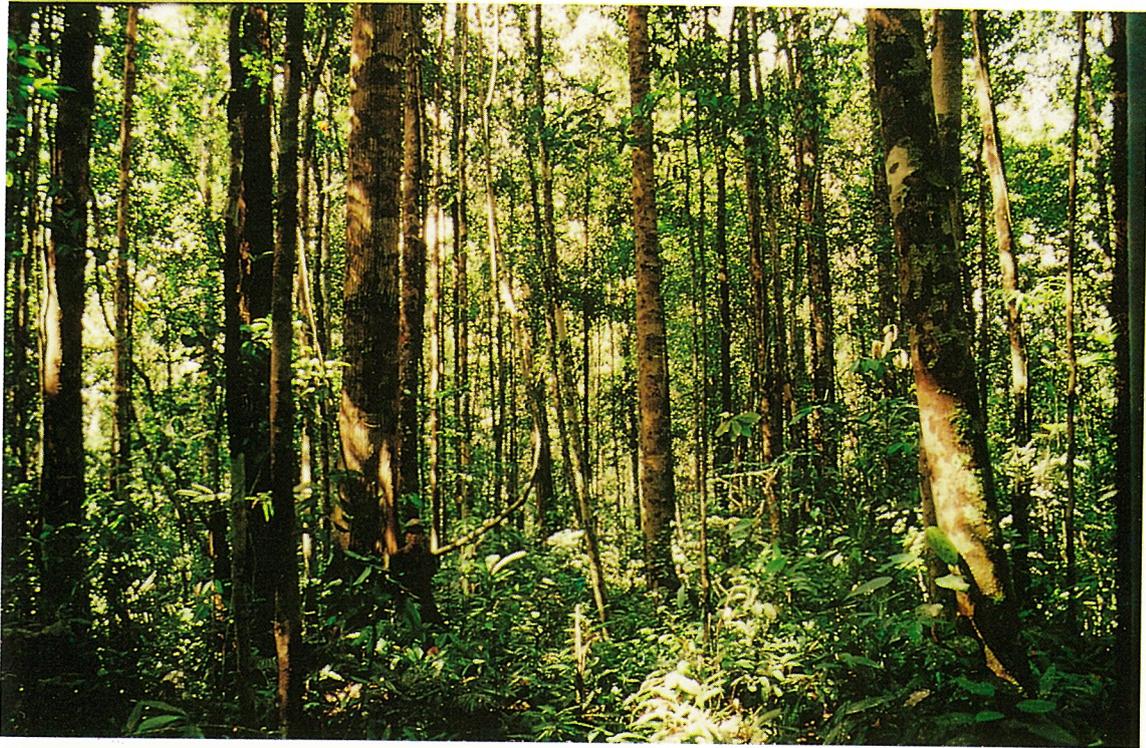
Table 11: Total nos. of taxa, trees and basal area in Old Secondary Forest plots.
Figures in brackets show density/ha

Locality		Segurugoh	Tekalit	Jela	Mean
No.					
Families		43	41	40	41
Genera		97	83	79	86
Species		167	167	146	160
Trees		396 (528)	469 (625)	457 (609)	441 (588)
Basal Area	Total	26.22	40.86	30.44	32.50
(m ² ha ⁻¹)	Dipts	1.12	6.46	4.06	3.82

Table 12 : The most common families in old secondary forest. The seven most common families in the forest are indicated by *

Family	Segurugoh			Tekalit			Jela		
	Genus	Spp	Trees	Genus	Spp	Trees	Genus	Spp	Trees per plot
Euphorbiaceae*	14	27	53	9	21	81	8	16	89
Myrtaceae*	1	12	24	2	21	38	2	17	50
Lauraceae*	8	9	49	6	8	19	2	10	20
Annonaceae	2	9	15	1	5	13	1	3	5
Guttiferae*	4	8	12	2	5	8	4	13	45
Myristicaceae*	4	6	16	4	11	18	2	5	7
Anacardiaceae	4	5	6	4	8	16	3	4	5
Burseraceae*	3	4	4	2	9	19	3	10	31
Fagaceae	2	3	8	1	6	9	3	6	7
Dipterocarpaceae*	3	3	7	4	9	27	2	4	38
TOTAL	49	95	214	38	108	255	32	90	302

In late 1994, residents of ulu Engkari reported to Sarawak Forest Department staff that local flowers of the giant *Rafflesia* (**Plate 6**) were blooming at the edge of a farming plot near the Lanjak-Entimau boundary, ulu Segerak, about two hours walk from the LEWS Base Camp. One flower and six buds were subsequently found on 23 March, 1995 (Tan, 1995).



P5 : Pole Forest on a Bukit Entimau ridge



P6 : The giant Rafflesia flower (*Rafflesia* cf. *keithii*) from ulu Engkari

Residents of the last longhouse (Rumah Lenggang) in ulu Engkari reported several sites within the Sanctuary (Emperan Lallang, Emperan Sarugar and Batu Galan) where *Rafflesia* had last been seen in flower in 1990-1991. No buds were found, though the host plant was present. The species of *Rafflesia* has been identified tentatively as a variety of *Rafflesia keithii*, one of the largest members of the species.

4.2.5 Dipterocarp Forest (530 - 900 m asl.)

Hill dipterocarp forest (HDF) occurs at elevations from 530-900 m asl. in Lanjak-Entimau, and has the same structure as lowland dipterocarp forest except for a more distinctly pole appearance (Plate 5). At least 70% of trees are below 30 cm in diameter. .

Dipterocarp seedlings are abundant in the understorey, under a main canopy from 24-28 m high. The five most common families are the Dipterocarpaceae, Euphorbiaceae, Guttiferae, Myrtaceae, and Myristicaceae. As in lowland dipterocarp forest, the Euphorbiaceae and Dipterocarpaceae are dominant (78 species). The total species found numbered 368, with 43 species of dipterocarps.

Bukit Lanjak has a higher tree density (940 per ha) but fewer genera and species. Elsewhere, in Sengayoh and Entimau, tree densities range between approximately 746-828 per ha . A summary is given in Tables 13 and 14.

Table 13: Total nos. of taxa, trees and basal area from Hill Dipterocarp Forest plots

No.	Locality	Sengayoh	Entimau	Lanjak	Mean
Families		30	35	38	41
Genera		85	71	64	90
Species		178	177		188
Trees		621 (828)*	574 (746)	705 (940)	608 (810)
Basal Area (m ² ha ⁻¹)	Total	57.33	55.50	51.14	51.45
	Dipts	29.39	24.93	13.26	20.49

* Figures in brackets show density/ha.

Table 14: Five most common families in Hill Lowland Dipterocarp Forest with total numbers of families, genera and species

Rank	Family	No. of Genera	No. of Species	Trees per plot
1	Dipterocarpaceae	7	43	553
2	Euphorbiaceae	15	35	113
3	Guttiferae	4	27	113
4	Myrtaceae	1	26	170
5	Myristicaceae	4	21	118
Total no. of families = 43				
Total no. of general = 123				
Total no. of species = 368				

4.2.6 Summit Ridge Forest (850-990 m asl.)

Summit ridge forest is a pole forest surveyed on steep narrow ridges in Bukit Sengayoh and Bukit Entimau. It differs substantially from the mossy submontane and montane forests of Bukit Lanjak, and thus a different terminology has been used.

These forests are unable to retain moisture because of constant exposure to direct sun and to wind currents with resulting high rates of evapo-transpiration. Trees are tall and slender, forming a canopy at approximately 25 m above the ground. The five most common families were the Myrtaceae, Euphorbiaceae, Guttiferae, Dipterocarpaceae and Anacardiaceae. Tree densities were comparable to other areas of dipterocarp forest.

The understorey contains rattan seedlings, small palms, ginger plants and ferns. Herbs (*Sonerila* sp) and orchids (including *Bulbophyllum lowii*) are common. Details for this forest type are summarised in Tables 15 & 16.

Table 15: Numbers of families, genera, species density and basal area from Summit Ridge Forest * No at 0.75 ha

No.	Locality	Sengayoh	Entimau	Mean
	Families		41	37
Genera		86	71	79
Species		173	152	163
Trees		495 (788)*	756*	716*
Basal Area (m ² ha ⁻¹)	Total	55.56	35.02	45.29
	Dipts	12.28	2.49	7.38

Table 16: The most common families in Summit Ridge Forest with total nos. of families, genera and species

Rank	Family	No. of Genera	No. of Species	Trees per plot
1	Myrtaceae	2	29	216
2	Euphorbiaceae	13	22	52
3	Guttiferae	4	20	58
4	Dipterocarpaceae	3	20	135
5	Anacardiaceae	8	17	58
6	Fagaceae	3	17	169
Total no. of families = 48				
Total no. of general = 110				
Total no. of species = 285				

4.2.7 Submontane Mossy Forest (approximately 1000 m asl.)

Submontane mossy forest is restricted to the Bukit Lanjak area, from Ubah Ribu ridge on the northeastern side, running northwest to Bukit Lanjak Mit and onto Bukit Peninjau, and grades into montane forest at elevations above 1000 m. Canopy height is generally 20-25 m, with emergents of *Shorea longifolia* and *Shorea obscura*. There is more tree diversity (families, genera and species), but lower population densities than in the montane forest. There are few dipterocarps, and the dominant families are the Myrtaceae, Guttiferae and Lauraceae. A summary is given in Table 17.

Table 17 : The most common families in Submontane Forest with a total no. of families, genera and species

Rank	Family	No. of Genera	No. of Species	Trees per plot
1	Myrtaceae	1	14	48
2	Guttiferae	3	11	75
3	Euphorbiaceae	6	8	11
4	Lauraceae	3	6	26
5	Dipterocarpaceae	3	6	24
Total no. of families = 40				
Total no. of general = 73 Basal area = 53.653 m ² ha ⁻¹				
Total no. of species = 123				

4.2.8 Montane Mossy Forest (1100 - 1250 m asl.)

This is the stunted forest found primarily on Bukit Lanjak, growing mainly in flatter areas. The canopy height is mostly less than 20 m and almost 90% of the trees are less than 30 cm in diameter. All are encased in water-saturated mosses, and the dominant families are the Myrtaceae, Guttiferae, Lauraceae, Elaeocarpaceae and Fagaceae. In total numbers of trees, the Euphorbiaceae are the most common. Total numbers of species are about 25% less than in submontane forest.

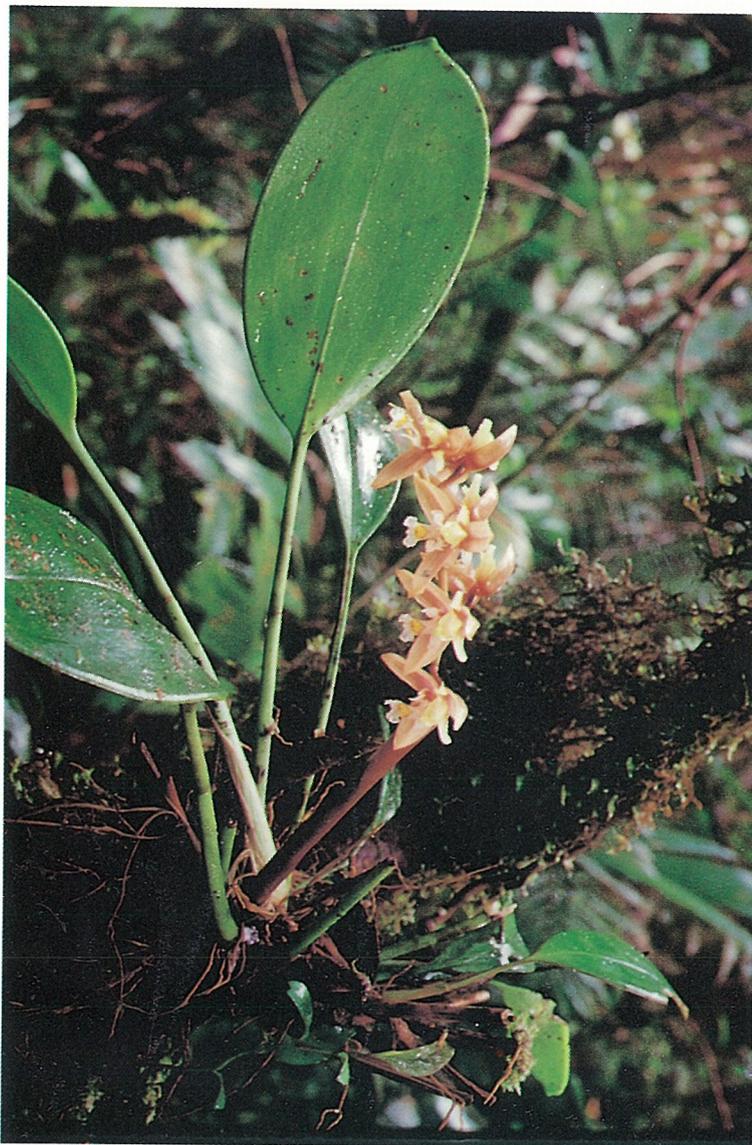
The ground flora is rich, and includes palms, gingers, ferns, herbs of the Rubiaceae and Melastomataceae, pandans, orchids (Plate 7) and abundant *Nepenthes* (Plate 8). Details are summarised in Table 18.

Table 18 : The most common families in Montane Forest with a total no. of families, genera, species and basal area

Rank	Family	No. of Genera	No. of Species	Trees per plot
1	Myrtaceae	1	12	58
2	Guttiferae	2	9	63
3	Lauraceae	6	8	27
4	Elaeocarpaceae	1	6	24
5	Fagaceae	3	4	17
Total no. of families = 33				
Total no. of general = 55 Basal area = 40.79 m ² ha ⁻¹				
Total no. of species = 93				

4.3 Medicinal and other plants of traditional use

Approximately 140 different kinds of plants for treating a variety of internal and external ailments were described from Lanjak-Entimau by traditional medical practitioners from the Kedayan, Lun Bawang and Iban communities. Plants with non-medicinal use such as in dye making were also identified (Appendix IV)



P7 : Orchid (*Chelonistele amplissima* var. *schweinsurthiana*) in mossy forest, Bukit Lanjak



P8 : *Nepenthes tentaculata*, a pitcher plant of Montane forest, Bukit Lanjak

4.4 Fruit trees and vegetables

Residents from areas adjacent to Lanjak-Entimau reported that they consumed over 114 varieties of wild fruits, and at least 36 varieties of jungle vegetables. Fruit producing trees used by local people are primarily from the Families Euphorbiaceae (principally *Baccaurea*), Leguminosae (principally *Dialium*), Moraceae (principally *Artocarpus*), and Sapindaceae (principally *Nephelium*). The Palmae and the Zingiberaceae are the two most important non-tree families producing edible fruits. Popular vegetables are produced mainly from palm and rattan shoots, and gingers.

Lanjak-Entimau also contains genetic stocks of important fruit species including *Artocarpus* (*nangka*, *cempedak*), *Baccaurea* (*tampoi*), *Dacryodes* (*kemayau*), *Canarium* (*dabai*) and *Garcinia* (*mangosteen*), to name just a few.

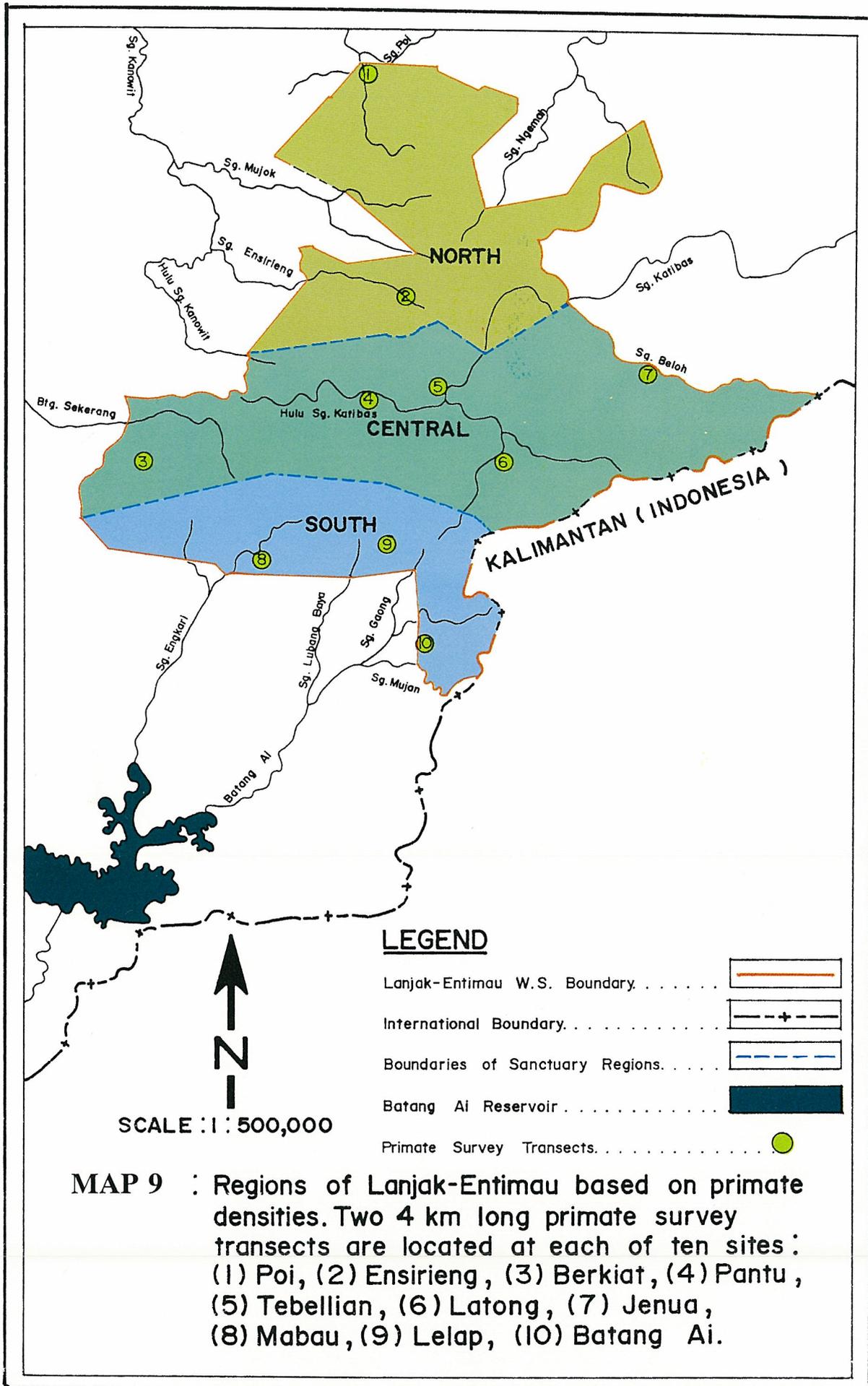
5.0 FAUNA

5.1 Primates

The Lanjak-Entimau forests have been known to possess a rich primate community for many years. In a faunal survey of Batang Ai, a total of 35 mammal species were reported, of which six were primates (Meredith, 1993; **Appendix V**). Identification of the ulu Batang Ai, contiguous with Lanjak-Entimau, as an important area of orangutan (*Pongo pygmaeus*) abundance was made as early as 1960 (Schaller, 1961).

Of 11 species of higher primates known to occur in Borneo, six of these are found in Lanjak-Entimau. In addition, the Sanctuary is also home to two primitive primates, the slow loris (*Nycticebus coucang*) and the western tarsier (*Tarsius bancanus*), though these nocturnal species were not surveyed during the present project.

Ten sites in the North, Central and South regions of Lanjak-Entimau were chosen to represent the range of altitudes, forest types and degrees of human activity to be found within the Sanctuary (**Map 9**). At each site, two transects each 4 km long were cleared and marked at 25 m intervals.



Surveys were performed by the ITTO Consultant or by Officers of the National Parks and Wildlife Section of the Sarawak Forest Department, totaling 1568.6 km over a period of 8 months. All primates seen or heard were recorded, and field data analysed via the computer programme Transect 2.2.

In addition, all fruit trees which were reported to be important to the orangutan diet, and greater than 10 cm Diameter Breast Height (DBH) were counted along a belt extending 10 m on each side of the transect. Details of all survey techniques are given in the ITTO Consultant's report (Blouch, 1994)

Incidental sightings of bird species such as the Great Argus (*Argusianus argus*) and hornbills (Bucerotidae) were also recorded and the data turned over to the ITTO Ornithologist. For purposes of comparison, the Sanctuary was divided into three zones (Figure 8)

5.2 Orangutan (*Pongo pygmaeus*)

5.2.1 Densities

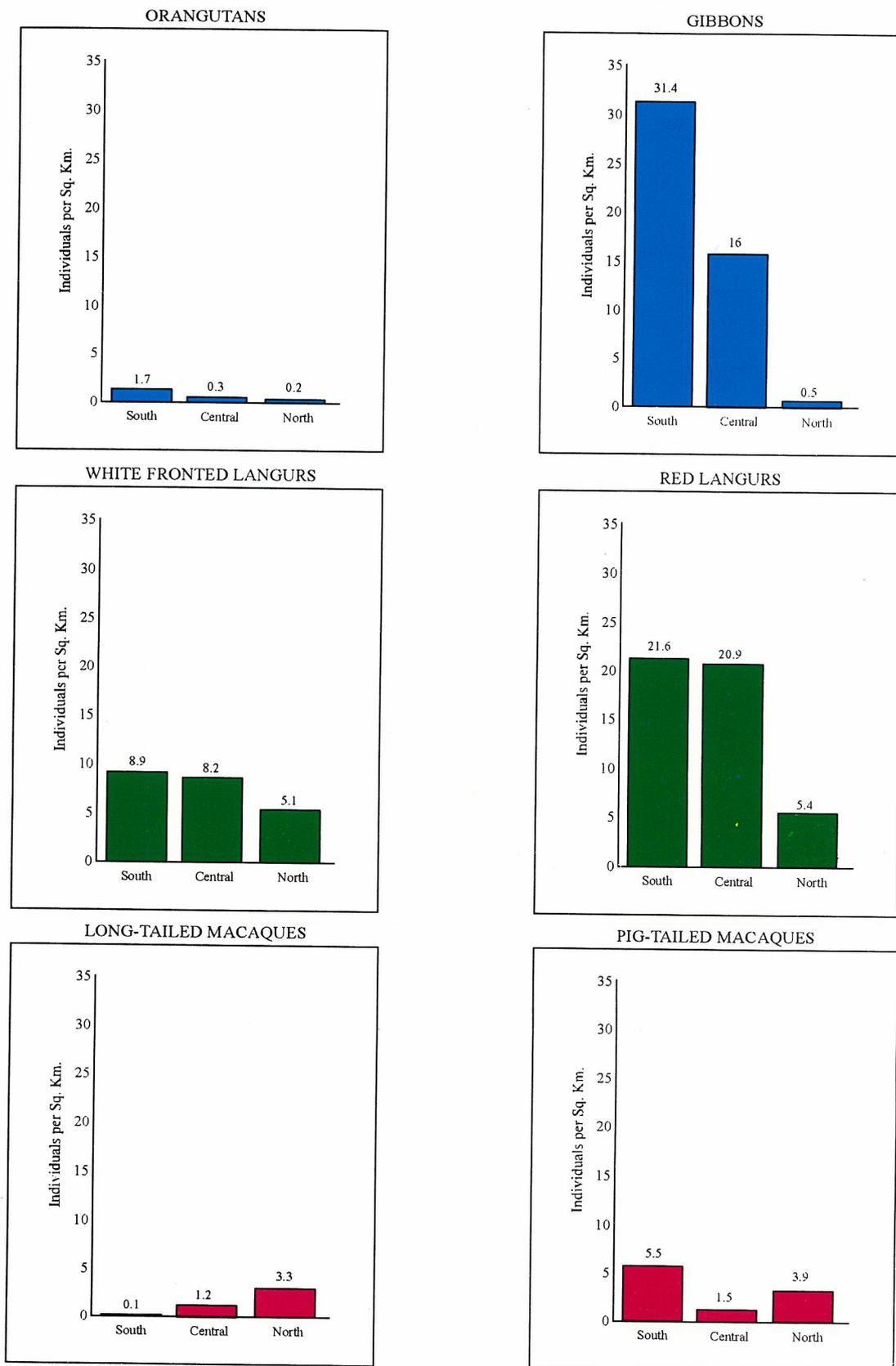
Comparative densities of primate species in Lanjak Entimau are shown in Figure 1 and given in detail in Appendix VI. Orangutans (Plate 9) are the least common primate in the Sanctuary, and were sighted only 27 times during the surveys. Orangutan densities were highest in the South (1.09 groups/km² or 1.73 individuals/km²), intermediate in the Central region and lowest in the North (0.13 groups/km²). The highest density of orangutan nests (151.6/km²) was found at approximately 500-800 m asl., while the population estimate for orangutans in the Sanctuary was slightly more than 1000 animals. Densities varied between sites, with the highest at Sg Lelap, and the lowest (none) at Sg Poi.

5.2.2 Correlation with fruit tree abundance

A total of 62 species from 39 genera of fruit trees were counted, of which eight genera (*Durio*, *Baccaurea*, *Castanopsis*, *Lithocarpus*, *Garcinia*, *Artocarpus*, *Ficus* and *Nephelium*) were selected as especially important for orangutan nutrition. Within the South region of the Sanctuary, the highest densities of orangutans were positively correlated ($r = 0.61$) with fruit tree density (Figure 2, Appendix VII). The overall

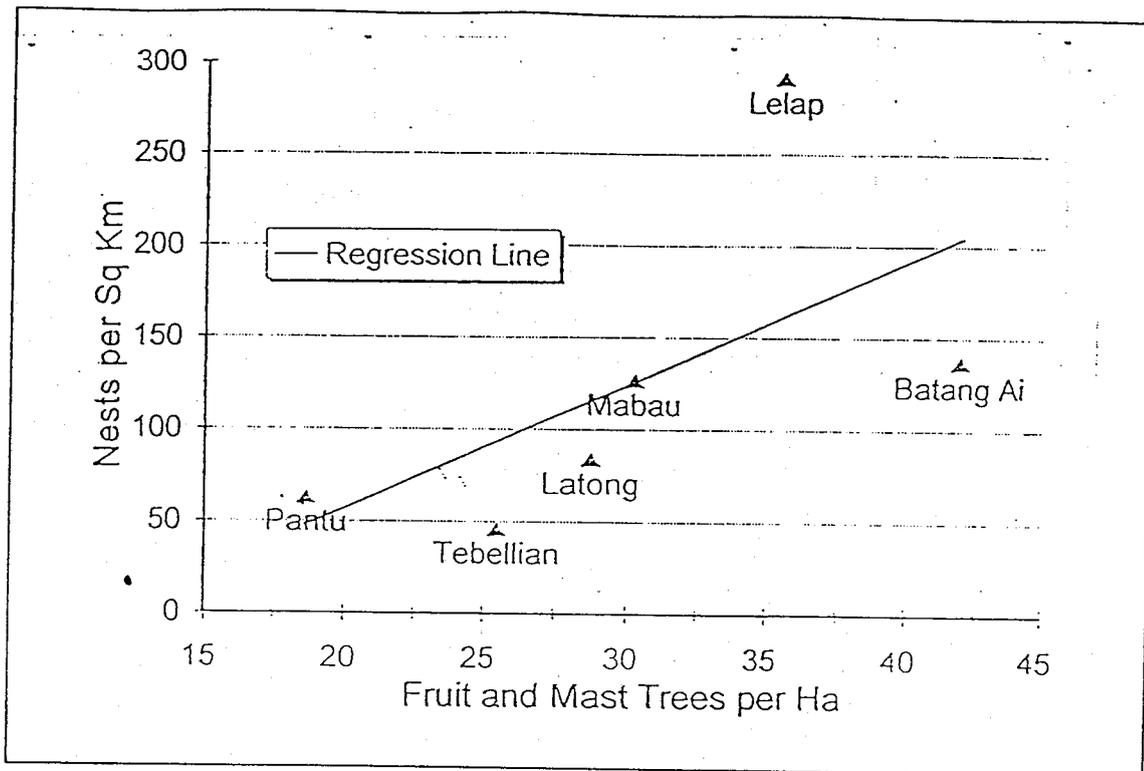
Figure 1

Primate Densities in Regions of Lanjak Entimau



picture of Lanjak-Entimau that emerges is that the Sanctuary is a marginal to fair orangutan habitat possibly because of the paucity of fruit trees in all but one of its regions.

FIGURE 2.: DENSITIES OF ORANGUTAN NESTS AND EIGHT GENERA OF FRUIT TREES



5.2.3 Illegal hunting of orangutans

There was little evidence of widespread hunting of orangutans, and virtually every hunter interviewed claimed he would not kill such an animal. Nevertheless in September-October 1993, orangutan parts were discovered in three separate areas, providing some proof that some orangutans are killed by hunters. Unfortunately, even a low rate of hunting can be a serious problem since birth intervals in orangutans can average as long as eight years (Galdikas and Wood, 1990).

Field observations support the view that if orangutans are few despite an apparent abundance of fruit trees, hunting is likely to be the problem. This situation applies to the Tebellian, Latong and Batang Ai sites. Nevertheless, Schaller's (1961) assessment of the Lanjak-Entimau/Batang Ai area 35 years ago suggested that orangutan populations even

then, were considered sparse, indicating that habitat quality rather than hunting may be the deciding factor in determining abundance. Thus, even if hunting were to cease entirely, Sanctuary managers should not anticipate any dramatic increase in orangutan densities.

5.2.4 Viability of the orangutan population

Even though small populations of vertebrate animals can face a high probability of extinction, the 1000 or so resident Lanjak-Entimau orangutans are part of a larger population extending both into the Batang Ai National Park where there are probably about 300 animals and the vast Gunung Bentuang-Karimun Nature Reserve with probably at least several hundred more individuals. The consolidation of these three geographical entities in late 1994, into the Lanjak-Entimau Bentuang-Karimun Biodiversity Conservation Area is a major accomplishment towards promoting the survival of the orangutan in western Borneo.

5.2.5 Rehabilitation of captive animals

The existence of a viable population of orangutans in Lanjak-Entimau makes it unnecessary and unwise to consider reintroduction of captive orangutans into the Sanctuary. Because the resident populations are probably at or near the carrying capacity of the forest environment, such introductions are likely to create competition for resources between residents and the newcomers, with potential negative effects. This fact in addition to the possibility of introducing disease from the outside, and the lack of veterinary and other support facilities for a rehabilitation programme, make consideration of the latter not advisable. Orangutans introduced from outside the Sanctuary pose the risk of causing instability in the resident population.

5.3 Bornean Gibbon (*Hylobates muelleri*)

5.3.1 Densities

Gibbons were the primate species most frequently encountered during surveys. The population of Bornean gibbons in the Sanctuary probably numbers more than 24,000, with densities of 10.2 groups/km² in the South, 5.2 groups/km² in the Central region, and only 0.2 groups/km² in the North (Overall the density is about 4.3 groups/km²). The

overall figure is considerably higher than that reported for Batang Ai National Park (1.7 groups/km²; Meredith, 1993).

In fact, the southern Lanjak-Entimau populations possess the highest density currently known for Bornean gibbons. MacKinnon (1977) reported a density of 10.5 groups/km² in ulu Segama, Sabah, but this figure was revised downwards to 5.3 groups/km² by Johns (1992) working subsequently in primary forest in the same area.

5.3.2 Correlation with fruit tree abundance

The relatively sparse densities of gibbons in the North region of Lanjak-Entimau, similar to the trend for orangutan distribution in the Sanctuary, may be caused by a low density of fruit trees. Nevertheless, the present surveys concentrated on fruits important to orangutans, who have only partial dietary overlap with gibbons.

Another explanation may be needed, particularly since surveys showed that numbers of trees of the genera *Ficus* and *Artocarpus*, supposedly key food sources for gibbons (Bennett, *et al.*, in prep.), are low in the South where gibbon densities are highest.

5.4 Langurs (*Presbytis* sp.)

5.4.1 Densities of Maroon langurs

Population densities for langurs in three regions of Lanjak-Entimau are shown in **Figure 9**. The estimate for the maroon langurs (*Presbytis rubicunda*) was 28,400, or about 3.5 groups/km². This figure is from 25-75% higher than that reported for Barito Ulu, Central Kalimantan (Bodmer, *et al.*, 1991) and Batang Ai National Park (Meredith, 1993) respectively. This species occurred at significantly higher densities in the Central and South regions than in the North.

5.4.2 Densities of White-Fronted langurs

The population of white-fronted langurs (*Presbytis frontata*) was estimated at 13,400, or 1.7 groups/km². This figure exceeds that thought to represent the approximate existing total population level (10,600) for all Indonesian Reserves. The density reported for

Batang Ai National Park (Meredith, 1993) was slightly lower than for Lanjak-Entimau, at about 1.2 groups/km².

The density of white-fronted langurs appears to be uniform throughout the three regions surveyed. Both species were least common in the North, however.

MacKinnon (1987) regarded the status of the white-fronted langur as vulnerable because of restricted range and relatively low densities, and because the animals are hunted for food. The Lanjak-Entimau population is thus significant for the long-term survival of this species.

5.4.3 Illegal hunting and population density

Since intensity of hunting does not appear to be correlated with langur abundance in Lanjak-Entimau, habitat quality in the form of food availability is likely to be the main factor controlling size of langur populations.

5.5 Monkeys (*Macaca* sp.)

5.5.1 Densities of pig-tailed and long-tailed macaques

For monkeys, neither the pig-tailed macaque (*Macaca nemestrina*) nor the long-tailed macaque (*Macaca fascicularis*) were common in Lanjak-Entimau, though the data suggest that the latter is more abundant in the North, while the former is more common in the South (**Figure 1**).

Our small sample of observation of Macaques in the Sanctuary makes it difficult to draw any conclusions concerning the reasons for their existing distributions. These monkeys may be more attracted to disturbed areas and are abundant outside protected areas. Therefore they are not really of special management concern in Lanjak-Entimau.

5.6 Birds

5.6.1 Background

The lowland and hill dipterocarp forests of Lanjak-Entimau form an important refuge for the at least two-thirds of the known resident avifauna of Sarawak. An earlier Lanjak-Entimau expedition listed a total of 165 bird species from the Sanctuary area (World Wildlife Fund, 1982).

Observations of birds and mist netting were carried out over a period of 13 months at nine different locations throughout the Sanctuary (ulu Engkari, Bukit Lanjak, Sg Jelak, ulu Mujok, ulu **Menyarin**, ulu Ensirieng, Sg Serembuang, Sg Lelap and Sg Beloh). Bird rings with the address of the Sarawak Forest Department were made and placed on 1709 birds from 113 species.

5.6.2 Diversity and abundance

A total of 213 species were found in the Lanjak-Entimau, comprising 203 resident Sarawak species and 10 migrants. This represents 53% of Sarawak's resident avifauna. The avifauna by family is given in **Table 19**. About 45% of the Bornean endemics found in Sarawak, or 13 of 29 species, were recorded in Lanjak-Entimau (**Plates 10 & 11; Table 20**). A complete list of the Lanjak-Entimau avifauna is given in **Appendix VIII**.

5.6.3 Importance of the avifauna to the forest

Ecologically, about 80% of the Sanctuary's birds are dependent on trees either for foraging, nesting or both, while seven percent depend on hill streams and rivers. The remaining species (13%) exploit a wide variety of habitats or are passage migrants.

While the bird fauna of Lanjak-Entimau presents a wide array of foraging habits, most birds (93%) partially or completely depend on a diet of insects. A total of 114 species from the Sanctuary were exclusively dependent on insects.

Fruits are taken by about 32% of the Sanctuary's birds, while around 20 % feed on small vertebrates. Even though the percentage of exclusively frugivorous (*e.g.*, fruit eating) species is relatively small compared to the number of insectivores, the amount of biomass consumed in the form of fruit is enormous because many of the frugivores are of large size or feed in flocks, such as hornbills and pigeons. Major diet components of Lanjak-Entimau birds are given in **Table 21**.

Through their feeding activities, Lanjak-Entimau birds contribute to four important ecological processes within the forest ecosystem; pollination, seed dispersal, nutrient enrichment and biological control of insects.

A substantial number of flowering plants of the forest require visits by birds for pollination. Some relationships have existed for such a long time that flowers (*e.g.*, of the Loranthaceae) have developed special structures to attract particular bird species in order to ensure pollination (primarily sunbirds and spiderhunters).

Frugivorous birds (*e.g.*, hornbills, pigeons, bulbuls) are crucial dispersal agents for fruit trees, promoting germination and dropping seeds far from parent trees, under the shade of which seedlings are unlikely to survive otherwise because of invertebrate predation.

Literally tons of nutrients rain down daily into the Lanjak-Entimau forest in the form of bird droppings. This easily absorbed source of nitrogen and phosphate plays an important role in the ecosystem's nutrient recycling.

Since more than 90% of the Sanctuary's bird species consume insects as at least a portion of their diet, the rôle of birds as controllers of insect populations is an important one. Caterpillars or flying insects are exploited, thus keeping insect populations in check.

Table 19

Familywise listing of the resident birds of Sarawak recorded from Lanjak-Entimau Wildlife Sanctuary

Family Name	Number of Resident Species Recorded		Percentage of the State List
	In the whole of Sarawak	in LEWS	
Anhingidae	1	1	100
Ardeidae	6	1	17
Accipitridae	16	6	38
Falconidae	4	1	25
Phasianidae	11	5	45
Columbidae	15	6	40
Psittacidae	3	2	67
Cuculidae	20	12	60
Titonidae	1	1	100
Strigidae	9	4	44
Caprimulgidae	3	1	33
Apodidae	10	5	50
Hemiprocnidae	2	2	100
Trogonidae	6	4	67
Alcedinidae	10	6	70
Meropidae	2	2	100
Bucerotidae	8	7	88
Capitonidae	9	8	89
Indicatoridae	1	1	100
Picidae	16	11	69
Eurylaimidae	8	6	75
Pittidae	7	5	71
Hirundinidae	1	1	100
Campephagidae	11	3	27
Aegithinidae	6	5	83
Pycnonotidae	22	16	82
Dicruridae	4	2	50
Oriolidae	4	1	25
Corvidae	6	2	33
Sittidae	1	1	100
Timaliidae	36	27	75
Turdidae	9	6	67
Sylviidae	11	5	45
Muscicapidae	26	17	65
Sturnidae	3	1	33
Prionopidae	1	1	100
Nectariniidae	17	12	71
Dicaeidae	12	5	42
Ploceidae	6	1	17
All species	380	202	53

Note : 10 species of non-residents (migrants) recorded from LEWS are excluded.

ENDEMIC BIRDS OF BORNEO

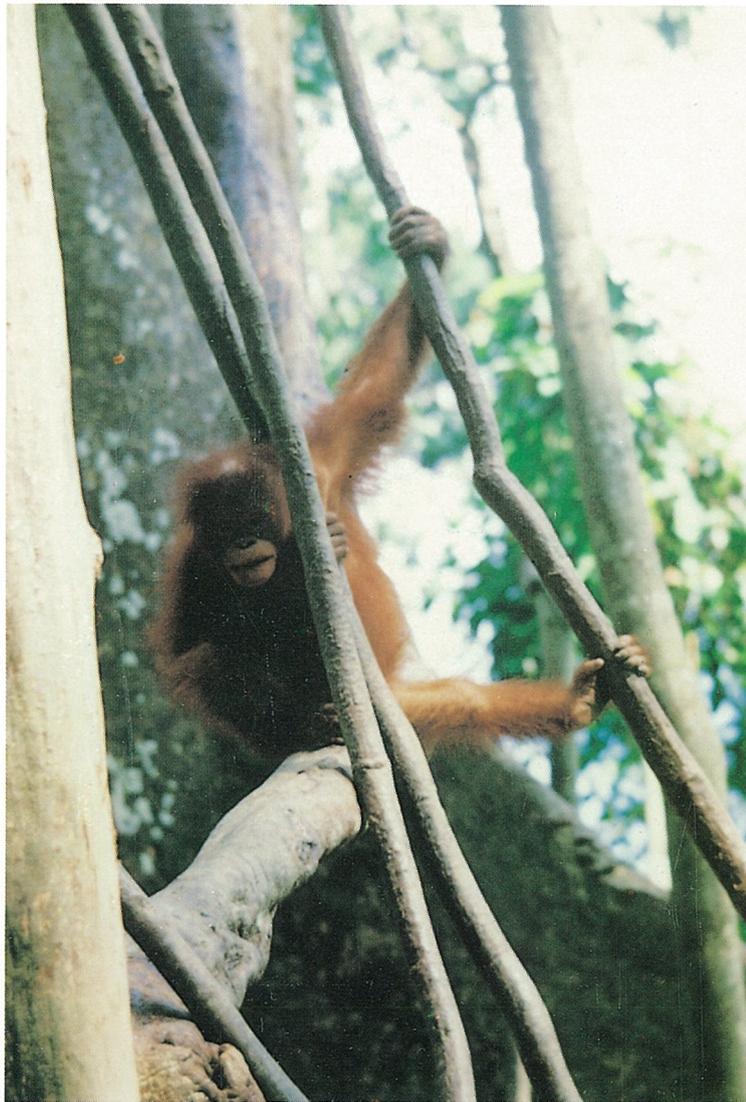
Scientific Name		Common Name	Recorded in LEWS
1	<i>Microhierax latifrons</i>	Whitefronted Falconet	
2	<i>Arborophila hyperythra</i>	Redbreasted Tree Partridge	
3	<i>Haematortyx sanguiniceps</i>	Crimsonheaded Wood Partridge	X
4	<i>Lophura bulweri</i>	Bulwer's Pheasant	X
5	<i>Batrachostomus harterti</i>	Dulit Frogmouth	
6	<i>Harpactes whiteheadi</i>	Whitehead's Trogon	
7	<i>Megalaima eximia</i>	Blackthroated Barbet	X
8	<i>M. monticola</i>	Mountain Barbet	
9	<i>M. pulcherrima</i>	Golden-naped Barbet	X
10	<i>Calyptomena hosei</i>	Hose's Broadbill	X
11	<i>C. whiteheadi</i>	Whitehead's Broadbill	
12	<i>Pitta arquata</i>	Bluebanded Pitta	X
13	<i>P. baudi</i>	Blueheaded Pitta	X
14	<i>Oriolus hosei</i>	Black Oriole	
15	<i>Chlamydochaera jefferyi</i>	Blackbreasted Triller	
16	<i>Zoothera everetti</i>	Everett's Ground Thrush	
17	<i>Ptilocichla leucogrammica</i>	Bornean Wren-Babbler	X
18	<i>Napothera atrigularis</i>	Blackthroated Wren-Babbler	X
19	<i>N. crassa</i>	Mountain Wren-Babbler	
20	<i>Cettia whiteheadi</i>	Short-tailed Bush Warbler	
21	<i>Bradypterus accentor</i>	Kinabalu Friendly Warbler	
22	<i>Muscicapa superba</i>	Bornean Blue Flycatcher	X
23	<i>Pachycephala hypoxantha</i>	Bornean Mountain Whistler	
24	<i>Prionochilus xanthopygius</i>	Yellowrumped Flowerpecker	X
25	<i>Arachnothera juliae</i>	Whitehead's Spiderhunter	
26	<i>Oculocincta squamifrons</i>	Pygmy White-eye	
27	<i>Chlorocharis emiliae</i>	Mountain Blackeye	
28	<i>Pityriasis gymnocephala</i>	Bornean Bristlehead	X
29	<i>Lonchura fuscans</i>	Dusky Munia	X

* only this species is not found in Sarawak

TABLE 21

**Feeding Habits of the forest birds of the Sanctuary
(non-aquatic birds, nectarinidae and flowerpeckers)**

Family	Examples	Number of species	Feeds on significant quantities of			
			Insects	Herpeto-fauna	Birds/rodents	Fruits/seeds
<i>Accipitridae</i>	Eagles	4		/	/	
<i>Falconidae</i>	Falconet	1	/	/	/	
<i>Phasianidae</i>	Partridges, Pheasants	5	/	/		/
<i>Columbidae</i>	Pigeons	5				/
<i>Columbidae</i>	Dove	1	/			/
<i>Psittacidae</i>	Parrots	2				/
<i>Cuculidae</i>	Cuckoos	7	/	/		/
<i>Cuculidae</i>	Malkohas, coucal	5	/	/		
<i>Tytonidae</i>	Bay Owl	1	/	/	/	
<i>Strigidae</i>	Owls	4	/(2)	/	/(3)	
<i>Caprimulgidae</i>	Nightjars	1	/			
<i>Apodidae</i>	Swifts	7	/			
<i>Trogonidae</i>	Trogons	4	/			
<i>Alcedinidae</i>	Kingfisher	1	/			
<i>Meropidae</i>	Bee-eaters	2	/			
<i>Bucerotidae</i>	Hornbills	7	/	/	/	/
<i>Capitoridae</i>	Barbets	8	/			/
<i>Indicatoridae</i>	Honeyguide	1	/			
<i>Picidae</i>	Woodpeckers	12	/			
<i>Eurylaimidae</i>	Broadbills	6	/(4)			/(2)
<i>Pittidae</i>	Pittas	5	/			
<i>Hirundinidae</i>	Swallows	2	/			
<i>Campephagidae</i>	Cuckoo-shrikes Minivets	3	/			
<i>Aegithinidae</i>	Iora, leafbirds, Fairy bluebird	5	/			/
<i>Pycnonotidae</i>	Bulbuls	16	/			/
<i>Dicruridae</i>	Drongos	3	/			
<i>Oriolidae</i>	Orioles	1	/			/
<i>Corvidae</i>	Crested Jay	1	/			
<i>Corvidae</i>	Magpies	1	/	/	/	/
<i>Sittidae</i>	Nuthatches	1	/			
<i>Timaliidae</i>	Babblers	27	/			
<i>Turdidae</i>	Thrushes, Forktails	5	/			
<i>Sylviidae</i>	Warblers	6	/			
<i>Muscicapidae</i>	Flycatchers	19	/			
<i>Sturnidae</i>	Hill Myna	1				/
<i>Prionopidae</i>	Bristlehead	1	/			
Percentage of species feeding upon different food sources		181	94%	20%	9%	33%



P9 : The Bornean orangutan, *Pongo pymaeus*



P10 : The Bornean flycatcher (*Cyornis superba*) an endemic species

5.6.4 Nesting and reproduction

Breeding activity of several bird groups from Lanjak-Entimau is given in **Figure 3**. A majority of Passerine birds, which include 19 families in Sarawak, have been reported to breed from December to May (Fogden, 1972). The brood patches of 1356 individuals of 63 species from several families of passerine birds (bulbuls, babblers, flycatchers, sunbirds, spiderhunters and flowerpeckers) were examined during the course of the fieldwork.

Overall, there appeared to be two breeding peaks, one from March to May, and a second from July to September.

Of the 203 bird species resident in Lanjak-Entimau, 36 species nest within tree-holes.

Certain species adapted to mature forests are adversely affected by human disturbance, including shifting cultivation and logging. Encroachment into the Sanctuary in several areas (e.g., ulu Mujok, Sg Ensirieng and Sg Kanowit) may have resulted in the disappearance of some species, including the argus pheasant. Hunting is also a factor affecting larger species such as hornbills and pheasants, which are hunted for food and for the decorative quality of their feathers.

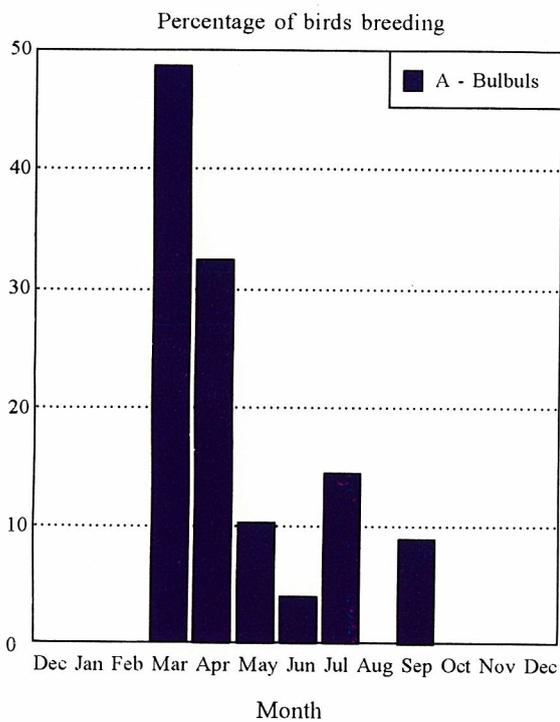
5.6.5 Hornbills

Hornbills, though primarily frugivores, are known to occasionally take small vertebrates such as lizards and birds. In Kalimantan, Leighton (1982) reported 240 species of fruit trees visited by hornbills, though the Genus *Ficus* (producing figs) was the most important one. Others included the Annonaceae, Lauraceae, Myristicaceae and Meliaceae. These are also, incidentally, the primary food sources for orangutans and gibbons.

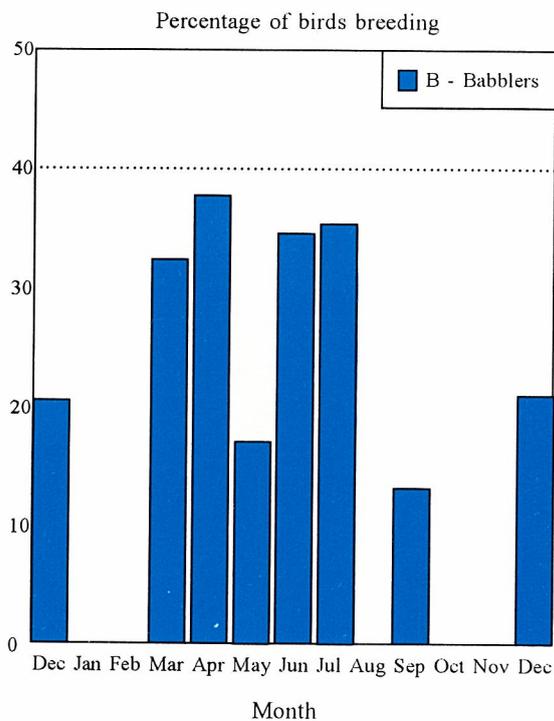
Trees recognised by local Iban residents as important to Hornbills include *Dacryodes rostrata*, *Ficus* spp., *Horsfieldia* spp., *Knema* spp., *Myristica* spp., *Litsia garciae*, *Cinnamomum pendulum* and *Mangifera havilandii*. A more complete list of fruits favoured by hornbills is given in **Appendix IX**.

Figure 3

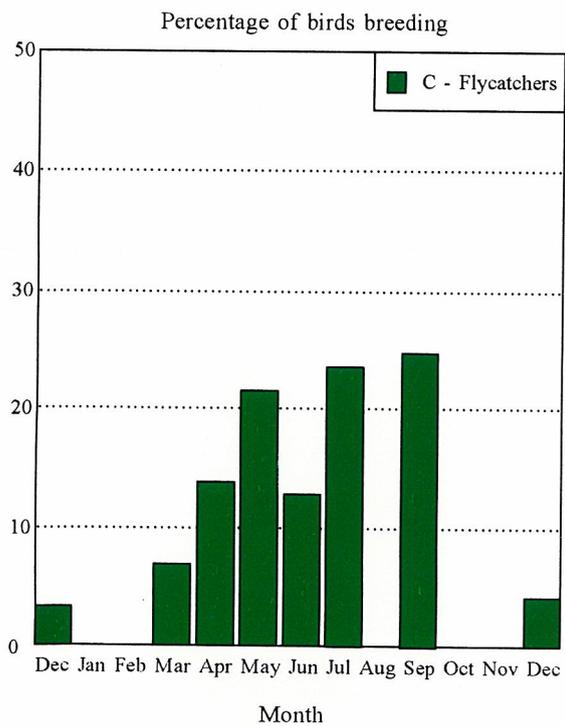
Breeding activity of selected groups of birds from Lanjak Entimau



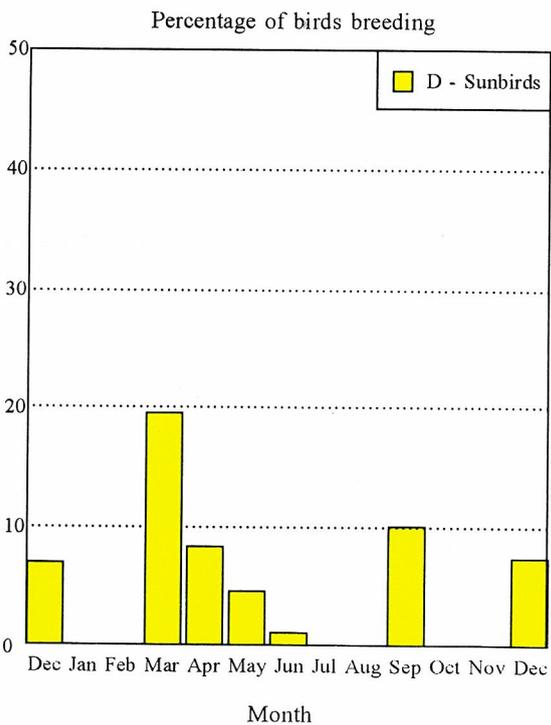
244 birds of 14 species



405 birds of 24 species. Individuals with breedpatch: 109



258 birds of 12 species. Individuals with breedpatch: 40



493 birds of 15 species. Individuals with breedpatch: 29

Locals also report that if the forest trees fail to produce much fruit, hornbills will not breed in that year. The unpredictable fruiting by trees in the Bornean forest requires frugivores such as hornbills to traverse large distances in search of food, so that preservation of large tracts of intact forest is necessary for the hornbills' survival.

Seven of the eight hornbill species known from Sarawak are found in the Lanjak-Entimau area (**Plate 12**). The most conspicuous are the rhinoceros and helmeted hornbills, which seem well distributed throughout the Sanctuary. The other species are seen and heard occasionally, though the wrinkled hornbill was the most infrequently recorded.

5.6.6 Pheasants

Both the Bulwer's pheasant and the Great Argus feed on a wide variety of items, including fallen fruits, insects and other invertebrates, and even small vertebrates such as frogs and lizards.

Pheasants of the Sanctuary include the Great Argus (*Argusianus argus*) and Bulwer's pheasant (*Lophura bulweri*). A single sight record of the crestless fireback (*Lophura erythrophthalma*) will require further verification. Pheasants though reported, were however not seen or heard in ulu Mujok and Sg Jepiu forests.

5.7 Herpetofauna

5.7.1 Background and methods

The great diversity of herpetofauna in Lanjak-Entimau is directly related to habitat complexity found in the Sanctuary. Major habitats and their associated microhabitats are given in **Table 22 & 23**.

Kavanagh reported 38 herpetofaunal species (World Wildlife Fund, 1982). Day and night sampling of both adults and larvae in mature vegetation, leaf litter and along streams led to the discovery of a total of 75 species of amphibians and reptiles at five sites over a period of six months.



P11 : Hose's broadbill (*Calyptomena hosei*), another Bornean endemic



P12 : ITTO ornithologist, Dr Robert Grubh and a local assistant ringing a juvenile bushy-crested hornbill (*Anorrhinus galeritus*) along the Bloh River, ulu Katibas

TABLE 22
Major habitats in the Lanjak-Entimau Wildlife Sanctuary,
and their associated microhabitats

Habitat Type	Component Habitats	Associated Microhabitats
Mixed dipterocarp	Flood plain forest	leaf litter, logs
Forest (MDF)	Lowland forest Hill forest	buttress, shrubs tree holes, canopy
Kerangas forest	Lowland & hill forest	tree holes, canopy
Rivers	Pools, rapids Streams of various sizes	torrents, riffles shingles, side pools, potholes
Swamps	Stagnant water	pools, seepages

TABLE 23
Major habitats and associated microhabitats occupied
by the Lanjak-Entimau herpetofauna

Family	Habitat/microhabitat	Activity
Pelobatidae	leaf litter buttresses small streams	foraging foraging and breeding
Ranidae	large rivers small streams, torrents riffles, side pools, rain pools leaf litter	foraging foraging and breeding foraging and breeding foraging
Bufo	large rivers, small streams torrents, riffles temporary forest pools leaf litter	foraging and breeding foraging and breeding breeding foraging
Microhylidae	temporary puddles pot holes, tree holes buttresses, leaf litter	breeding breeding foraging
Rhacophoridae	streams, temporary pools, pot holes, animal wallows canopy	breeding breeding foraging and breeding

Daytime sampling included systematically clearing - 56m² quadrats of leaf litter for small amphibians and reptiles, while sampling in aquatic habitats (for tadpoles) was done with electrofishing apparatus. Night samples were conducted as either stream or forest transects of approximately 500 m length 90-120 minutes walk from 8-16 workers using headlamps.

Species found totaled 49 amphibians, one turtle, 12 lizards and 13 snakes. Specimens have been deposited in the laboratory of the National Parks and Wildlife Office of the Sarawak Forest Department.

5.7.2 Diversity and abundance

So far, at least 26 species endemic to Borneo have been found in Lanjak-Entimau, and seven species known only from Sarawak. Among the significant finds were a frog not previously known from Sarawak (*Rhacophorus reinwardti*; **Plate 13**); two new species of frog of the genera *Pelophryne* and *Philautus*; the fourth known specimen of a rare legless lizard (*Ophisaurus hüttikoferi*; **Plate 14**) known only from Borneo and two previously undescribed species, a lizard (*Pseudocalotes saravacensis*; **Plate 15**); and a pipe snake, *Cylindrophis engkariensis*). Undoubtedly, there are more species awaiting discovery.

Diversity of sites and frequency of encounter of herpetofaunal species are given in **Appendix X**. Details of sampling techniques, habitats and specimens collected are given in the ITTO Herpetologist's report (Stuebing, 1994)

5.7.3 Distribution

Overall, most of the amphibian and lizard fauna was well distributed throughout the Sanctuary (species found at all five sites). However, species of tree frogs (Rhacophoridae) and most snakes were found at only one or two sites (**Plate 16**).

No strictly montane species were obtained, even on Bukit Lanjak, though small areas of submontane and montane vegetation occur at that site (Chai, 1995). Lack of aquatic breeding habitats apparently has restricted the number of frog species able to exist on Bukit Lanjak.



P13 : Reinwardti's flying frog (*Rhacophorus reinwardti*), a new record for Sarawak



P14 : The extremely rare Bornean "glass snake" (*Ophisaurus büttikoferi*) a legless lizard



P15 : A new species of lizard, *Pseudocalotes saravacensis*, found in Ng Segerak, ulu Engkari



P16 : A beautiful endemic snake (*Gonyophis margaritatis*) also from Ng Segerak

5.7.4 Conservation aspects

Threats to the Lanjak-Entimau herpetofauna are minimal at present, and it remains difficult to distinguish between active rarity of herpetofaunal species and insufficient information about their distributions. Nevertheless, a majority of the forest herpetofauna would become rare if the primary forest is sufficiently disturbed.

Many amphibians, such as frogs of the genera *Meristogenys* and *Ansonia*, to name a few, decline or disappear when rivers become silted. Shifting agriculture destroys many leaf litter species such as microhylid frogs and snakes of the genera *Calamaria* and *Rhabdophis*. The long term effects of such losses are not known.

Fortunately, shifting cultivation is generally uncommon and peripheral to the Sanctuary, and apart from opportunistic use of a several species for food (ranid frogs, turtles and pythons), exploitation of the herpetofauna by local people is not yet a significant threat.

5.8 Fish

Fish were collected incidental to the collection of aquatic herpetofauna. A total of 36 species were found, including two new species, *Puntius katibasensis* and *Protomyzon* sp. nov. A list of all fish currently known from Lanjak-Entimau is given in **Appendix XI**.

The Lanjak-Entimau fish fauna is obviously extremely diverse and there are likely to be numerous species awaiting discovery in its numerous complex aquatic habitats.

5.9 Insects

A total of 5927 individuals were collected from 48 families in Lanjak-Entimau, and are listed in **Appendix XII**. The target groups studied were the social insects, termites (Isoptera), ants and bees (Hymenoptera). The large number of indeterminate species indicates the enormous potential for the discovery in the Sanctuary of numerous species unknown to science.

6.0 SOCIO-ECONOMIC ASPECTS

6.1 Background

6.1.1 Conservation goals

Lanjak-Entimau Wildlife Sanctuary lies within a region of inland hills and steep valleys, with large areas mainly of primary forest. The main community living at the periphery of the Sanctuary are Iban, who were the "pioneers" of the area with a total of 102 longhouses and an estimated population of 12,400 people (**Appendix XIII**).

The principal objective for developing Lanjak-Entimau as a Totally Protected Area is to preserve its unique natural environment, most importantly its flora and fauna. Socio-cultural aspects cannot be ignored however, as rural communities rely on natural forest for food, fuel, building materials and income. Conflict of interest between the Protected Area and the indigenous community are bound to occur, particularly in a situation where people have resided in the area for generations. Thus, an integral part of the Project is to involve local people in the planning and implementation, and to simultaneously raise their standard of living and to motivate them towards assuming a positive role in management and conservation efforts. Their direct participation in development of the Sanctuary will be a crucial component in fostering the success and sustainability of the programme.

The communities now living at the periphery of the Sanctuary are subsistence farmers who have only recently incorporated cash crops as part of their farming efforts. However, poor soils, difficult access to markets, costly inputs and related problems often make cash crops uneconomical, resulting in few opportunities for them to supplement their income.

6.1.2 Identification of community needs

The socio-economic study of the communities living on the periphery of the Sanctuary has been undertaken to determine current attitudes, needs and problems in relation to future conservation and management of Lanjak-Entimau as a Totally Protected Area.

Data has been collected on demography, land use and ownership, socio-economic status, economic activities, use of forest resources and general attitudes and opinions regarding the establishment of the Sanctuary.

Two sets of structured questionnaires developed by the ITTO Sociologist (who is a member of the Iban Community) were used, one for background information on the village through group interviews and the other for detailed information based on interviews with selected heads of households. The latter were chosen via systematic random sampling, and the number of households interviewed was proportionate to the size of the longhouse, usually about 15% of existing households (except in ulu Engkari with 28% of three longhouses only). Of the 102 longhouses within the vicinity of Lanjak-Entimau, 74 (73%) were included.

All longhouses with admitted rights under the Second Schedule of the Lanjak-Entimau Wildlife Sanctuary Order (a total of 35 longhouses, in ulu Ngemah, ulu Kanowit and ulu Katibas), irrespective of whether they had less than 10 households, were included.

6.2 Demographic characteristics

6.2.1 Distribution of population

Location and number of all villages and households involved in the study are given in **Table 24** and in **Map 3**. A total of 102 longhouses comprising 1,761 households with 12,398 persons were determined to be within close proximity of the Sanctuary (within approximately two hours travel by boat). This figure represents 13% of the population of the Districts of Julau, Kanowit, Song and Lubok Antu, and about six per cent of the population of Sarawak.

Table 24 : Total number of villages & households selected for the study

Area/River System	Number of Longhouse	Total Household	No. of Respondents
Upper Kanowit - Julau District	26 (25)	559	841 (15%)
Upper Ngemah - Kanowit District	51 (24)	747	72 (10%)
Upper Katibas - Song District	22 (22)	415	62 (15%)
Upper Engkari - L.Antu District	3 (3)	40	12 (30%)
Total	102	1,761	230 (13%)

Note: Figures in brackets refer to the number of selected longhouses and percentage of households sampled

Of the existing 1,761 households, the average household had approximately 5 members. Women outnumber men about 54:46. Some ratios were affected slightly by having one or more male members on *bejalai* (temporary migration; see Section 4.2.3). About 53% of the population were within the "economically active" age group of 15 and 60.

6.2.2 *Bejalai* and outside income

Men on *bejalai* now seek income from either unskilled work in logging camps, plantations or jobs in major towns in the construction and petroleum industries. Some communities have more than 15% of young males involved in temporary employment away from the longhouse. The custom has become an economic necessity for them to acquire savings for the family needs.

6.3 Education and Health

6.3.1 School attendance and educational level

The level of education is relatively low compared to urban areas of Sarawak, with only 52% of the population with education, including those still in school. The main reason given for children not attending secondary school was the distance to the schools and the (unaffordable) costs involved. The educational level of women is about 10-15% lower

than that of men, since female children are frequently confined to the home to aid in domestic chores..

6.3.2 Health facilities

For the communities on the LEWS periphery health and sanitation facilities are limited. Most hospitals are at least a day's travel, frequently two, from the longhouse. Most clinics are so far located only in the vicinities of Julau and Lubok Antu. Most areas have a dispensary within a hour's journey or so by boat, but these facilities are usually capable of meeting and handling only the most basic health or medical needs. Malnutrition among children remains high compared to urban areas in Sarawak, with longhouses near Lubok Antu and Julau having 30-50% of children with some degree of malnourishment.

6.3.3 Water and electricity supply

Most water systems (except for the ulu Ngemah Resettlement area) are gravity-fed, and many are inadequate for parts of the year so that many communities still rely heavily on rivers as a source of water for domestic use.

Electricity supplies are limited, with 82% of the longhouses in ulu Katibas, 62% in ulu Kanowit and 33% in ulu Engkari still without electricity supply. Portable generators supplied under the MRP (Minor Rural Projects), or occasionally owned by individual families, are sometimes used.

6.4 Land tenure and use

Land on the periphery of the Lanjak-Entimau Sanctuary is claimed by local longhouse communities under Native Customary Rights (NCR). In pre-colonial times these rights were exercised merely through the felling of virgin forest. However, under the State Land Code of 1957, with effect on 1st January, 1958 opening of any new land requires the written permission of relevant authorities (Zainie, 1994). No NCR is created unless such permission is granted.

Iban families will usually claim rights over old secondary forest or *damun* cleared by them, or by their forebears, including fruit trees or other permanent plantings. Farming

rights over this land are inherited in the same manner as other heirlooms or property. Use of virtually all land on the periphery of Lanjak-Entimau has been acquired in this way.

The majority of households in the peripheral communities occupy cultivated or fallow land, averaging about 20 ha per household. This varies, however, between areas. Whereas those households from communities on the northern and western boundaries of Lanjak-Entimau have usually from 5-200 ha of land, 92% of ulu Engkari households possess only eight hectares, or less (**Plate 17**). Approximately 1-10% of the households of all the surrounding communities have no land at all.

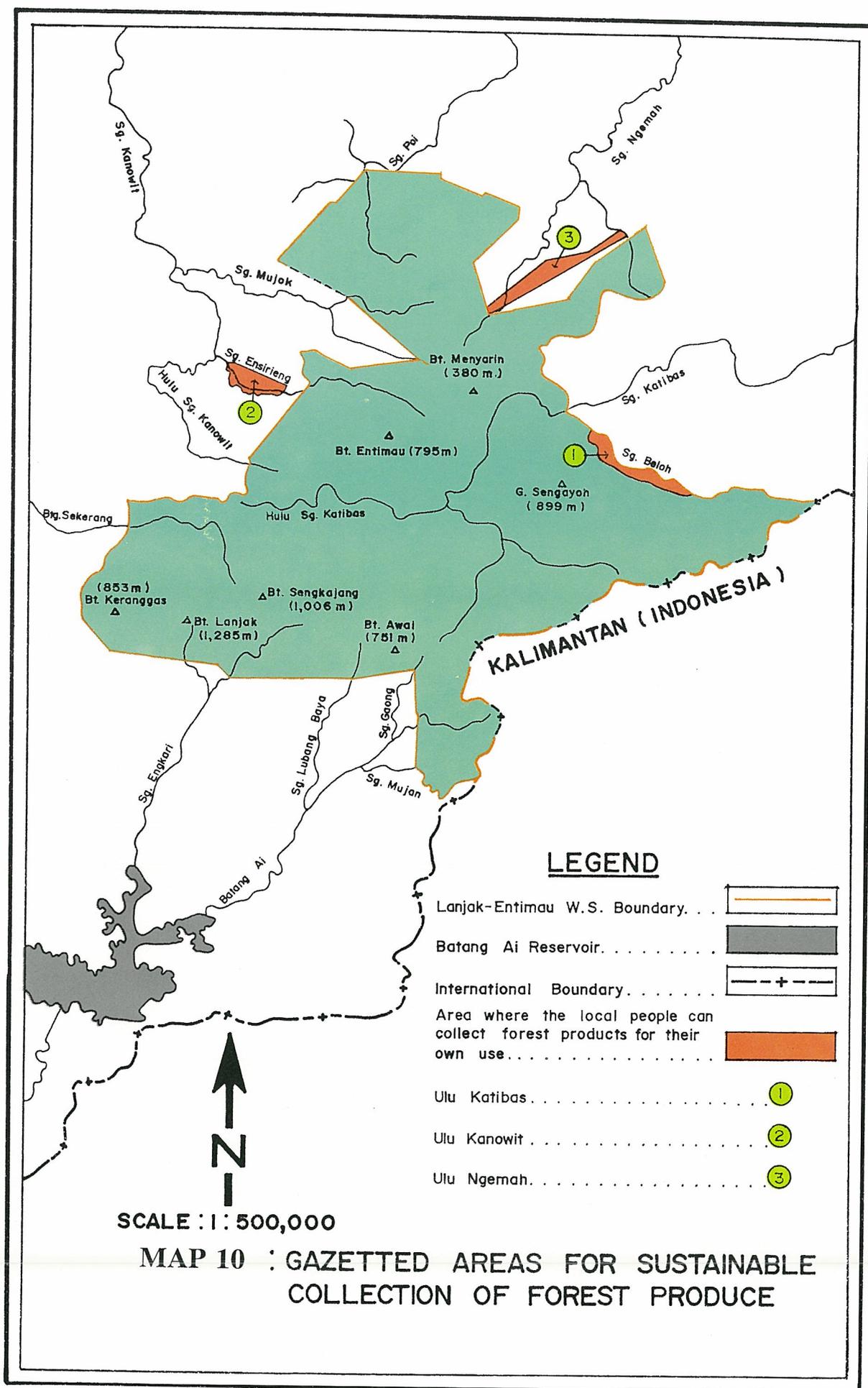
Disputes can arise over ownership of cleared land or even uncut forest (*pulau kampong*) near the longhouse. Furthermore, traditional claims over a long period often make local people skeptical about any development plan involving resettlement (since absentee claims have never been recognised under the State Land Code. The original gazettelement of Lanjak-Entimau in 1983 sought to offset some of these problems by granting special privileges to certain communities in ulu Ngemah, ulu Kanowit and ulu Katibas for collecting forest produce (**Map 10; Appendix IIC**).

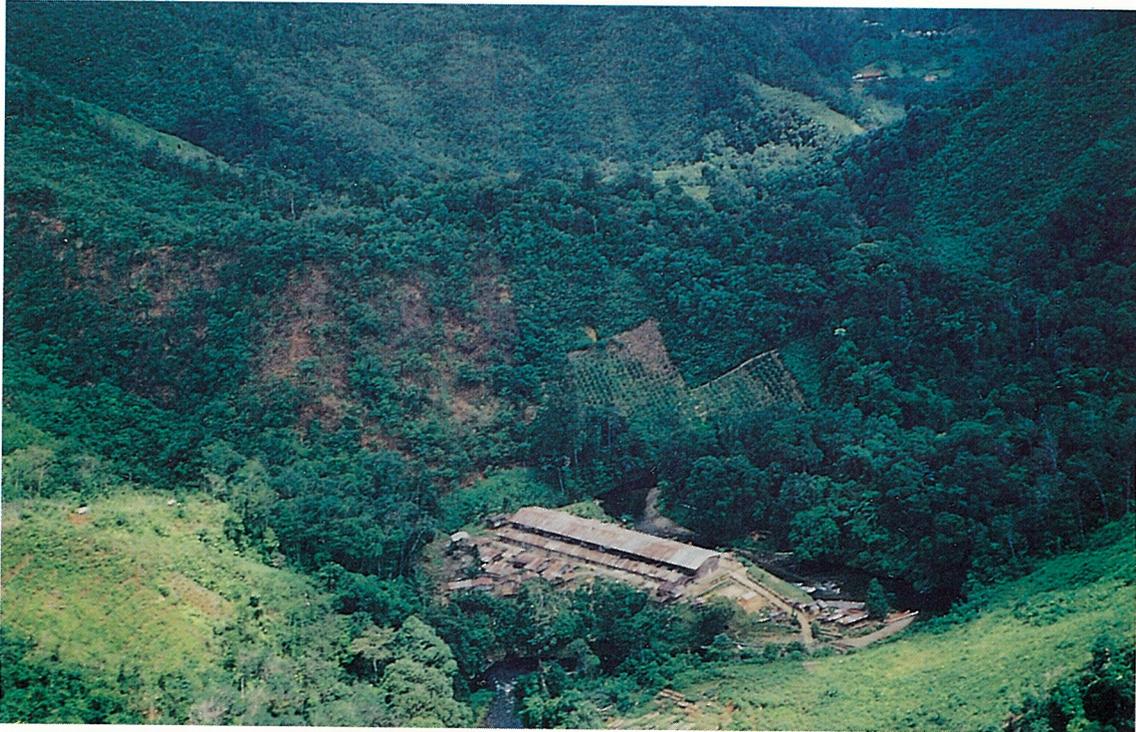
6.5 Farming and protein sources

6.5.1 Crops and cultivation cycles

Land is kept primarily for the production of hill rice, cultivation of which is done by 94% of all households near the Sanctuary, who cultivate anywhere from 0.5-6 hectares each. Yield (kilograms per hectare) ranges from 464 in the Kanowit area to 590 in the area surrounding Lubok Antu.

After harvest, the land must be left fallow (**Plate 18**). Until several decades ago, such land would have remained fallow for at least 20 years to allow regrowth of closed canopy forest. Land shortages faced by most households, however have caused the fallow period to be shortened to as little as five years in up to 79% of the cultivated land. This shortened cycle reduces fertility while increasing losses to insect and plant pests. Near the Lanjak-Entimau boundary, additional losses are regularly caused by wild pigs, monkeys and other wildlife from the forest.





P17 : Rumah Lenggang, an Iban longhouse in ulu Engkari, surrounded by plots of shifting cultivation



P18 : A recently cleared farming plot, surrounded by regenerating forest, Batang Ai area

Virtually all households now face a chronic shortage of rice. The proportion of the households having insufficient rice ranges from 60-70% in ulu Ngemah, to only 30-40% in ulu Kanowit and ulu Katibas, with the figure for ulu Engkari somewhere in between. This situation forces most Iban households near Lanjak-Entimau to purchase rice from traders in the towns, eroding the community's already meagre cash reserves, leading to demands for more land. Dependence on produce collected from the forest (rattan, *mengkuang*, wild vegetables and game) also increases.

Often thought to be a solution to this dilemma, cultivation of cash crops such as rubber, pepper, cocoa, or fish and livestock rearing has only partially succeeded. A number of these crops, particularly pepper and cocoa, require costly maintenance in the form of pesticides and fertilisers, beyond the means of most farmers given the already high cost of transporting the produce to market (Appendix XIV).

6.5.2 Socio-economic consequences of land shortages

A widespread shortage of land forces farmers to reduce the fallow period of their "temuda" (secondary forest) leading in turn to reduced yields of their staple crop, rice. Poor crop production is also intensified by the loss of working male members who seek cash income away from the longhouse, resulting in neglect of farms and gardens. The Iban of the Lanjak-Entimau area remain isolated, and face a lack of crucial infrastructure and services, revolving around poor transport facilities to major towns. This in turn limits their ability to acquire capital, either via sale of produce or part-time employment. Income for heads of households from communities on the Sanctuary's periphery averages less than half of the State Poverty line income level of RM495/month, causing negative impacts on health and education, and increased pressure on the Sanctuary.

6.5.3 Hunting

Hunting and fishing are indispensable to the Iban communities residing near Lanjak-Entimau for obtaining sufficient protein in their diet. All longhouses are involved in hunting to some degree, and the target species is the bearded pig, though other game are taken opportunistically. Most hunting is reported to take place outside the Sanctuary, though incursions into it are perhaps not uncommon. Nevertheless, local farmers report that they most frequently hunt in their own temuda (in the game seasons), where they

often plant certain crops as an attractant to wild game. Hunting success is given in **Table 25**.

Table 25 : Average number of animals obtained per hunting trip

Area	Average number per trip			
	Wild Boar *	Deer	Barking Deer	Other Animals
Ulu Kanowit	3.4	1.4	1.7	1.5
Ulu Ngemah	1.4	3.0	2.0	0.0
Ulu Katibas	1.6	1.3	1.4	1.6
Ulu Engkari	1.0	0.0	0.0	0.0
Overall	1.8	1.9	1.7	1.5

* Wild boar = *Sus barbatus*; Deer = *Cervus unicolor*; Barking deer = *Muntiacus* sp.

6.5.4 Fishing

Subsistence fishing is one of the most important activities of the longhouse communities, which usually depend on a consistent catch (about 2-3 kg/day) as the protein supplement to daily meals of rice. Intensive fishing is done via cast nets, gill nets and rarely through the use of poison.

Fish catches are reported to have declined significantly. Certain kinds of highly prized fish (e.g., *ikan tenggadak*) are now uncommon, their scarcity reflected in their market price of RM60-70 per kg. This decline is attributed by the people to increased exploitation of the resource, although there could be other contributing factors such as a decline in water quality (from erosion/siltation and waste of human origin) in downriver areas.

6.5.5 Use of Wild vegetables

In addition to hunting and fishing, high percentage of longhouse residents depend on wild vegetables as an important component of their diet. (Table 26)

Table 26 : Percentage of households involved in collection of wild vegetables

Wild Vegetables	Upper Katibas		Upper Ngemah		Upper Katibas		Ulu Engkari		Total	
	Freq	%	Freq	%	Freq	%	Freq.	%	Freq.	%
<i>Daun sabung</i>	81	95	58	81	14	23	n.a	0	153	67
<i>Kepayang</i>	43	51	41	57	16	26	n.a	0	100	43
<i>Paku</i>	57	68	68	94	50	81	n.a	0	175	76
<i>Miding</i>	77	92	70	97	29	47	n.a	0	176	76
<i>Tubu</i>	78	93	70	97	51	82	n.a	0	199	87
<i>Kulat</i>	46	55	30	42	22	35	n.a	0	98	43
	n=84		n=72		n=62		n=12		n=230	

n.a. - Data not available

* *Daun sabung* (*Gnetum gnemon*), *Kepayang* (*Pangium edule*), *Paku* (*Athyrium esculentum*), *Miding* (*Stenochlaena palustris*), *Tubu* (*Saccharum* sp.), *Kulat* (Edible fungi).

6.6 Community relations

6.6.1 Attitudes towards the forest

Forested areas are still viewed positively as a source of stability and sustenance. However, since the Iban community has no tradition of planting trees, and since land rights might appear threatened, people of the Lanjak-Entimau area remain suspicious of large scale estate or agroforestry developments. Nevertheless, they generally support preservation of virgin areas as long as they retain some harvesting rights over local forest products.

6.6.2 Attitudes towards regulations and enforcement

Limited opportunities to earn a living cause a dependence of Sarawak's interior people on the surrounding forests not only to supply their basic needs, but to supplement their diet and income. For this reason the longhouses in closest proximity unconsciously exercise informal control over their immediate areas to ensure a constant supply of food and other jungle products.

It is important to note that seventy per cent of respondents in the LEWS survey supported strict enforcement of regulations regarding the Sanctuary, including a ban on logging. Only in some densely populated areas, such as small portions of the ulu Ngemah and ulu Katibas, residents expressed interest in agricultural development schemes. Thus, an

overwhelming majority of the respondents from the periphery of Lanjak-Entimau prefer to maintain the Sanctuary as it is.

Other perceived needs were more involvement of locals in administration of the area, and a desire for more Wildlife Ranger (NPWO) posts. In addition, there were requests for more areas of communal forest (e.g., *pulau kampong*), and the direct participation of longhouse leaders, or *Tuai rumah*, as (paid) honorary wardens of the Sanctuary.

6.7 Local infrastructure

Lanjak-Entimau is still relatively isolated, and is not yet accessible by road. Travel to the Sanctuary involves links by either by air or by road to particular access or “jumping off” points, from which the boundary can be reached in varying lengths of time, from about half an hour to approximately one day (Table 27).

Table 27 : Transportation access points to Lanjak Entimau Wildlife Sanctuary as of 1995

Area	Access Point	Forms of transport	Travel Time to LEWS boundary from staging point	Form of transport
ulu Engkari ulu Batang Ai	Lubok Antu	Road	6 hours (Ng Segerak) 2 days (Ng Giling)	Longboat Longboat (through Btg Ai National Park)
Sg Skrang	Pakan-STK Stolak Camp	Road	1.5 days (Ng Serembuang)	Landcruiser & longboat (Sg Skrang)
Sg Mujok & ulu Ensirieng	Kanowit	Road	1 day (Jemarang)	Longboat
ulu Poi	Kanowit	River	5 hours (Ng Bilat)	Longboat
ulu Ngemah	Sibu	Air road or river	1 day (Rantau Lugai)	Longboat
ulu Katibas Sg Latong & Sg Ngemang	Song	River	1 day (Ng Beloh)	Longboat

The Lemanak River is the only non-navigable gateway to Lanjak-Entimau, but the boundary at Lemanak is accessible by timber road (via the STK Stolak Camp, Pakan).

River travel is possible in most months of the year except during the northeast monsoon, when rivers can experience dangerous flash floods. Travel during the dry season of July-August can also be difficult when water levels drop too low, and longboats have to be dragged with great difficulty over numerous shallow areas.

7.0 CONCLUSIONS

Biologically, Lanjak-Entimau Wildlife Sanctuary is one of Sarawak's richest natural areas. Its stable climate, wide range of topographical features and mosaic of habitats created a great diversity of communities.

Conservation prospects for biodiversity in this part of interior Borneo have been greatly enhanced by the inclusion of Lanjak-Entimau with the Bentuang-Karimun Reserve in West Kalimantan, Indonesia. The two reserves form a trans-border protected area of pristine tropical forest which is one of the largest in the world.

It is extremely likely that thousands of species of plants and over eight hundred species of vertebrate animals live within the Lanjak-Entimau Sanctuary. Insects contribute additional thousands of species. In less than one year, three species of plants, two frog species, two species of reptiles, two species of fish and four crabs, all new to science, have been discovered.

Beyond these discoveries, which have merely scratched the surface, is the role of the Sanctuary as a permanent reserve for seed stock and seedlings.

This bank for genetic material from ancestral varieties of timber and fruit trees, and other biological resources, provides for the renewal or improvement of genetic quality of commercial species. This forms a crucial backup system for the agriculture and forestry sectors of the State and National economy. Furthermore, there is great potential benefit to Sarawak's people via the investigation and use of genetic resources under licensing agreements developed by the Sarawak Government, patterned after the Biological Diversity Convention of the United Nations.

Research into ecological processes within the forest will advance our understanding of the principles important for sustainable forest management.

Lanjak-Entimau also serves to protect the watersheds of two of Sarawak's main rivers, and to preserve and maintain water quality for the Batang Ai Reservoir. A supply of clean water will be an increasingly important resource for the future.

Finally, the Sanctuary forms an important spiritual heritage for the people of Sarawak as one of the last great virgin forests of the interior. Its magnificent beauty optimizes Borneo's dynamic strength, pristine natural beauty and remarkable diversity, as one of the world's oldest and most majestic tropical rain forests.

Lanjak-Entimau, along with Sarawak's other protected natural areas, will inspire a sense of community and common heritage for the people of Sarawak, Malaysia and the region.

PART III

**MANAGEMENT AND DEVELOPMENT
OBJECTIVES**

PART III : MANAGEMENT AND DEVELOPMENT OBJECTIVES

1.0 MANAGEMENT PRINCIPLES

1.1 Fundamental considerations

The success of any management plan for the Lanjak-Entimau Wildlife Sanctuary must include several fundamental aspects:

- Biological diversity and species survival

This need is determined by the status of Lanjak-Entimau Wildlife Sanctuary as a Totally Protected Area, equivalent to a Strict Nature Reserve in which disturbance is to be minimised for the protection of biological diversity and endangered species. This need is met through protection and enforcement, conservation research and monitoring.

- Requirements of local communities

This need involves the right of local residents to enjoy socioeconomic well-being and the right pursue their livelihood and traditions. The need is met through acknowledging their true rights and their pivotal role in the success of the Sanctuary programmes, building on their existing expertise, and providing new opportunities for that expertise to be profitably used.

- The Government of Malaysia and the State of Sarawak

This need involves the Malaysian Government's as well as State's duty to safeguard its Natural Heritage, while developing its natural resources, as well as the intellectual resources and capabilities of its people, for the greater good of all. This need is met through ensuring that all management programmes are consistent in their objectives with the established policy of the Malaysian Government and the State of Sarawak.

- Requirements of the sponsor or funding agency

This need involves the need for specific goals and priorities of sponsors or donors to be adhered to in the design and implementation of the project. This need is met through the integration these goals and priorities into the management plan to make the latter consistent with these explicit requirements.

- Coordination with management of other Protected Areas in Sarawak and the trans-boundary Bentuang-Karimun National Park in Kalimantan

This need is based on the importance of managing separate but similar biogeographical units or a single unit which is composed of two separate political entities. This need is met through coordination of management regimens through mutual consultation to produce an effective, integrated programme appropriate to the single biogeographical whole.

2.0 OBJECTIVES

2.1 Development Objective

The management plan will provide an outline for implementation of policies, strategies and procedures in the development of Lanjak-Entimau Wildlife Sanctuary, to serve as a model in the conservation, protection and scientific utilisation of other Totally Protected Areas in Sarawak and Malaysia.

2.2 Specific Objectives

- To conserve the biological diversity (including the important genetic component) of the Sanctuary. This includes programmes which focus on conservation and research on biological and genetic diversity and forest ecology in the Sanctuary to improve knowledge of sustainable forest management.
- To establish protection programmes (with associated infrastructure for research centres and subcentres, monitoring and research programmes for flora and fauna) while reducing pressure on the Sanctuary through community-targeted programmes integrating conservation with a forested Buffer Zone designed for sustainable use by local communities.

3.0 SPECIFIC PROBLEMS TO BE ADDRESSED

3.1 Protection of the Sanctuary from encroachment or other illegal activities

This problem is caused primarily by the remoteness of Lanjak Entimau and the time and effort involved in reaching most of the sites. Gradual improvement of infrastructure and transportation facilities, creating a permanent NPWO presence in key areas of the Sanctuary should improve this situation considerably.

3.2 Ensuring the survival of the complex biodiversity of the Sanctuary

The survival of species and biotic communities of the Sanctuary is linked directly to their sensitivity, and their extremely slow rate of recovery from low population

levels. Populations of many species (such as orangutans) are at rather sparse densities.

This problem can be overcome only through comprehensive inventories and understanding of factors affecting survival, such as nutrition. Intensive research on ecological processes of the forest will gradually provide knowledge appropriate for sustainable forest management, including the management of rare animals.

3.3 Ensuring the participation of local communities in the development of the Sanctuary

This situation could pose a problem as efforts to assert authority over areas traditionally used by local communities can cause suspicion and potential conflict over policies or practices. The problem can be addressed by an active programme of consultation with local communities to seek their support and involvement. The latter includes their direct participation via employment in infrastructure development in the Sanctuary, research and education programmes and involvement in community improvement projects.

4.0 SPECIFIC GOALS

4.1 Conservation of biodiversity

Conservation of biodiversity will be accomplished through:

- research and acquisition of scientific data on species and communities
- monitoring of threatened, endangered or "indicator" species
- improvement in the understanding of interactions within the biological community and natural forest processes

4.2 Protection

Protection of the Sanctuary will be achieved through:

- 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 Zonation

4.3 Research and Education

Research and educational goals will be attained through:

- ensuring local participation in basic biodiversity research projects
- channeling research findings into staff and student training, as well as other educational and interpretive programmes

4.4 Community involvement and socio-economic benefits

Community involvement and promotion of socio-economic benefits will be achieved through:

- regularly scheduled consultative meetings with local community leaders
- employment of local residents in management programmes
- development of beneficial or profitable ventures in the buffer zone areas

Since most of area within the boundaries of the Sanctuary is in a pristine ecological condition, disturbance or manipulation of this natural environment should be avoided, except where absolutely essential (such as for development of infrastructure).

4.5 Long-term goals

Long-term goals include steps taken to:-

- (i) conserve biological diversity
- (ii) ensure the maintenance of ecological integrity
- (iii) enhance scientific knowledge through research
- (iv) promote public education through interpretive programmes
- (v) protect the Batang Ai reservoir through the control of erosion, and
- (vi) preserve scenic beauty.

Inclusive within these goals is the preservation of cultural resources and integrity.

PART IV
MANAGEMENT PROGRAMMES

PART IV : MANAGEMENT PROGRAMMES

1.0 PROTECTION

1.1 Role of existing laws

No new legislation should be required for the protection of Lanjak-Entimau, since relevant aspects were adequately covered under the Wildlife Protection Ordinance 1990 (Anon, 1990a; Anon 1990b). Nevertheless, enforcement should be strengthened against hunting of all totally protected and protected species as a major part of the overall management of the Sanctuary.

Extensions of the Lanjak-Entimau boundary proposed in 1983 (Anon, 1983) gazetted may have to be revised based on Ago (1991).

1.2 Boundary cleaning and monitoring

One of the principal features of the Sanctuary's protection programme should be regular surveys of its boundary. These team patrols should involve NPWO staff and one or two persons from local communities to enhance the local participation and a sense of joint responsibility. These patrols may be augmented by periodic helicopter flights along the boundary, and by examining satellite imagery (already available in the Sarawak Forest Department) on a yearly basis.

1.3 Anti-poaching and anti-encroachment measures

Anti-poaching measures must emphasise education of local people, and enlistment of their active cooperation. In addition to prominent boundary markers, easily read information boards concerning basic regulations of conduct within a Totally Protected Area must be set up at all points of entry into Lanjak-Entimau.

Secondly, supervision of all those entering the Sanctuary (and enforcing the prohibition on firearms) can be carried out at its access/entry points. Regular patrols into the Sanctuary must also be scheduled in areas known to be frequented

by hunters. Such patrols should include areas between ulu Mujok and Menyarin, Batang Ai and Lubang Baya, and ulu Skrang.

In the event of serious incursions into the Sanctuary involving poaching or illegal tree felling, major enforcement operations may occasionally be required.

Ranger patrols of the boundary should be supplemented with aerial boundary checks twice a year. Any land clearing activities within the Buffer Zone less than two kilometers from the boundary should be immediately investigated before the boundary is breached (MAP 11).

1.4 Principles of zonation

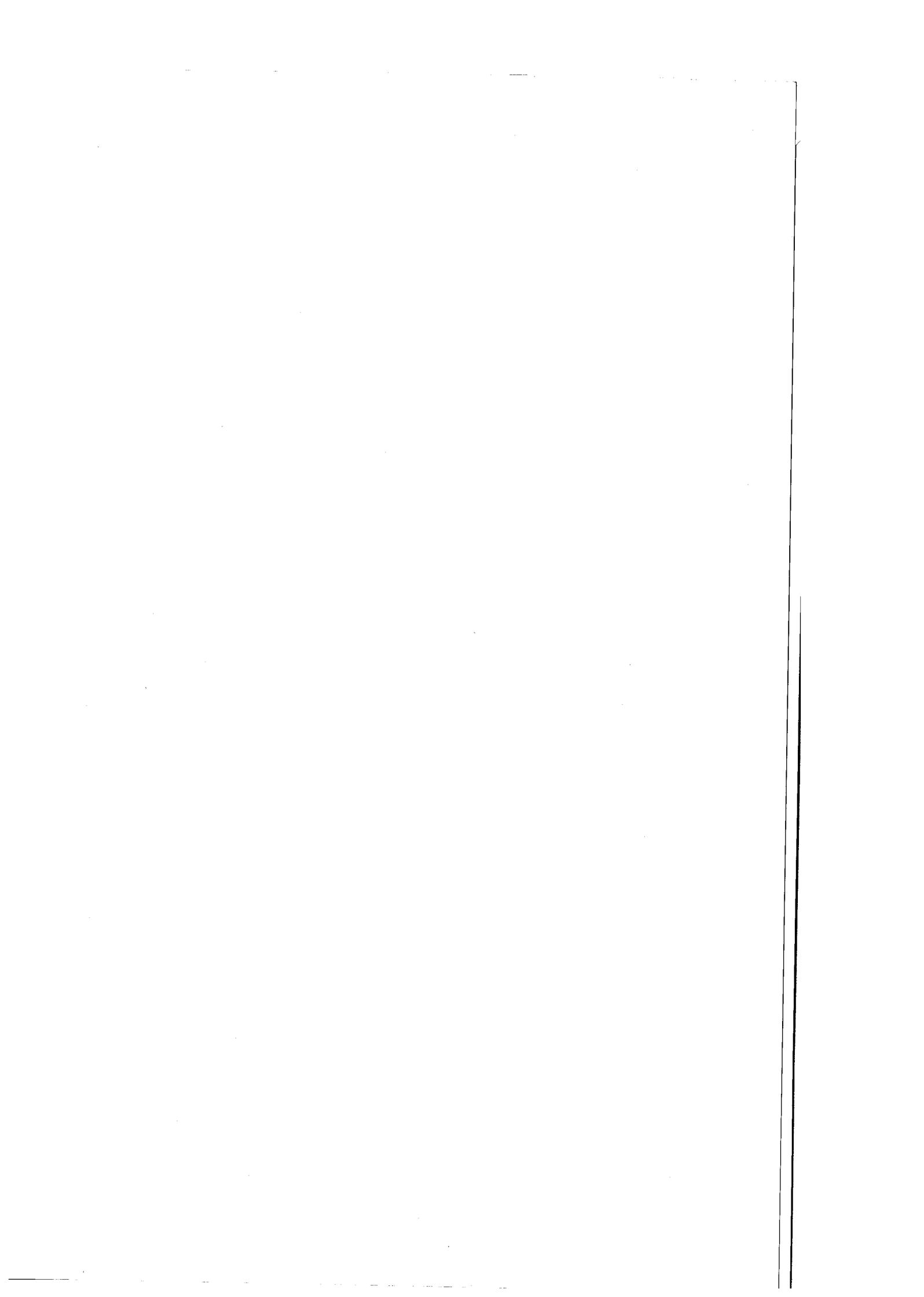
1.4.1 Theoretical aspects

Since Lanjak-Entimau is to be managed as a Totally Protected Area (or, "Strict Nature Reserve" as defined by IUCN), human activities within it will be limited. Based on scientific evaluation of the area, the ITTO consultants have suggested that Lanjak-Entimau be subdivided into several zones for the purpose of managing its diverse habitats and species (MAP 11).

In principle, pristine habitats should be insulated from disturbance through concentric natural barriers of increasingly stringent protection, beginning with an initial buffer zone between the Sanctuary boundary and any highly disturbed areas, and ending with a pristine or totally undisturbed "core" zone. Delineation of all of these zones should reflect:

- i) their conservation value in terms existing flora & fauna, and
- ii) the potential impact of human intrusion.

Through zonation, concentric layers (zones) of an increasing degree of protection are created, culminating in a central core pristine in its habitat quality and free of human intrusion.



A zonation plan must assess the extent of current human disturbance, as well as the potential for human disturbance. Location of sensitive ecosystems, communities or specific flora or fauna must also be identified before zones can be delineated.

This structured approach not only assists in protection programmes but also increases diversity of wildlife by creating a diverse habitat mosaic. Ideally, boundaries should be stable and not consist of abrupt changes in habitat type or land use.

A buffer zone should be included and involve a gradual change from modified to primary habitats where possible (IUCN, 1986; Schonewald-Cox, 1988).

The Report of the ITTO Commission suggested a minimum of three chains of protected areas or managed forests should surround Sanctuaries or National Parks (Anon, 1990a)

1.5 Boundary management

1.5.1 Surveys

The original boundary for the Lanjak-Entimau Wildlife Sanctuary was established in the original gazette notice (Anon, 1983)

Subsequently, in 1990 a confirmational survey of the boundary was accomplished. Several anomalies were found where boundaries on the ground differed from what had had been originally gazetted, so that several adjustments were necessary (Ago, 1991).

Most of these difficulties have been resolved, though the boundary from Ng Igan to Maong Langkau in ulu Mujok remains unmarked because it passes through the temuda of several longhouses, who expressed reservations about its location through that particular area (Ago, 1991). This section is in the process of being marked, following negotiations with the affected communities.

1.5.2 Boundary markers

i) Forest Department Plates

Apart from the area mentioned in Section 2.2.1 above, and a minor portion along a steep ridge near Bukit Sengkajang, ulu Skrang, the entire Lanjak-Entimau boundary was surveyed, cleared and marked with red paint and aluminium "FD" (Forest Department) plates in 1990-1991.

ii) Wooden signboards

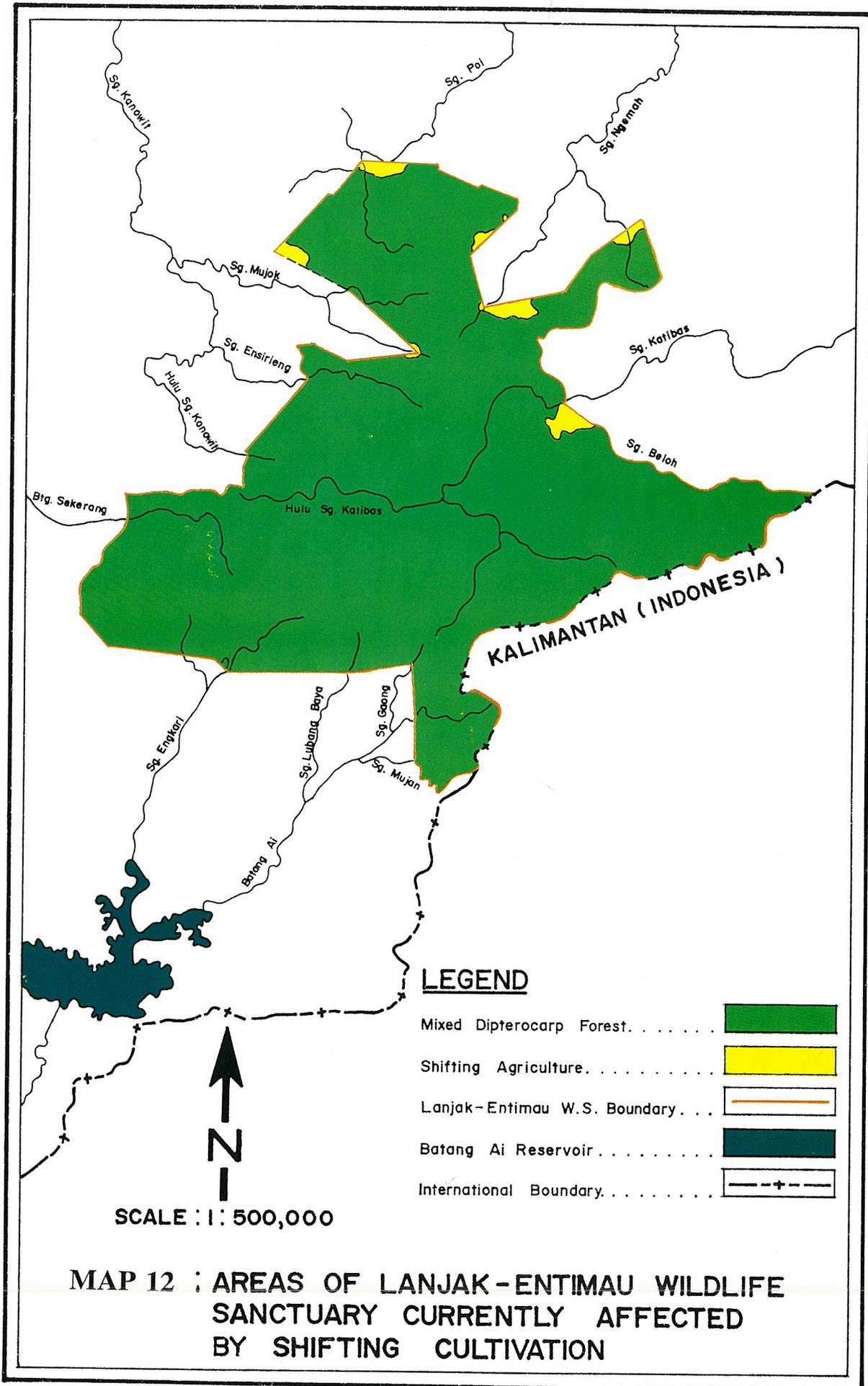
Signboards have been placed at Ng Mejarang, Bukit Batu, Ng Ju and Ng Sega (ulu Mujok), Sg Beloh (ulu Katibas), at every main river in Batang Ai, at Ng Segerak and between Ng Segerak and Bukit Kerapa (ulu Engkari) and at Sg Semeruang (= Serembuang) in ulu Skrang.

1.5.3 Shifting cultivation and logging activities

The Lanjak-Entimau Boundary passes through *temuda* in Sg Igan-Maong Langkau (Mujok), Ng Tiga - Sg Pungkang (Poi), and Ng Sebiru (Sg Junan) to Ng Mersala = Menoasalak (Ngemah). Current areas under *temuda* are given in MAPS 12 & 13. Some *temuda* is associated with areas of special rights, though not all are considered encroachment. These areas must however be monitored to prevent further expansion.

Forest Department survey parties in 1990-91 encountered logging roads and other evidence activities potentially crossing the Lanjak Entimau boundary. Following action taken by the Forest Department in 1991, these encroachments ended.

Since logging activities are still conducted in area adjacent to the Sanctuary, re-inspection of the entire western boundary is advisable, since five years have passed and many of the original boundary markers may no longer be visible. All logging roads found to be serviceable and leading into the Sanctuary, must be blocked.



1.6 Management zones

(Zonation is shown in MAP 11)

1.6.1 Buffer Zone

Concept and boundaries

Buffer zones serve several functions, including:-

- (i) "insulating" the Sanctuary from human intrusion in the form of hunting and habitat modification;
- (ii) providing secondary habitats in which some species of birds and mammals may find important food resources;
- (iii) providing additional foraging and habitats and extended genetic variability for populations (particularly animals) within Lanjak-Entimau.

Existing forested areas surrounding the Sanctuary are composed entirely of State land, including portions which are licensed for logging. These lands should not be alienated, but remain as production forests and serve as source of natural products for local communities.

Areas to be designated as parts of a Buffer Zone include all currently forested lands along the edges of the Sanctuary, along its non-international boundaries (MAP 2).

These lands are located external the intersection of the Lanjak-Entimau boundary with the watersheds of the Sg Engkari, Batang Ai, Sg Mujan, Sg Beloh (North bank), Sg Katibas (North bank, downstream from Ng Beloh), Sg Ngemah, Sg Poi, Sg Kanowit, Sg Skrang (at Ng Serembuang) and Sg Lemanak

No buffer zone will be necessary along the Sarawak (Malaysian)-Indonesian border, since these areas are uninhabited, and contiguous with the Gunung Benuang-Karimun Reserve in West Kalimantan.

No buffer zones are needed at the boundary of Lanjak-Entimau and Batang Ai National Park since the latter is already a Protected Area

Multiple use aspects

Habitat disturbance in the form of harvesting natural products (e.g., rattan, *pandan*, forest fruits) is limited to Buffer Zones, preferably permanent forest reserves surrounding the Sanctuary, and zones established for special rights under the Lanjak-Entimau Enactment (1983).

A substantial number of residents from ulu Kanowit and ulu Ngemah (40-50% from the Socio-economic survey) favour land schemes such as estates for the economic development of their respective areas. Unfortunately, the development of estates adjacent to a Totally Protected Area such as Lanjak-Entimau could create problems stemming either from access via estate roads (human intrusion) or from raids on estate crops by wildlife originating from within the Sanctuary.

Thus conversion of forested or *temuda* land to estate agriculture is not recommended.

Nevertheless, cultivation of rattan or other forest products with economic potential should be encouraged, since such schemes cause minimal disturbance and are compatible with wildlife. This type of cultivation requires relatively little technical or capital input and can succeed economically where estates requiring more technical assistance, besides startup and maintenance capital, might fail.

Access to the buffer zone will not be limited in any way, apart from recognition of the existing proprietary claims of local communities.

Ecotourism access points

Low-impact ecotourism (natural history tours) is allowable only in the Buffer Zones along designated portions of the Sanctuary's boundaries, preferably allied with the presence of either the Field Centre, Sanctuary Headquarters or specific and limited entry points possessing ranger stations.

Ecotourism developed in conjunction with the Sanctuary should be located within the Buffer Zone, providing areas for tourists to assemble before their departure to

various designated sites. Basic facilities for tourists already exist in certain longhouses (in Batang Ai and Btg Skrang, for example) which provide overnight facilities. Lubok Antu is already a major staging point for ecotourism.

Generally, however, tourists should be directed towards the Batang Ai National Park, set up for this purpose and not to Lanjak-Entimau. Lanjak-Entimau, which has been set aside primarily for conservation of biological diversity and should limit tourist use to low impact activities, such as trekking or observing nature (*e.g.*, birdwatching) in the Buffer Zone near the boundary.

Small scale ecotourism areas can be developed in Btg Skrang and Sg. Katibas near the boundary of Lanjak-Entimau and pose no threat to the integrity of the Sanctuary. Tourists must be excluded from the Primitive and Core Zones.

1.6.2 Scientific or Wilderness Zone

Concept and limits

The limits of this zone are the existing boundaries of the Sanctuary, and internally are posted at rivers and ridges, which must bear conspicuous permanent signboards notifying visitors at points of entry. The Wilderness Zone's inner limits are follow the boundary of the Core Area.

The Wilderness Zone is for scientific research and monitoring, and no permanent facilities are to be constructed apart from basic camp shelters for research or survey teams.

No collection of forest products will be allowed, though this restriction may have to be imposed in stages over five to ten years in conjunction with consultations with local communities.

Research in the Wilderness Zone will provide valuable information needed to understand the composition and dynamics of communities within the Core Zone.

Access and restrictions

Access is restricted to staff of the Sarawak Forest Department and local or visiting scientists. Entry of visitors should be authorised by the Management Committee headed by a senior officer of the Forest Department. All forms of motorised transport are prohibited, except for longboats used by NPWO staff on patrol or scientists conducting research

1.6.3 Core Zone

Concept and limits

The Core Area must be a stringently protected area for endangered species (such as the orangutan), and serve as an example of pristine tropical rainforest habitat free of human disturbance. It will also contain approximately 90% of the known distribution of Lanjak Entimau orangutans.

This area will generally function a "gene reserve" for plants and animals which could eventually become rare or extinct in other parts of Borneo.

The entire central portion of Lanjak-Entimau will be designated as the Core Area (MAP 11). The boundaries of this part of the sanctuary will be the Kalimantan international border to the East, and the entire south bank of the Sg Beloh; the east bank of the Sg Katibas to Ng Bedawak, and all areas southwards, joining with ulu Ensirieng; all areas south of ulu Ensirieng to ulu Skrang; in ulu Skrang southwards from Ng Bekiat to ulu Kaup South of Bkt Lanjak, westwards to Ng Mabau; from the northern bank of the Sgn Mabau, extending west to the source of the Ng Nyawang, thus following the Kalimantan border in a north easterly direction to the source of Sg Beloh.

Access and restrictions

Access will be severely restricted, with entry limited to Forest Department (NPWO) staff, or scientists with permission of Director of Forests. Ideally, to avoid disturbance, the sum of all such visits by any and all groups including Department staff should be limited to a total of 60 days per year. No hunting,

fishing or gathering of forest products will be permitted, and there will be no construction of trails except for monitoring purposes. No permanent campsites or other such facilities may be constructed.

Where access by river exists, this zone must be demarcated by large explicit signboards.

1.6.4 Special Areas

Recovery areas

Several areas included in this zone currently under natural recovery from secondary forests or *temuda*, they be used for research. Localities include ulu Mujok and ulu Ngemah.

Historical sites

Historical sites such as the abandoned Iban fort at Bukit Entimau, several former longhouse sites (including Sg Latong) dating back at least a century and several traditional burial sites (one immediately downstream of Ng Bekiat) are also included for special protection.

Access and restrictions

Access is open to all, contingent on proprietary claims and consultation with longhouse communities in individual areas in the Buffer Zones. Access to historical sites should be based on advice from the Sarawak Museum concerning the vulnerability of these areas, and legislation relevant to the preservation of historical sites and artifacts. Restrictions will be defined according to the existing laws of the State of Sarawak, specifically the Wildlife Ordinance & Amendments, 1990 as well as land use restrictions relevant to the protection of the Batang Ai watershed.

2.0 RESEARCH PROGRAMME

2.1 Rationale and policy

Lanjak-Entimau represents one of the largest areas of undisturbed tropical rain forest in the Southeast Asian Region. The Reserve has proven its richness as a reservoir of biological diversity and refuge for endangered species. The Sanctuary as a gene bank and as a source of new bioactive compounds has enormous potential. All these aspects will be enhanced by further scientific study. The research programme is summarised in **Section 10**.

Research should have strong local participation, and the results channeled into the interpretive programmes for the Sanctuary, as well as extension activities to bring benefits to the local community.

Information acquired via scientific inventories and monitoring in the Sanctuary should feed back directly into management decisions for ensuring survival of particular communities, species and populations. This data should be incorporated for retrieval and comparison purposes into the Geographical Information System (GIS) which has already been initiated for the Sanctuary.

Lanjak-Entimau should provide the research underpinning for identification of useful species or isolation of new compounds, but not harvest or production (which must be pursued in areas outside the Sanctuary).

Research findings should feed back directly into management decisions for ensuring survival of particular communities, species and populations. Research should also have strong local participation, and the results channeled into the interpretive programmes for the Sanctuary, and extension activities to benefit the local community.

The Lanjak-Entimau Sanctuary as a gene bank and as a source of new bioactive compounds has enormous potential, but should only provide the research underpinning for identification of useful species or isolation of new compounds, and not harvest or production (which must be pursued in areas outside the Sanctuary).

Linking of research programmes between commercially exploited habitats (i.e., the ITTO Model Forest Management Area) would be extremely valuable in understanding the effects of long-term exploitation the forest ecosystem, to what degree exploited systems are successful in retaining components of the original biodiversity and lessons to be learnt from modified habitats re: management strategies and biological resilience.

Standardised comparisons between Lanjak-Entimau and the Model Forest Management Area, regarding particular species groups, ecological processes such as productivity of biological communities, long-term quality of gene banks and socio-cultural development of local stakeholders in the respective areas will provide valuable inputs for fine-tuning of management programmes in the long-term.

Collection of scientific specimens for research is allowed in the Sanctuary with written permission from the Director of Forests. Botanical and zoological specimens are to be deposited with the Sarawak Forest Department.

All researchers must be required to deposit three copies of any research findings/publications with the Forest Department, for eventual deposition with other relevant institutions.

Should the Sarawak Forest Department be corporatised, it may eventually wish to recoup some of the costs of management through fees charged to foreign scientists based on the type and length of their research programme.

2.2 Botanical Research

2.2.1 Systematics and taxonomy

The Malaysian flora consists of more than 10,000 kinds of seed plants, many of which can be lost if forest habitats are modified. The present botanical inventory of Lanjak-Entimau has merely scratched the surface, and should be extended for at least five years.

2.2.2 Medicinal plants

A total of 125 plant species of medicinal use have so far been identified from Lanjak-Entimau forests (Chai, 1995). These are but a fraction of the currently recognized number of 285 (Chai, et al., 1994). The flora should be systematically investigated for compounds of potential use as therapeutic agents. General phytochemical screening will be necessary as part of an intensified taxonomic survey of the Lanjak-Entimau flora. Simple tests and extractions can be accomplished at the Field Station, with more complete analyse performed elsewhere.

2.2.3 Ecology

Studies of succession within Sanctuary forests of various ages or on various soil types will be of interest to foresters where sustainable use of timber resources is practiced. Comparative ecological studies between secondary and virgin forests with reference to species colonisation, succession and mortality should be implemented in appropriate areas of Lanjak-Entimau.

2.2.4 Gene banks and seed sources

Seed reservoirs should be established for commercially valuable plants such as timber species and fruit trees, as well as species for use in dyes or perfumes, or plants of medicinal significance.

A forestry gene bank in the Core Zone will be located at two sites, Bukit Sengayoh (ulu Katibas) and Bukit Entimau (ulu Mujok). These sites both possess a high concentration of dipterocarp species between 200-700 m asl.

2.3 Zoological Research

2.3.1 Primates and other mammals

Primate research should focus primarily on the orangutan and to a lesser extent, the white-fronted langur. Other species can be included as sub-projects of the

main research programme. Research projects suggested by the ITTO Primatologist, as well as projects relevant to the mammal fauna as a whole, are given below:

- Survey Lanjak-Entimau orangutan population densities extending into Batang Ai National Park, and their correlation with fruit tree abundance (maintain a long-term database on tree phenology); include investigation of competitive interactions between orangutans and gibbons in Lanjak-Entimau.
- Sample of genetic variability within the Lanjak-Entimau orangutan population as an index of ecological resilience of the population (a safe, specially developed darting technique will be used for this).
- Investigate competitive interactions between white-fronted and maroon langurs in Lanjak-Entimau
- inventory of the small mammals of the Sanctuary (including bats)

2.3.2 Birds

The diversity of birds in the Sanctuary mirrors the species richness of Sarawak's interior forests as a whole. Much remains to be learned of species interactions within avian communities. Future management decisions can be guided by such data. Suggested research projects are listed below.

- Ranging behaviour and competitive interactions of hornbills (Bucerotidae)
- The biology of avian pollinators in the forest
- Seed dispersal by frugivorous birds
- Habitat use by avian community in forests of different ages in Lanjak-Entimau

(Most of these will be implemented as independent projects, e.g. by outside agencies)

2.3.3 Herpetofauna

An inventory of the Lanjak-Entimau herpetofauna should continue for a period of five years to provide reliable faunal check lists, and to provide baseline data for a monitoring programme. Such data will complement a global interest to monitor amphibians, which are reported to be declining in pristine habitats in other countries. The suggested research programmes are:

- Audiovisual documentation of forest herpetofauna, such as sound, video and photographic records of individual species;
- Radio tracking for population and home range studies
- Studies of trophic (feeding) relationships and community composition
- Studies of genetic variability of selected species of herpetofauna

Research projects linked to development of the economic potential of the herpetofauna include:

- Research on the suitability of certain herpetofaunal species such as *Rana blythi* (*pamah*) or *Trionyx chinensis*, and *Dogania subplana* (*labi-labi*); *Varanus salvator* (*biawak*)
- Non-food uses of the herpetofauna (for medicines, etc.) including bioactive compounds from herpetofaunal venoms or skin secretions

2.3.4 Fish

Casual collections of fish made during herpetofaunal surveys indicate a rich and highly distinct fish fauna in the intricate watersheds of Lanjak-Entimau. Thus, systematic collections of fish should continue in conjunction with herpetofaunal surveys. Also, since overfishing has tended to deplete fish stocks in downriver

areas, and has led to encroachment problems in the Sanctuary, making studies of the Lanjak Entimau fish fauna rivers a high priority.

Suggested studies include:

- An inventory of the fish species of Lanjak-Entimau
- experimental fish farming of selected local fish species (in conjunction with a watershed protection programme)

2.3.5 Insects and other invertebrates

Systematic collections of insects and other invertebrates groups should continue, and a central synoptic collection of insect specimens retained in a State level facility for reference purposes, and for training local entomologists in the future. Cooperation with local and international scientific institutions will obviously be important for purposes of identification and other technical support. Research projects should include:

- A more in-depth inventory of the insect fauna of the Sanctuary, with emphasis on the Coleoptera (beetles)
- Pollination and biological control by insects (because of the obvious economic application in the forestry and agriculture sectors)

2.3.6 Applied zoological research

The matter of overpopulated species or badly distributed species is occasionally raised in Parks and Protected Areas, but such a phenomenon is unlikely to arise in the climax habitat of Lanjak-Entimau, where a natural "equilibrium" already exists. Although there will be fluctuations in local populations, long-term population trends should stabilise naturally without any need for human intervention.

Baseline studies are required on fish and game species upon which local people depend. Such studies should be goal-oriented, to promote effective non-destructive harvest methods and to estimate sustainable rates of exploitation (based on objective, long-term field data).

Because of their significance as sources of protein for surrounding communities, game animals found in Lanjak-Entimau should be among species targeted for research. A long-term research programme should be initiated on the distribution, abundance and population dynamics of sambar deer (*Cervus unicolor*), barking deer (*Muntiacus muntjac*), mouse deer (*Tragulus napu* and *T. javanicus*) and bearded pigs (*Sus barbatus*).

Local experts are available for this work (i.e., in Malaysian universities), and overseas cooperation can be easily obtained. Local longhouse people must also be recruited since such information is crucially important to them.

A related problem of "incursions" or invasions by species from inside the Sanctuary into crops growing outside the boundary is a serious matter. Crops grown in shifting agricultural plots are natural targets not only of insect pests but of forest rodents, primates and ungulates, which can and do cause serious losses. Research projects to develop effective approaches to crop protection will be much appreciated by local residents, and will foster cooperation between the community and the Sanctuary authority.

2.4 Socio-economic research

2.4.1 Shifting cultivation and rice growing

The slash and burn methods of shifting cultivation are an ongoing threat to Lanjak Entimau, the most active areas located on the northern (ulu Mujok, ulu Ngemah and ulu Poi) boundaries (MAP 12).

Thus research should concentrate on :

- analysis of factors contributing to the proliferation of shifting cultivation, and possible solutions to the problem, such as development of terraced rice culture;
- evaluation of current measures and policies, and feasibility studies of measures to rehabilitate degraded boundary areas through new forestry programmes;
- development of seed nurseries or herb gardens of economically valuable plants.

2.4.2 Community development-oriented research

Further research on the current problems and needs of communities also needs to be done, such as:-

- Evaluation of current health care needs through a study of public health in longhouses near of Lanjak Entimau (Ministry of Health)
- feasibility studies of how local longhouses may participate directly in low-impact ecotourism (Ministry of Tourism)
- further studies on longhouse development programme (e.g., growing of rattan in the Buffer Zone), in line with current changes in demography and the local economy (Ministry of Agriculture; Ministry of Resource Planning)

2.5 Research policy

Researchers from local institutions should be encouraged to do research in the Sanctuary, perhaps through concessionary rates on use of the field station facilities, partial assistance with manpower needs, or through small grants of financial assistance from a fund specially set up for the purpose of promoting local research.

Researchers from institutions of higher learning should receive the consistent backing and research projects by secondary school students should also be encouraged. Participation in species or population counts by local upper form or university students will enhance levels of local expertise while providing valuable input into interpretive programmes for the general public.

The principal condition for their participation will be only that they agree to follow any regulations or restrictions as laid down by the Forest Department for the protection of the Sanctuary and non-interference with the projects of other researchers.

2.6 International collaboration

Local researchers should also be encouraged to collaborate with international institutions, particularly those with an existing large database in plant or animal systematics and taxonomy from Borneo. Many of these institutions have tens of thousands of reference specimens, and can provide crucial technical support in identification of specimens, bibliographies for taxonomic research and other publications.

Research proposals should be submitted for approval to the Sarawak Forest Department. Guidelines for priority areas, charges for facilities, and other regulations will be decided by the Department. These Guidelines may be drawn up by the NPWO to avoid conflict between, or duplication of projects. The central philosophy of the guidelines should promote research into basic systematics/taxonomy and ecology for better management of the Sanctuary and enhancement of knowledge concerning Sarawak's Natural Heritage

2.7 Priority research areas

Though the policy for disbursement of grants any Lanjak-Entimau-related fund should not be restrictive, studies involving animal and plant taxonomy (the Sanctuary's real wealth) or related disciplines such as the studies of bioactive compounds, should be given priority.

Second priority should be given to autecological studies (studies of the natural history of single species), with other projects to be considered for funding subsequently. Ecological projects can potentially aid management decisions as well as furnish raw materials for an interpretive program both for Lanjak-Entimau and also for the adjacent Batang Ai national Park.

3.0 EDUCATION AND TRAINING

3.1 The role of the National Parks and Wildlife Office

The existing education programmes of the NPWO should be extended to the communities residing on the periphery of Lanjak-Entimau Sanctuary, to foster dialogues with community leaders on the Sanctuary's functions and goals. The meetings should include the usual illustrated talks, posters on wildlife conservation, pamphlets on conservation-related matters. Short courses for longhouse leaders on biological conservation and its purposes can be given by the NPWO.

3.2 Secondary school programmes

Visits by schools and special student programmes relating to Lanjak-Entimau will enhance perception of the Sanctuary as a heritage in which all Sarawakians have an interest. All visits by secondary or primary schools must be well-supervised, efficient, and safe.

3.3 Field Courses

The use of the Sanctuary Field Station for field courses conducted by institutions of higher learning should be encouraged, with the view to producing more local experts (both amateur and professional) in systematic biology and ecology.

3.4 Training Programme

3.4.1 Key features

The training programme will be based on several basic features, which include

- integration with the research programme;
- on-the-job or work-study in collaboration with recognised local or international experts with direct Bornean or Southeast Asian experience);
- conducted both in the field and in the laboratory, with opportunities for occasional presentations of results by local staff;
- based at the Field Centre, though it can be conducted throughout the Sanctuary;

3.4.2 Levels of training

Training will also be offered at a variety of levels, appropriate to the selected officers, staff or local residents who may be involved. Categories or levels which should be available and their contents are given below:

<u>Category</u>	<u>Content or emphasis</u>
Local residents	"Parataxonomy", including basic identification and basic ecological concepts; Basic life history information for use in experimental farming of species; 1-3 month attachment to a field project
Forest Guard	Learn or refine observational or experimental techniques of studying flora and fauna in the field; Identification and basic taxonomy ,life history of species; recording of scientific data; operation and maintenance of field equipment; 1-3 month attachment to a field project

Science Officer Learn or refine observational or experimental field techniques of research on flora and fauna; Defining objectives and hypothesis testing; Identification and taxonomy, life histories of important species; operation and maintenance of field equipment; recording of scientific data and analysis of results; oral and written presentation of results; 3-6 month attachment to a field project

Senior Forest Officer Personnel management (instruction by local consultant or expert); Prioritising and coordination of projects; Compilation and referencing of research results and their use in management; collaboration with project consultants

Training of NPWO staff and other Forest Department will be on a regularly scheduled basis, and will take place both in the field and in the classroom. Special courses for local community leaders or other residents in scientific techniques and conservation will have been conducted and will be refined and modified according to perceived needs.

4.0 COMMUNITY RELATIONS PROGRAMMES

4.1 Traditional Use Zones and protection programmes

The longhouse communities granted special privileges in the Sanctuary in 1983 will require special attention to ensure the integrity of the boundary of the Sanctuary. The following longhouses should be linked to any special development efforts or cooperative programmes involving the Sanctuary:

Area	Number of longhouses*
ulu Mujok	3
ulu Ensirieng	1
ulu Ngemah	2
ulu Katibas	3
ulu Engkari	3
ulu Poi	2

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* Uppermost along the respective rivers, *i.e.*, nearest to the Sanctuary. This list may require revision, as there have been changes in the names and/or location of some of the longhouses since 1983.

4.2 Education and outreach programmes

An outreach effort to promote the positive values of the Sanctuary should be instituted as soon as possible, based on the existing programme of the NPWO. Positive values of conservation include:

- i) availability of clean water
- ii) refuge for replenishment of fish and game stocks
- iii) seed stock of economic or conservation significance for forest products
- iv) Buffer Zone for obtaining non-timber forest products

The outreach programme tailored to reinforce existing socio-cultural views, to encourage cooperation in protection of the Sanctuary and its resources.

4.3 Agricultural extension programmes

As emphasised in the ITTO Sociologist's report, the most pressing problem of the local communities is insufficiency of rice and to a certain extent, protein. This problem should be addressed to ensure the assistance and cooperation of local people in managing the Sanctuary.

Also, the role of local communities and their use of the Sanctuary must be thoroughly understood through research into their perceptions and problems.

Experimental husbandry of animal species with economic potential, or extension assistance for livestock should be introduced such as better quality chickens and pigs, for example.

4.3.1 Aquaculture

Longhouses located within the Buffer Zone will benefit from expansion of Agriculture Department in fish culture facilities (ponds or cages) to their areas, since fish is still the chief source of protein in rural localities such as Lanjak-Entimau. Nevertheless, these programmes should use local fish species to avoid any possibility of damage to local ecosystems by the escape of exotics (*e.g.*, tilapia).

Development efforts should include watershed protection programme, as has been implemented in Gunung Leuser National Park (Griffiths, 1993), where fishing is banned completely from specific stretches of river within the Protected Area, which results in recovery of fish stocks and generally improved fishing downstream. Such areas not only provide improved yields for community use, but might also be used by licensed sports fishermen guided by local residents for a fee.

4.3.2 Animal husbandry

Assistance in providing improved livestock, particularly chickens and pigs, should also be considered, though no large scale livestock (or fish) husbandry projects should be permitted within less than 10 km of the Sanctuary boundary. The danger of encroachment and pollution from such operations makes them highly undesirable in the vicinity of a pristine area.

4.4 Changes in land status

The ITTO Sociologist has reported that at least have the local residents interviewed are in favour of strict adherence to Forestry regulations generally and Sanctuary regulations in particular.

Among their reported requests were the allocation of communal forest areas within the vicinity of their longhouses (*e.g.*, the Buffer Zone) for the gathering of construction materials and other natural forest products. These areas should be discussed with appropriate representatives of the Forest Department and District Office.

4.5 Community-based self-help programmes

4.5.1 Horticulture, husbandry and cottage industries

Assistance from appropriate Government agencies (such as the Agriculture Department) in the marketing of natural forest products from the Buffer Zones. Sustainable use of certain forest products such as engkabang ("illipe nuts") has been practiced for centuries, and the collection and marketing of other non-timber forest products can be further developed. Local agencies such as universities should conduct studies on ways to improve marketability of jungle fruits. Prospects of annual return via accessibility to reliable markets may curb the cutting of mature trees to obtain fruit, and the planting of orchards as an alternative.

Natural materials such as bamboo, rattan, economically valuable wild fruits (*e.g.*, durian) and fast growing pulpwood tree species or species with plywood potential (*kalumpayan*) & associated handicrafts can be developed as cottage industries, with Agriculture Department assistance in marketing and logistics.

Cultivation of forestry seed stock by longhouse communities near Lanjak-Entimau also has economic potential. Assistance in the experimental cultivation of seedling nurseries or herb gardens (medicinal plants) by local communities in conjunction with the research programme can generate needed cash income.

The Agriculture Department or the Forest Department should investigate the feasibility extension education in the development of such herb gardens or animal breeding programmes. Short courses accompanied by simple handbooks containing concise descriptions of how to set up small-scale fish culture or other breeding projects such as butterfly farming can be produced by the Agriculture Department as part of the extension programme.

The popularity of local honey can make bee keeping by longhouse people, now merely a subsistence activity, a potentially profitable venture. A network of production and distribution of *kampung* honey already exists in Sabah (under Kooperasi Pembungunan Desa), and could serve as a model.

Finally, cottage industries in handicraft should be developed, including basketry, wood carving and painting. Assistance such as improved tools should be provided, along with assistance in marketing (especially where transport is concerned).

4.5.2 Participation in ecotourism and research

Local people already possess considerable expertise and talent to work as guides for wildlife research tours. Activities in which they could participate effectively include trekking (limited to their traditional areas near the Sanctuary boundaries (Buffer Zone), birdwatching, herpetology tours and sport fishing or whitewater rafting expeditions, to name a few. Culture aspects of tourism can be easily integrated with such programmes.

4.6 Management of hunting

The Sanctuary has been a traditional hunting ground of the local Iban people for centuries, so that hunting can be controlled only gradually, perhaps over a period of 10-20 years. Data on hunting should be compiled on a regular basis so that its frequency and extent can be monitored. Hunting within the Buffer Zones will be permitted since it not only provides cheap and nutritious protein, but performs a traditional/cultural function.

Nevertheless, intrusions of hunters into the Sanctuary proper must be consistently discouraged, and anti-hunting regulations strictly enforced.

5.0 INFRASTRUCTURE

5.1 Headquarters

5.1.1 Rationale

The Headquarters for Lanjak-Entimau Sanctuary should be located at Ng Beloh in ulu Katibas. (Locations of all proposed facilities are given in **MAP 13**). Although this location is relatively isolated, it is accessible most of the year, and provides the most extensive access into Lanjak-Entimau. The Katibas watershed covers the largest area of any single river in the Sanctuary. Justification and uses of facilities is given in **Table 2**.

Furthermore, administrative and technical backup are available from the existing Sarawak Forest Department office in Song, on the Rejang River.

5.1.2 Facilities and functions

The Headquarters should consist of an office cum visitors quarters which can also serve as a meeting room, and accommodation for a minimum of four rangers (forest guards) and their families, either in a separate longhouse-style block or as individual housing units. All buildings must be on high ground with a good vantage point.

5.2 Research or Field Centre

5.2.1 Rationale

The Research Station (Science Centre) will serve for basic field research in taxonomy and ecology, as well as for daily collection of environmental data.

Research into biodiversity-related fields such as traditional use of plant and animal products by local communities can also be done at this facility.

5.2.2 Facilities and functions

The existing Base Camp at Ng Segerak is suitable for development as a permanent Research Station. A Base Camp with a dormitory and dining facilities for 20 persons currently exists. Additional facilities which will be required include:

- i) a split-level or double-storey building housing a laboratory with basic facilities for Botany, Zoology and Entomology;
- ii) a hydrological/climatological station;
- iii) separate store rooms suitable for temporarily housing plant and animal specimens (before they are transferred to proper facilities such as the Sarawak Biodiversity Centre;
- iv) a drying facility (solar) for plant specimens
- v) a general administrative office;
- vi) a multipurpose / assembly room.

Electricity supply could possibly be provided via solar panels, depending on expense and efficiency.

A wide variety of aquatic, terrestrial and altitudinal habitats are accessible either by longboat or via a good trail network within a day's travel (**Map 14, Appendix XV**). Bukit Lanjak with its montane and hill forest lies within a one to one and one-half day's walk.

Additional facilities required at the Station are a laboratory, generator / maintenance shed and a weather station with basic environmental monitoring equipment. The laboratory should be spacious enough to allow sufficient bench space (ideally not less than a two meter portion per person) for at least eight scientists working simultaneously,

The Field Station for Lanjak-Entimau should be set up to cater principally for biodiversity-related research projects. However, restrictions on any project should be made only if it provides no information relevant to management or education programmes.

5.3 Ranger stations

5.3.1 Rationale

Ranger stations should be allocated according to population density in peripheral areas of Lanjak-Entimau, and protection of sensitive floral or faunal elements. An NPWO station currently exists in Ng Ju, ulu Mujok, which should be refurbished to the same standard as other stations to be developed in Phase II. Population densities in Kanowit/ulu Mujok and ulu Ngemah are relatively high thus requiring an NPWO to curb illegal entry or use of the Sanctuary.

A history of incursions, particularly of hunting by outsiders in ulu Katibas suggests the importance of a ranger station there also as an integral part of a Headquarters at Ng Beloh. Regarding sensitive species, a ranger presence is necessary in ulu Engkari (Nanga Segerak) to monitor possible incursions or disturbance in areas of high orangutan densities.

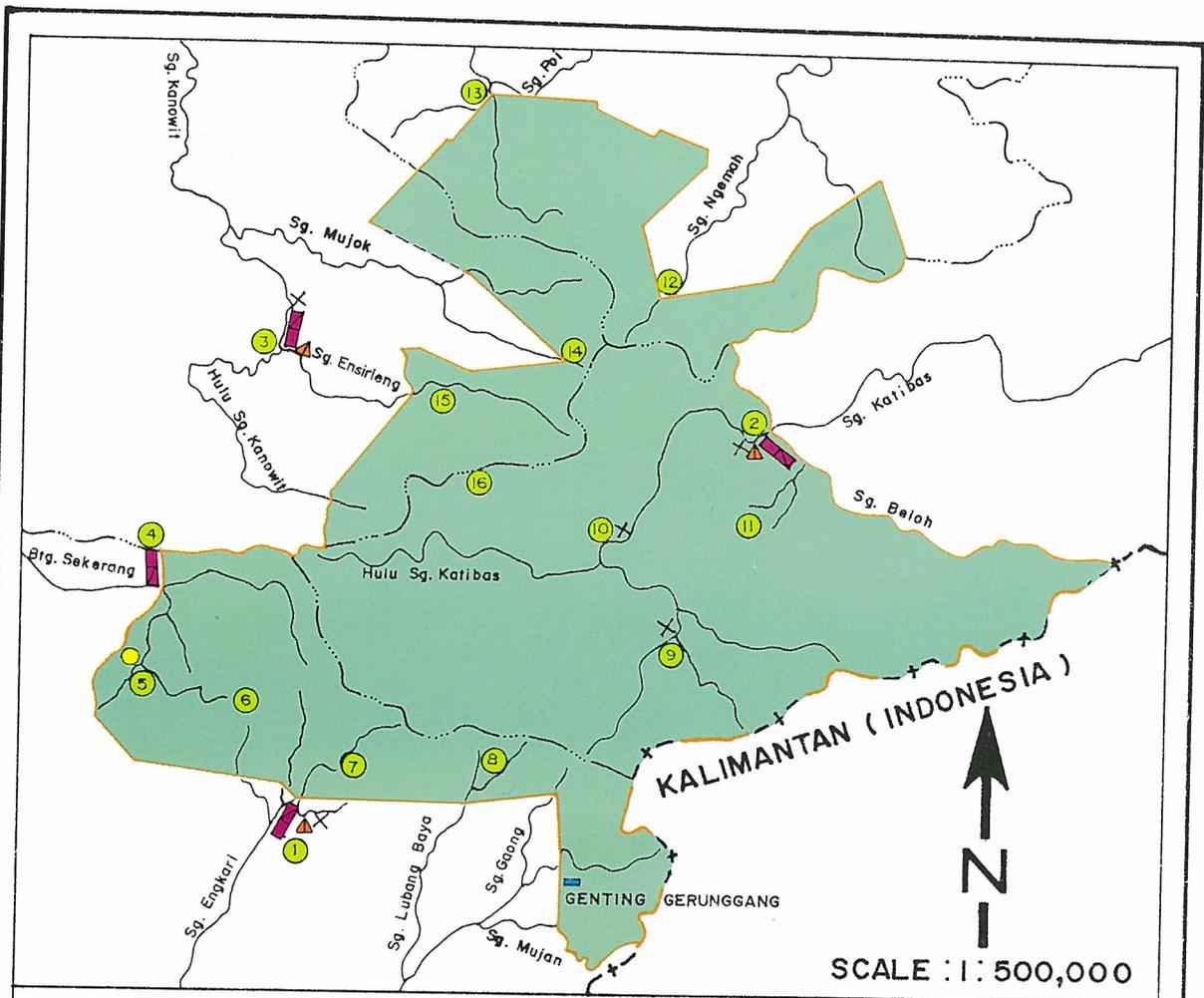
All stations (including the Headquarters and Field Centre) must be linked by radio, perhaps via repeaters installed on Bukit Lanjak, Bkt. Entimau and Bkt. Sengayoh.

Locations of all ranger stations and guard posts are given in **MAP 13**.

5.3.2 Facilities and functions

Each ranger station should consist of the following quarters for four visitors:-

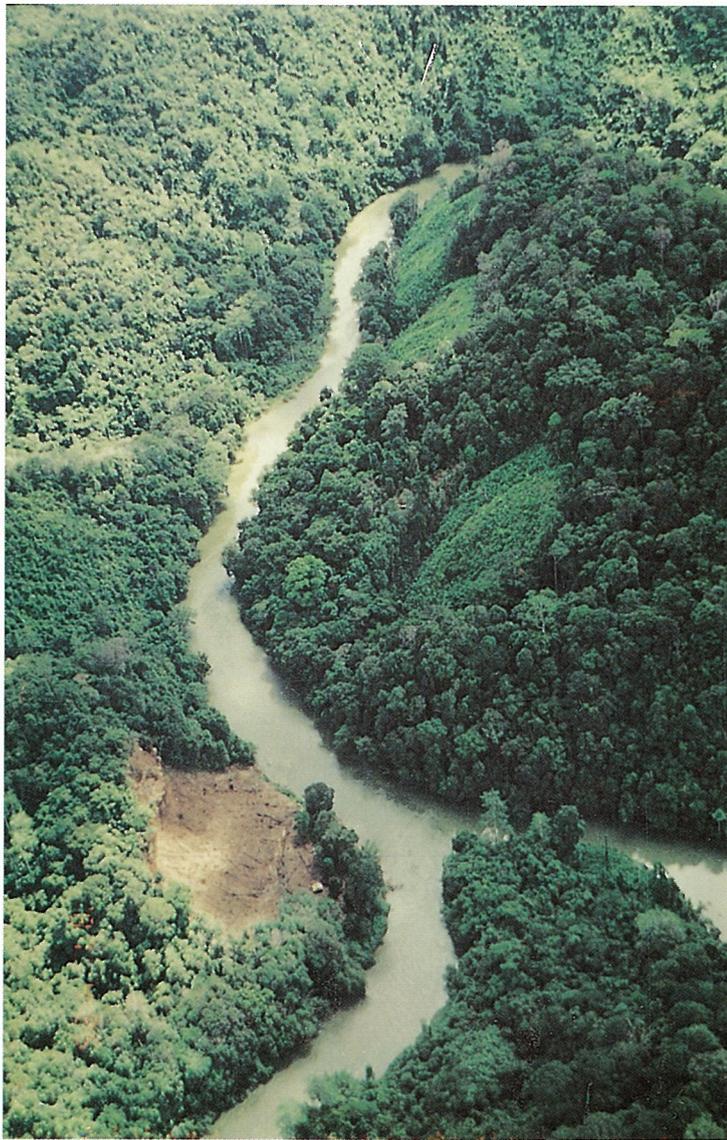
- i) a small office with administration
- ii) Ranger living quarters either single or as duplex units, depending on terrain or plans for sequential expansion
- iii) Separate quarters for field assistants and visitors



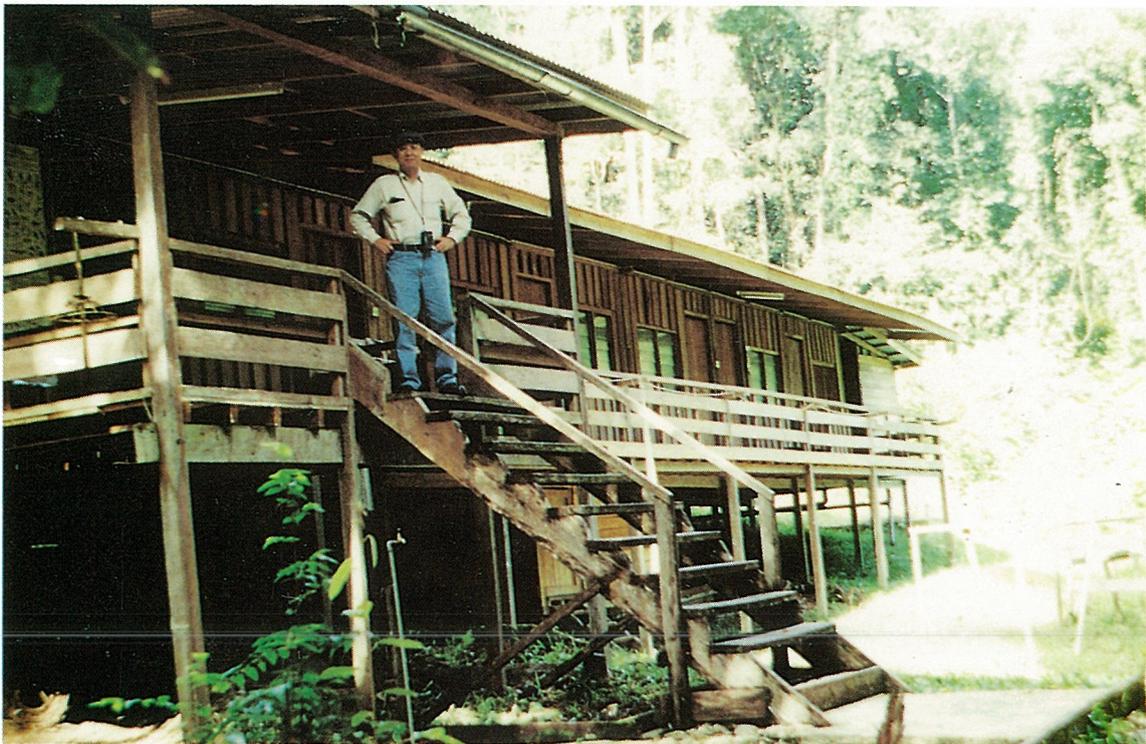
LEGEND

Lanjak-Entimau W.S. Boundary		5	NG. BEKIAT (ULU SEREMBUANG)	SUB CAMP
Sub Camp.		6	UBAH RIBU (AT 700 M)	SUB CAMP
Climatological Station		7	MABAU	SUB CAMP
Ranger Station		8	SG. LELAP	SUB CAMP
Heli Pad / Landing site		9	SG. LATONG	SUB CAMP
Divisional Boundary		10	SG. TEBELLIAN	SUB CAMP
International Boundary		11	BUKIT SENGAYOH (AT 500 M & 900 M)	SUB CAMPS
		12	SG. PEDALAI	SUB CAMP
		13	NG. BILAT	SUB CAMP
		14	NILAU	SUB CAMP
		15	SG. ENSIRENG	SUB CAMP
		16	BUKIT ENTIMAU (AT 600 m)	SUB CAMP
1	NG. SEGERAK	FIELD STATION : RANGER STATION, QUARTERS, CLIMATOLOGY STATION, LABORATORY FACILITIES.		
2	NG. BELOH	HEADQUARTERS : RANGER STATION, QUARTERS, LABORATORY FACILITIES, CLIMATOLOGY STATION.		
3	NG. JEMARANG	RANGER STATION, STAFF QUARTERS, GUEST QUARTERS, CLIMATOLOGY STATION.		
4	NG. SEREMBUANG	RANGER STATION, STAFF QUARTERS.		

MAP 13: LOCATIONS OF ALL FACILITIES WITHIN THE LANJAK-ENTIMAU WILDLIFE SANCTUARY.



P19 : Proposed Headquarters site at Nanga Bloh, ulu Katibas



P20 : ITTO forest ecologist, Dr P.K. Chai at the Ng Segerak base camp, ulu Engkari

Visiting Department staff or scientists can be accommodated either in special quarters or in a multipurpose room which can be converted to temporary accommodation.

A small interpretive centre can be constructed separately so in conjunction with the simple accommodation unit for visitors.

Ranger posts will be used for checking traffic into the Sanctuary at their entry point, and the recording of the names and particulars of those entering this information is necessary for safety as well as enforcement purposes.

5.4 Patrol posts and sub-camps

5.4.1 Rationale

Staff or scientists will require permanent camp sites for use in monitoring or research programmes. All such camps must be located peripheral to the Core Zone (MAP 11).

5.4.2 Facilities and functions

Basic camp facilities will require the following:

- i) a floor composed of a cement slab
- ii) a galvanised steel pole framework for canvas flysheets. These sites will be the point of origin for a limited trail network located in the Primitive Zone.

Camps will be an operational base or stopover points either for ranger patrol groups or for scientists working on taxonomic and ecological surveys, or population monitoring.

6.0 STAFFING

6.1 Consultants and local counterparts

<u>International Recruitment</u>	<u>Local Recruitment</u>	<u>Forest Department Counterpart</u>
A Hydrologist	Private sector	Forest Dept Engineer
B Forest Ecologist	University	FD Research (Herbarium)
C Primatologist	University	NPWO
D Game Management Specialist	University	NPWO
E Ethnobotanist	Traditional medicine specialist	FD Research
F Small mammal taxonomist	University	NPWO
G Herpetologist	University	NPWO
I Ichthyologist	University	NPWO
J Entomologist (Beetle specialist)	University	FD Research
K Audiovisual specialist	Sound Engineer or photographer	NPWO photographer
L Horticulturalist	Horticulturalist	Ministry of Agriculture
M Rattan specialist	Applied Botanist	Ministry of Agriculture

6.2 Sanctuary staff

<u>Position</u>	<u>Qualifications and experience</u>
Sanctuary Warden/ Ecologist	Must have a basic degree, and experience in field postings; must possess a high level of motivation and initiative in conservation work, organisational ability and be able to communicate well with his superiors, co-workers and local community leaders.
Administrative officer	Must have experience in office work, such as maintaining records and files; Must be willing to assist in the production of regular reports on the activities of the Sanctuary, and be able to communicate well with visitors.
Rangers/Forest Guards	Must have experience in field work and ability to keep daily records. Must be willing to spend considerable portion of time on field projects.

7.0 TARGET BENEFICIARIES OF MANAGEMENT PROGRAMMES

7.1 Biological communities of Lanjak-Entimau

The natural biological communities will benefit not only from protection programmes, but from the findings of research into their ecological requirements, via inputs for management.

7.2 Staff of the NPWO and others of the Sarawak Forest Department

These staff members will receive training and experience in scientific and field techniques, and in conservation management, while the Department will benefit directly from scientific information acquired;

7.3 Local community leaders and longhouse residents

These local inhabitants on the periphery of the Sanctuary will be employed in scientific field research, infrastructure development or other sanctuary programmes, and will be offered special training in field biology and conservation;

7.4 Local students

Local students at the secondary and tertiary level will be provided opportunities for valuable field training or longer-term research programmes in Lanjak-Entimau. The usual problem of conservation areas linked to research programmes has been that development of local expertise consistently lags behind, partly because of focus on projects proposed primarily by international researchers. Emphasis on direct local participation in research and educational programmes should help to address the problem, particularly if local students are given encouragement and incentives to work in the Sanctuary.

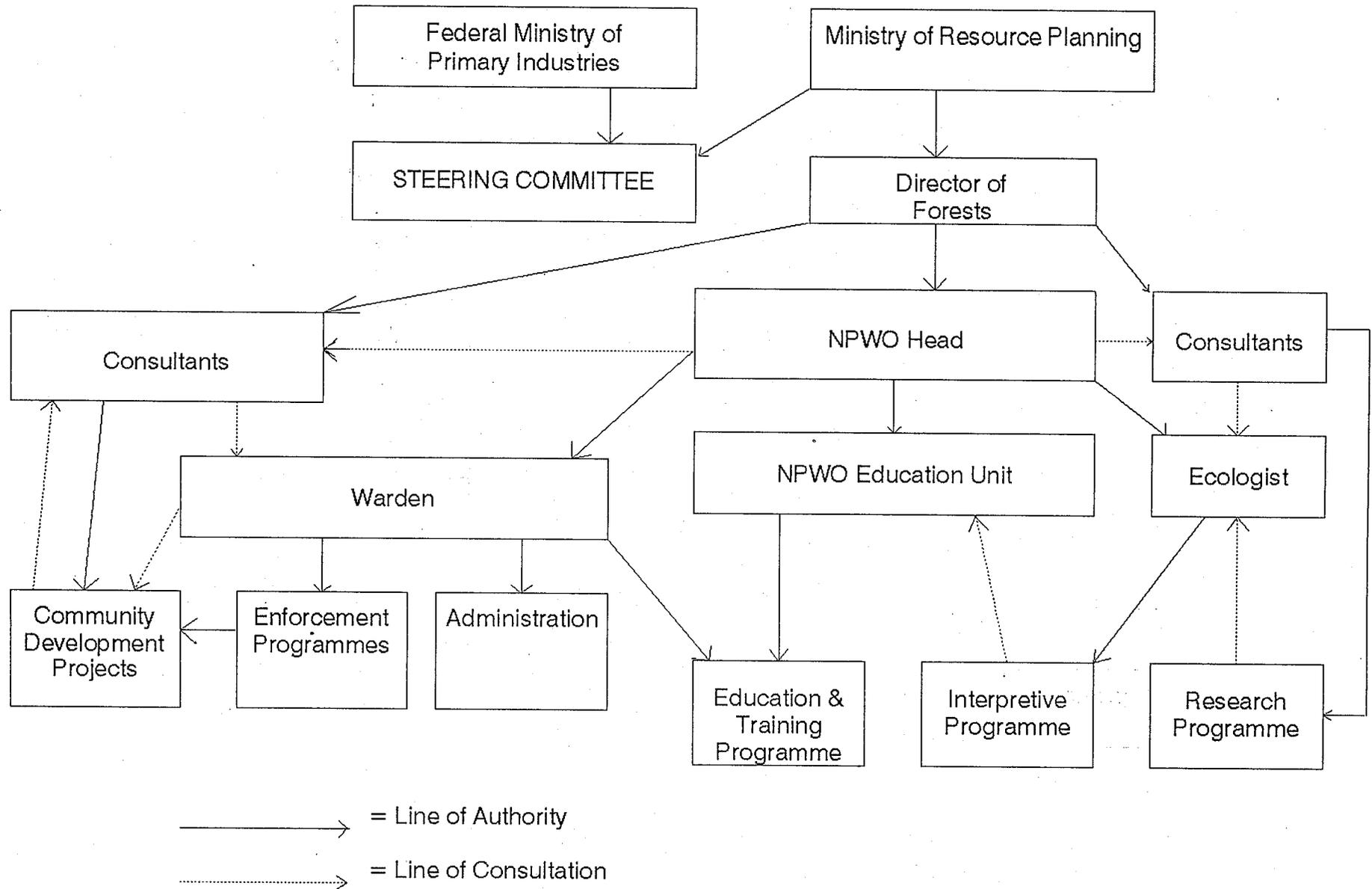
8.0 SCHEDULE FOR MANAGEMENT ACTIVITIES

The programmes described in the management plan will be implemented according to the Work Plan (**Figure 4a**):

8.1 Zonation

- Establishment and marking of Core Area, Wilderness and Buffer Zones (Year 1)

FIGURE 4a : Organisation chart for implementation of the Lanjak Entimau Management Plan



8.2 Infrastructure

- Construction of Headquarters, Field Centre and Ranger Stations (Years 1& 2)
- Trail network for research and monitoring (Years 1&2)

8.3 Protection

- Boundary cleaning (Year 1)
- Patrols and enforcement (Years 1-3)

8.4 Staffing

- Recruitment of consultants (Year 1)
- Recruitment of Sanctuary staff (Year 1)

8.5 Community consultation and development

- establishment of community consultative groups (Year 1)
- review the list of designated longhouses in the 1983 Gazette
- development of non-timber products cultivation, community development projects (herb gardens, fish protection and farming, etc., Years 1-3)
- development of limited oil palm estates managed by independent communities

8.6 Research

- Core Area (Monitoring 30 days per year, Years 1-3)
- Wilderness/Scientific Zone (Initial surveys, Year 1)
- Research projects (Years 1-3, extensions possible)

8.7 Education and Training

- Technical instruction field methods (Year 1)
- Independent sub-projects (Year 2)
- Integrated research and monitoring (Year 3)

9.0 PROJECTIONS FOR THE YEAR 2000

9.1 Changes in Sarawak

By the year 2000, the process of development currently underway will bring significant changes to Sarawak. Changes in harvesting techniques such as helicopter logging, will have markedly reduced environmental damage to the forest. Regeneration within these selectively logged forest should allow the populations of many kinds of wildlife to stabilise, not only from reduction in damage to the habitat, but from the reduced human presence (since the number of access roads and skid trails will be greatly reduced in these areas).

Demographically, Sarawak's market economy will push it towards increasing urbanisation, as great numbers of rural dwellers will continue the present trend of moving into towns or cities in search of employment and better education. This trend can be seen in many of Lanjak-Entimau's peripheral communities, where households are frequently composed of persons past employment age. The effects on Conservation areas such as Lanjak-Entimau will be positive, since pressure on land near the Sanctuary should decrease, and potentially detrimental activities such as hunting of non-game species may be reduced to occasional visits by "urban cowboys", incursions which are more easily prevented.

9.2 Accomplishments of Sanctuary management

The accomplishments in and around the Lanjak-Entimau Wildlife Sanctuary by the year 2000 should include:

- a stable, well-demarcated boundary, with regular patrols;
- a fully operational Headquarters (ulu Katibas), Field Centre (Ng Segerak), Ranger Stations (Ng Jemarang and Ng Serembuang) and twelve sub-camps within the Sanctuary;
- facilities manned by staff trained in personnel management, and scientifically and technically competent to conduct independent field studies;

- monitoring studies of selected plant and animal species and regular consultative discussions with longhouse leaders and residents to receive feedback and iron out problems if any arise;
- permanent research plots for forest ecology and faunal studies
- Seedling and gene banks will be operational in the Bukit Entimau, Bukit Sengayoh and other suitable areas of the Sanctuary.
- record keeping and data analysis for species hunted in the Buffer Zone
- small scale exhibits and trails with interpretive facilities in designated areas near the Headquarters and Ranger Stations
- community development programmes, such as:
 - i) affirmative-action employment of local residents in Sanctuary management programmes;
 - ii) fisheries protection and management programmes by local communities;
 - iii) small scale fish farming (ponds) and herpetofauna farming;
 - iv) Seedling and herb gardens, and marketing of their produce;
 - v) communal harvesting and marketing of non-timber forest products (rubber and rattan, wild fruits, etc.) from forested Buffer Zone Areas;
 - vi) growing of pulpwood trees as rehabilitation of degraded secondary forest;
 - viii) terraced padi cultivation
 - ix) established cottage industries such as weaving, mat-making and basketry
- an official Annual Report on the activities and achievements of the Sanctuary management programme.

10.0 INTERNATIONAL COOPERATION

10.1 Need for International Assistance

Sarawak has an excellent network of national parks and wildlife sanctuaries, and its existing qualified staff obviously contribute to an encouraging outlook for conservation of the biological diversity. Nevertheless, adequate funds, training and research are still needed.

Support and assistance in specialised fields of research will be needed in the short-term to ensure long-term success, i.e., continuation of protection and research programmes by local staff and scientists beyond the year 2000.

10.2 Financial Assistance

Apart from ITTO, potential sources of assistance and funding include organisations such as the United Nations Development Programme (UNDP), international bilateral assistance organisations, national government and non-governmental agencies with international programmes, international banks, corporations and trusts.

In tropical countries the main international agencies that have been involved in conservation are UNDP/FAO and WWF/IUCN, and to a lesser extent the World Bank, UNEP and UNESCO. The range of funds provided by these organisations vary from US\$100,000 to a million dollars or more by UNDP to US\$10,000,000 by the World Bank, over several years.

United Nations agencies most concerned with environmental affairs are FAO, UNESCO and UNEP. The United Nations agency responsible for the execution of protected area management projects is the Food and Agriculture Organisation or FAO with United Nations funding sources, primarily from the United Nations Environmental Programme (UNEP).

Direct support has been given to many protected areas by the United Nations Education, Scientific and Cultural organisation (UNESCO) through the World Heritage Convention and the Man and Biosphere Programme (MAB). These funds are given as grants for research, technical assistance, training and equipment.

The United Nations Environment Programme executes some projects and supports other initiatives such as CITES. The UNEP has a catalytic rather than a mandate for direct involvement in project management and implementation.

Smaller grants or assistance may be sought through organisations such as Conservation International in co-operation with UNESCO and private industry, *e.g.*, in communications technology support.

Nevertheless, support by the International Tropical Timber Organisation as has been shown in Phase I, is perhaps the most efficient and effective means of support for the implementation of the Management Plan.

11.0 SUMMARY OF OUTPUTS FOR THE MANAGEMENT PLAN

(A summary of Project Objectives & Outputs and their verifiable indicators is given in **Table 28 & 29**)

11.1 Infrastructure

- i) a permanent management Headquarters with accomodation for 12 persons;
- ii) a permanent Field Station with laboratory facilities and accomodation for 20 persons
- iii) three permanent Ranger Stations with office and accomodation for six persons
- iv) Twelve permanent subcamps, with basic cement slab and frame for flysheet and hammock beds
- v) A monitoring network of climatology and hydrometric stations (3)
- vi) Two designated seed source / gene bank areas

11.2 Management Guidelines

- i) priorities for biodiversity inventories
- ii) priorities for ecological studies
- iii) identification of areas in the Buffer Zone for community-based forestry projects

11.3 Training

- i) training for rangers, forest guards and local community residents in field techniques and use of equipment *
- ii) conservation courses (flora & fauna, ecology, laws) for local community leaders and residents
- iii) training of local secondary and tertiary students in biodiversity (flora and fauna) and in scientific research techniques*

* i.e. training as "parataxonomists"

Table 28 : Implementation of Project objectives and their verification

Development of Lanjak Entimau Wildlife Sanctuary
as a Totally Protected Area

Project Elements	Objectively Verifiable Indicators	Means of Verification	Important Assumption
<p><u>Development Objective</u></p> <p>Policies, Strategies and implementation procedures for conservation of Lanjak–Entimau Wildlife Sanctuary to provide a development model for other protected areas in Sarawak</p>	<p>(i) Implementation based on completed management guidelines</p> <p>(ii) Strategies and policies adopted</p>	<p>(i) Guidelines in Management Plan</p> <p>(ii) Implementation schedule according to Management Plan</p>	<p>Approach and strategies consistent with Forest Department Policy and local aspirations</p>
<p><u>Specific Objective</u></p> <p>To contribute to knowledge of the ecology and biodiversity of natural forest to improve sustainable forest management</p>	<p>(i) List research project results</p> <p>(ii) List number of local scientists staff, students, local residents trained or involved</p> <p>(iii) List current uses of (i) in development programmes</p>	<p>(i) Research reports and management guidelines</p> <p>(ii) Records of project/course participation</p>	<p>Management programs will be acceptable to various sectors involved</p>

TABLE 29

Elements of Project infrastructure and their verifiable indications
Project Title : Development of Lanjak Entimau Wildlife Sanctuary
as a Totally Protected Area

Project Elements	Objectively Verifiable Indicators	Means of Verification	Important Assumption
1	<u>Infrastructure</u>		
Facilities (1.1-1.3)	Structures to be in place by 18 mo.	Physical inspection	Sub-contracts, award and equipment received
Networks (1.4-1.5)	Stations to be in place by 18 mo.	Physical inspection	Sub-contracts, award and equipment received
2	<u>Management guidelines</u>		
(2.1-2.3)	Two drafts by end of year 2 Final version by end of year 3	Reports	Consultants appointed
3	<u>Research and Development Database</u>		
(3.1-3.3)	Computerised data bases and research reports	Reports and physical inspection	Consultants appointed and equipment received

- iv) interpretive and educational training materials for local residents and general public
- v) Audio-visual documentation of bio-diversity for scientific or office use

11.4 Research

Data Bases on:

- i) climatic and hydrological data;
- ii) key ecological processes (predation, seed dispersal, succession or other community effects, etc.)
- iii) floral and mycological inventories
- iv) floral (and faunal) species of significance or other traditional use;
- v) faunal inventories (small mammals and insects)
- vi) distributions and population of rare or threatened species, and autecology of key species

12.0 SUMMARY OF MANAGEMENT STRUCTURE

12.1 Execution

The project will be executed by the Sarawak Forest Department, Malaysia through the National Parks and Wildlife Office.

The Sanctuary Manager will obtain feedback or dialogues with local communities to be taken into consideration prior to implementation of the various stages of the Management Plan.

12.2 Work Blocks

The main blocks of work for development of the Sanctuary will be implemented as follows (see Work Plan, Figures 4a & 4b)

- i) Infrastructure
 - Headquarters, Field and Ranger Stations through sub-contracts by Forest Department under supervision of Department Engineer.
 - Gene bank/seed source plots by NPWO and Forest Department Botanist.
- (ii) Research and Education
 - NPWO and other relevant Sections of the Forest Department, collaboration with institutes of higher learning.
- (iii) Community development
 - NPWO Education Unit, Forest Department Research Unit and Silviculture Unit
 - NPWO Education Unit

12.3 Organisation

The organisation structure for implementation of the project is given in **Figure 5**.

13.0 BUDGET

A budget for the Project is outlined in **Table 30**

**FIGURE 4b : Time Schedule for Consultants for implementation of the Management Plan
Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area**

	YEAR 1	YEAR 2	YEAR 3				
	12 m/m	12 m/m	12 m/m	Estimated time in weeks			
1. International Coordinator	[Gantt chart: 12m, 12m, 12m]			156			
SHORT-TERM CONSULTANCIES							
2. Environmental Monitoring							
Climatology/Hydrology	8 [Gantt chart: 8m]	8 [Gantt chart: 4m]	8 [Gantt chart: 0m]				
Gene bank/seed source plots	8 [Gantt chart: 8m]	4 [Gantt chart: 4m]	4 [Gantt chart: 4m]				
TOTAL :							
Local	16 = 4 m/m	12 = 3 m/m	12 = 3 m/m				
International	16 = 4 m/m	8 = 2m/m	4 = 1m/m				
3. Research Programme							
R1 Forest succession and growth (ecology)	12 [Gantt chart: 24m]	12 [Gantt chart: 12m]	12 [Gantt chart: 12m]				
R2 Endangered species (orangutan)	8 [Gantt chart: 8m]	8 [Gantt chart: 4m]	4 [Gantt chart: 4m]				
R3 Wildlife (Game species)	8 [Gantt chart: 12m]	8 [Gantt chart: 8m]	4 [Gantt chart: 4m]				
R4 Flora inventory	12 [Gantt chart: 12m]	8 [Gantt chart: 8m]	8 [Gantt chart: 8m]				
R5 Mycology inventory	12 [Gantt chart: 12m]	8 [Gantt chart: 8m]	8 [Gantt chart: 8m]				
R6 Mammals inventory (small mammals)	8 [Gantt chart: 8m]	4 [Gantt chart: 14m]	4 [Gantt chart: 4m]				
R7 Entomology Inventory	8 [Gantt chart: 24m]	8 [Gantt chart: 12m]	8 [Gantt chart: 12m]				
R8 Herpetofaunal inventory	8 [Gantt chart: 12m]	8 [Gantt chart: 8m]	8 [Gantt chart: 8m]				
R9 Fish fauna Inventory	8 [Gantt chart: 8m]	8 [Gantt chart: 4m]	8 [Gantt chart: 4m]				
R10 Audiovisual documentation	8 [Gantt chart: 8m]	8 [Gantt chart: 4m]	8 [Gantt chart: 4m]				
TOTAL :							
Local	92 = 23 m/m	80 = 20 m/m	72 = 18 m/m				
International	132 = 33m/m	52 = 14 m/m	68 = 17 m/m				
4. Community Development & training							
C ₁ - Ethobotanical gardens	12 [Gantt chart: 12m]	12 [Gantt chart: 8m]	8 [Gantt chart: 8m]				
C ₂ - Cultivation of non-timber forest products	16 [Gantt chart: 8m]	8 [Gantt chart: 4m]	8 [Gantt chart: 4m]				
T ₂ - Training courses in conservation & ecotourism	8 [Gantt chart: 4m]	8 [Gantt chart: 4m]	8 [Gantt chart: 4m]				
TOTAL :							
Local	36 = 9 m/m	28 = 7 m/m	24 = 6 m/m				
International	24 = 6 m/m	16 = 4 m/m	16 = 4 m/m				
GRAND TOTAL :							
Local	36 m/m	30 m/m	27 m/m	93 m/m			
International	43 m/m	20 m/m	22m/m	85 m/m			

NOTE : 4  = Local Consultant
4  = International Consultant

4  = Local Consultant
4  = International Consultant

**FIGURE 5 : Work Plan for Management Plan
Development of Lanjak–Entimau Wildlife Sanctuary as a Totally Protected Area**

ACTIVITY	YEAR 1				YEAR 2				YEAR 3			
INFRASTRUCTURE												
Headquarters												
Field Station laboratory												
Ranger Station												
Sub-camps												
Hydrology Stations (and consultant's visits)												
APPOINTMENT OF CONSULTANTS												
RESEARCH + DEVELOPMENT												
R1 Forest ecology & succession												
R2 Orangutan												
R3 Game species												
R4 Flora/ethnobotany												
R5 Mycology inventory												
R6 Small mammals												
R7 Entomology inventory												
R8 Herpetofauna												
R9 Fish fauna inventory												
R10 Audiovisual documentation												
COMMUNITY DEVELOPMENT												
C1 Ethnobotanical gardens												
C2 Cultivation of non-timber products												
Training												
T1 Courses												

TABLE 30 : Proposed Budget for the implementation of the Lanjak Entimau Management Plan
FINANCIAL PLAN FOR F
Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area

ITEM	YEAR 1	YEAR 2	YEAR 3	CONTRIBUTION BY MALAYSIA (MR)	ITTO CONTRIBUTION (\$US)
A PERSONNEL – INTERNATIONAL (M/M)	\$ 297,500	\$ 297,500	\$ 297,500	–	\$ 892,500
B PERSONNEL – LOCAL					
Government counterparts	RM 300,000	RM 300,000	RM 300,000	RM 900,000	
Local Consultants	\$ 124,000	\$ 124,000	\$ 124,000	–	\$ 372,000
LEWS Staff	RM 240,000	RM 240,000	RM 240,000	RM 720,000	
Local Supporting Staff	\$ 80,600	\$ 80,600	\$ 80,600	–	\$ 241,800
SUB-TOTAL	\$ 204,600 RM 540,000	\$ 204,600 RM 540,000	\$ 204,600 RM 540,000	– RM 1,620,000	\$ 613,800 0
C FIELD ACCOMODATION AND TRANSPORTATION					
Headquarters	RM 300,000	–	–	RM 300,000	–
Field Centre/laboratory	RM 300,000	RM 200,000	–	RM 500,000	–
Ranger Stations	RM 200,000	RM 100,000	–	RM 300,000	–
Sub-camps	RM 80,000	RM 40,000	–	RM 120,000	–
2(4x4) Vehicles purchase	RM 150,000	–	–	RM 150,000	–
Setting up/maintenance of Gene Bank	RM 20,000	RM 10,000	RM 10,000	RM 40,000	–
Transport	RM 90,000	RM 90,000	RM 90,000	RM 270,000	–
Helicopter Hire (120 hrs)	RM 32,000	RM 32,000	RM 32,000	RM 96,000	–
SUB-TOTAL	RM 1,172,000	RM 472,000	RM 132,000	RM 1,776,000	–

ITEM	YEAR 1	YEAR 2	YEAR 3	CONTRIBUTION BY MALAYSIA (MR)	ITTO CONTRIBUTION (\$US)
D SURVEYS Boundary Maintenance	RM 150,000	RM 50,000	–	RM 200,000	
E INTERNATIONAL TRAVEL External travel to similar projects	–	\$ 10,000	\$ 10,000	–	\$ 20,000
F FIELD EQUIPMENT					
3 Manual climatological stations (including installation)	\$ 18,000	–	–	–	\$ 18,000
3 Remote rainfall stations (including installation)	\$ 10,000	–	–	–	\$ 10,000
3 River gauging stations (including installation)	\$ 12,000	–	–	–	\$ 12,000
1 Portable equipment set	\$ 20,000	–	–	–	\$ 20,000
Laboratory equipment and supplies (including computer equipment)	\$ 100,000	\$ 50,000	\$ 50,000	–	\$ 200,000
GPS units	\$ 10,000	–	–	–	\$ 10,000
Audio–visual equipment	\$ 20,000	\$ 10,000	–	–	\$ 30,000
Electronic tagging & tracking equipment	\$ 15,000	\$ 10,000	–	–	\$ 25,000
Tools	RM 5,000	RM 5,000	–	RM 10,000	RM 10,000
Nursery pump, piping et.c	RM 75,000	RM 75,000	–	RM 150,000	RM 150,000
SUB–TOTAL	\$ 205,000 RM 80,000	\$ 70,000 RM 80,000	\$ 50,000 RM 0	0 RM 160,000	\$ 325,000

ITEM	YEAR 1	YEAR 2	YEAR 3	CONTRIBUTION BY MALAYSIA (MR)	ITTO CONTRIBUTION (\$US)
G OFFICES AND COMMUNICATION					
Office at HQ (100m2)	RM 15,000	RM 15,000	RM 15,000	RM 45,000	—
Office Supplies	RM 8,000	RM 8,000	RM 8,000	RM 24,000	—
Telephone and fax	RM 5,000	RM 5,000	RM 5,000	RM 15,000	—
Office computers	\$ 10,000	—	—	—	\$ 10,000
SUB-TOTAL	\$ 10,000 RM 28,000	RM 28,000	RM 28,000	RM 84,000	—
H ITTO MONITORING, REVIEW AND EVALUATION	\$ 20,000	\$ 20,000	\$ 30,000		\$ 70,000
I REPORTS, PROMOTION	\$ 10,000	\$ 10,000	\$ 15,000		\$ 35,000
TOTALS	\$ 737,100 RM 1,970,000	\$ 612,100 RM 1,170,000	\$ 607,100 RM 700,000	RM 3,840,000	\$ 1,956,300
CONTINGENCY 5%	\$ 36,855 RM 98,500	\$ 30,605 RM 58,500	\$ 30,355 RM 35,000		\$ 97,815
GRAND TOTAL	\$ 773,955 RM 2,068,500	\$ 642,705 RM 1,228,500	\$ 637,455 RM 735,000	RM 4,032,000	\$ 2,054,115

SUM OF ITTO AND MALAYSIAN CONTRIBUTION US\$3,666,915

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ACKNOWLEDGEMENTS

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GLOSSARY

GLOSSARY

<u>Term or abbreviation</u>	<u>Meaning</u>
Btg (Batang)	principal or main river
Bilek	longhouse apartment/household
Kampung (Iban)	forest
Kampung (Malay)	Village
Ng (Nanga)	river mouth
Penghulu	community leader (of several longhouses)
Pulau kampung	primary forest, left uncleared but surrounded by secondary forests or <i>temuda</i>
Rumah	longhouse or house
Sungai	river/tributary
Temuda	secondary forest or regrowth stage of shifting cultivation
Tuai Rumah	headman of an Iban longhouse
Ulu	interior (upstream)

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APPENDICES

APPENDIX IA

TOTALLY PROTECTED AREAS (TPAs) OF SARAWAK*

Gazetted National Parks

Name	Area (ha)	Locality	Date Gazetted
Bako N.P.	2,727	Kuching Div.	30.04.1957
G. Mulu N.P.	52,865	Kuching Div.	03.10.1973
Niah N.P.	3,140	Miri Div.	02.01.1975
Lambir Hills N.P.	6,952	Miri Div.	04.10.1973
Similajau N.P.	7,067	Bintulu Div.	04.06.1976
G. Gading N.P.	4,196	Kuching Div.	02.12.1982
Kubah N.P.	2,230	Kuching Div.	11.05.1989
Batang Ai N.P.	26,040	Sri Aman Div.	11.04.1991
Logan Bunut N.P.	10,740	Miri Div.	29.08.1991
Tanjung Datu N.P.	1,379	Kuching	19.08.1995

Proposed National Parks

Name	Area (ha)	Locality	Constitutional Stage
Santubong N.P.	1,641	Kuching Div.	Final
Pulong Tau N.P.	63,700	Miri/Limbang Div.	Proposal
Hose Mountain N.P.	32,430	Kapit Div.	Proposal
Usun Apau N.P.	49,760	Miri Div.	Proposal
Pulau Bruit N.P.	1,776	Sarikei Div.	Proposal
Pelagus N.P.	2,040	Kapit Div.	Proposal
G. Mulu N.P. (Ext)	4,453	Limbang Div.	Proposal
Bako N.P. (Ext)	870	Kuching Div.	Proposal
Talang-Satang N.P.	363	Kuching Div.	Proposal
Kubah N.P. (Ext)	1,700	Kuching Div.	Proposal
Niah N.P. (Ext)	12.14	Miri Div.	Proposal
Kalambuku N.P.	32,436	Miri Div.	Proposal

Constituted Wildlife Sanctuaries

Name	Area (ha)	Locality	Date Gazetted
Samunsam	6,092	Kuching Div.	22.03.1979
Lanjak Entimau	168,758	Sri Aman/Sibu/ Sarikei/Kapit Div.	11.01.1980
Pulau Tukong Ara- Banun	1.4	Kuching Div.	29.08.1985

Proposed Wildlife Sanctuaries

Name	Area (ha)	Locality	Constitutional Stage
Sibuti	1,213	Miri Div.	Final
Lanjak Entimau (Ext)	18,414	Sibu/Kapit Div.	Preliminary
Samunsam (Ext)	14,810	Kuching Div.	Proposal
Limbang Mangrove	4,500	Limbang	Proposal
Batu Laga	200,000	Kapit Div.	Proposal
Maludam	8,700	Sri Aman	Proposal

Wildlife Rehabilitation Centre (WRC)

Name	Area (ha)	Locality	Year Established
Semengoh WRC	740	Kuching Div.	1975

Wildlife Centre (WC)

Name	Area (ha)	Locality	Year Established
Matang WC	40	Kuching Div.	1993

Proposed Nature Reserve (NR)

Name	Area (ha)	Locality	Constitutional Stage
Bukit Hitam	147	Limbang Div.	Proposal
Bukit Mersing	1,180	Bintulu	Propsoal
Bukit Sembiling	101	Limbang Div.	Proposal
Fairy Cave	109.3	Kuching Div.	Preliminary
Stutong	30	Kuching Div.	Final
Wind Cave	6	Kuching Div.	Preliminary
Stapok	7.2	Kuching Div.	Proposal

* Prepared by Victor Luna
National Parks and Wildlife Officer
Sarawak Forest Department

Total Area of Totally Protected Forests (ha)

Total area of constituted National Parks = 113,955
Total area of proposed National Parks = 451,593.14

565,548.14

Total area of constituted Wildlife Sanctuaries,
WRC and WC = 175,761.4
Total area of proposed Wildlife Sanctuaries = 286,694

462,325.4

Total area of proposed Nature Reserves **1,573.5**

Grand Total of Totally Protected Area (ha) **1,029,447.04**

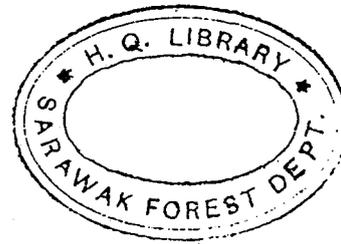
<u>Nos.</u>	<u>NATIONAL PARKS CONSTITUTED</u>	<u>Area in Hectares.</u>
1	BAKO NATIONAL PARK	2,728
2	SIMILAJAU NATIONAL PARK	2,067
3	NIAH NATIONAL PARK	3,140
4	LAMBIR HILLS NATIONAL PARK	6,952
5	GUNUNG GADING NATIONAL PARK	52,965
6	GUNUNG GADING NATIONAL PARK	4,106
7	KUBAH NATIONAL PARK	2,230
8	BATANG AI NATIONAL PARK	24,040
9	LOAGAN BUNUT NATIONAL PARK	10,740
	<u>SANTUARIES ESTABLISHED</u>	
10	SAMUNSAM WILDLIFE SANCTUARY	6,092
11	LANJAK ENTIMAU WILDLIFE SANCTUARY	168,758
12	P. TUKONG ARA BANUN SANCTUARY	1.4
	<u>WILDLIFE CENTRE ESTABLISHED</u>	
13	SEMENGOH REHABILITATION CENTRE	740

<u>Nos.</u>	<u>NATIONAL PARKS PROPOSED</u>	<u>Area in Hectares</u>
14	EXTENSION MULU N.P.	4,453
15	SANTUBONG N.P.	2,080
16	EXTENSION BAKO N.P.	870
17	PULONG TAU N.P.	63,700
18	TANJONG DATU N.P.	1,379
19	TALANG-SATANG MARINE PARK	14,480
20	USUN APAU N.P.	50,000
21	HOSE MOUNTAIN N.P.	284,700
22	BRUIT N.P.	1,776
23	PELAGUS N.P.	2,044
	<u>SANCTUARIES PROPOSED</u>	
24	SIBUTI BIRDS SANCTUARY	1,213
25	EXTENSION SAMUNSAM W.S.	14,810
26	EXTENSION LANJAK ENTIMAU W.S.	18,141
27	BATU LAGA W.S.	200,000
28	MELUDAM W.S.	47,757
<u>Nos.</u>	<u>WILDLIFE CENTRE PROPOSED</u>	<u>Area in Hectares</u>
29	MATANG W.C./MINI ZOO	40
<u>Nos.</u>	<u>NATURE RESERVE PROPOSED</u>	
30	STUTONG N.R.	33.37
31	BUKIT MERSING N.R.	1,214
32	WIND CAVE AND FAIRY CAVE N.R.	115.43
33	SEMBILING/BUKIT HITAM N.R.	257.1
34	BINATANG N.R.	138.75
35	BUAN N.R.	18,458.30

Note: Boundary information could not be obtained to include the following:-
Tanjong Datu N.P. (gazetted)
Kubah N.P. (proposed extension)
Niah N.P. (proposed extension)
Limbang Mangrove (proposed W.S.)
Stapok (proposed Nature Reserve)

APPENDIX IIA

GAZETTE NOTICE ON THE PROCLAMATION OF
LANJAK ENTIMAU WILDLIFE SANCTUARY



THE
SARAWAK GOVERNMENT GAZETTE
PART II

Published by Authority

Vol. XXXVIII

3rd March, 1983

No. 6

Swk. L.N. 19

THE WILD LIFE PROTECTION ORDINANCE

THE LANJAK-ENTIMAU WILD LIFE SANCTUARY ORDER, 1983

(Made under section 9)

WHEREAS on the 27th day of December, 1979, the Yang di-Pertua Negeri in pursuance of the provisions of section 5 of the Wild Life Protection Ordinance (Cap. 128) issued a Commission under the Commissions of Inquiry Ordinance (Cap. 6) to inquire into the proposal that the Lanjak-Entimau Protected Forest be constituted a Wild Life Sanctuary for the purpose of protecting all animals and in particular maias and hornbills living in the area: G.N. No. 157/80.

AND WHEREAS after consideration of the report of the Commissioners, the Yang di-Pertua Negeri in Council has pursuant to the provisions of section 9 of the Wild Life Protection Ordinance (Cap. 128) made the following Order—

Citation.

1. This Order may be cited as the **Lanjak-Entimau Wild Life Sanctuary Order, 1983.**

Constitution of the Lanjak-Entimau Wild Life Sanctuary.

2. It is hereby directed that, with effect from the 2nd day of February, 1983, the area of land described in the First Schedule shall be constituted a Wild Life Sanctuary to be known as the Lanjak-Entimau Wild Life Sanctuary.

Rights and privileges.

3. Subject to and in accordance with any directions which may be issued by the Director of Forests, it is hereby established that the native community of Ulu Ngemah in the Third Division, as specified in Part I of the Second Schedule, may collect forest produce for their own consumption from an area specified in Part I of the Third Schedule. The native community of Ulu Kanowit in the Sixth Division, as specified in the Part II of the Second

Schedule, may collect forest produce for their own consumption from an area specified in Part II of the Third Schedule. The native community of Ulu Katibas in the Seventh Division, as specified in Part III of the Second Schedule, may collect forest produce for their own consumption from an area specified in Part III of the Third Schedule.

FIRST SCHEDULE

(Article 2)

BOUNDARIES OF THE LANJAK-ENTIMAU WILD LIFE SANCTUARY

Boundaries:

Commencing at Nanga Langau (Ulu Lemanak) the boundary proceeds in a north-westerly direction for about 3622 metres to the summit of Bukit Bangai; it then proceeds generally northwards to the Bukit Kranggas watershed and thence along the ridge to Nanga Semeruang. It continues northwards for about 1610 metres to the Second-Sixth divisional boundary which it follows eastwards to Bukit Sengkajang. It then follows the true left bank of Sungai Nassau to Nanga Nassau; thence in a northerly direction, in a straight line, for 9054 metres or until it reaches Nanga Jemarang. The boundary then proceeds on a straight line generally east for about 13 078 metres until it reaches Nanga Sega in the Sungai Mujok; thence by a straight line in a north-westerly direction for about 11 267 metres until it reaches Nanga Igan in the Sungai Sugai. It then proceeds in a north-easterly direction for 11 569 metres to Nanga Poi Kiri, then roughly east for 7042 metres to Nanga Pungkang (both Ulu Poi). The boundary now proceeds in a generally eastwards direction for 7847 metres until it reaches Nanga Sengkabang in the Sungai Junan. Thence proceeding in a south-westerly direction for 7042 metres to Nanga Tebalong in the Sungai Pang, and in a southerly direction for 4929 metres to Nanga Pedalai in the Sungai Ngemah.

From Nanga Pedalai the boundary follows a straight line in a north-easterly direction for about 8048 metres until it reaches Nanga Sebiru in the Sungai Tuang; thence in an easterly direction for about 3521 metres to Nanga Gerugo in the Sungai Semarjah; thence in a north-easterly direction for 5533 metres to Nanga Sebut in the Sungai Lakah. Thence the boundary proceeds south-east for about 6036 metres to Gunung Sepali and then follows the main north Katibas watershed (Second-Seventh divisional boundary) generally in a south-westerly direction to Bukit Tunggai (Ulu Katibas). It then proceeds generally south-east for about 5533 metres to Nanga Takai; then north-easterly for about 6941 metres to Nanga Kelimau and generally east for about 3822 metres to Nanga Joh (all Ulu Katibas). Thence, it follows the true left bank of Sungai Bloh in a south-easterly direction until it reaches that confluence at Sungai Bloh at grid reference 742743; thence in a southerly direction for 6740 metres to the Sarawak-Indonesian Kalimantan boundary which it follows in a generally south-westerly then southerly direction to Bukit Jako.

Thence the boundary continues in a south-westerly direction for about 500 metres until it meets the true right bank of the Sungai Wong (Ulu Mujan); thence following Sungai Wong to Nanga Wong; thence following the true right bank of Sungai Mujan to Nanga Gelong; thence in a northerly direction for about 3722 metres until it meets Nanga Supa (Ulu Ai); thence continuing northwards for about 4929 metres to Nanga Masum (Ulu

Sungai Gaong); thence westerly for 5634 metres to Nanga Giling and continues westwards for a further 11 167 metres to Nanga Segrak and north-westerly for 1509 metres to Nanga Gerugang (both Ulu Sungai Engkari); thence in a westerly direction for about 9959 metres to the point of commencement at Nanga Langau.

Note: The distances are approximate.

SECOND SCHEDULE

(Article 3)

PART I. THE NATIVE COMMUNITY OF THE FOLLOWING LONGHOUSES IN ULU NGEMAH IN THE THIRD DIVISION MAY COLLECT FOREST PRODUCE:

Rumah Besi
Rumah Balan
Rumah Dingun
Rumah Sauh
Rumah Geraji
Rumah Lebi
Rumah Giman
Rumah Ramping
Rumah Nanja
Rumah Manggau
Rumah Saging
Rumah Renga
Rumah Sigam

PART II. THE NATIVE COMMUNITY OF THE FOLLOWING LONGHOUSES IN ULU KANOWIT IN THE SIXTH DIVISION MAY COLLECT FOREST PRODUCE:

Rumah Mengering
Rumah Taboh
Rumah Mading
Rumah Entili
Rumah Anthony Bau
Rumah Bunsu
Rumah Tubam
Rumah Jayan
Rumah Buda
Rumah Narau
Rumah Balai
Rumah Bagum

PART III. THE NATIVE COMMUNITY OF THE FOLLOWING LONGHOUSES IN ULU KATIBAS IN THE SEVENTH DIVISION MAY COLLECT FOREST PRODUCE:

Rumah Api
Rumah Barang
Rumah Utom
Rumah Gerinang
Rumah Janting
Rumah Anjoh
Rumah Nyantau
Rumah Rambo
Rumah Jempai
Rumah Sumok

THIRD SCHEDULE

(Article 3)

**PART I. AREA WHERE THE NATIVE COMMUNITY OF ULU NGEMAH
IN THE THIRD DIVISION MAY COLLECT FOREST PRODUCE:**

Boundaries:

Commencing at the confluence of Ulu Sungai Ngemah and Sungai Pedalai the boundary follows a straight line in a north-easterly direction for about 8048 metres until it reaches Nanga Sebiru in the Sungai Tuang; thence in an easterly direction for about 3521 metres to Nanga Gerugo in the Sungai Semarjah, thence in north-easterly direction for 5533 metres to Nanga Sebut in the Sungai Lakah; thence in a south-easterly direction for 1000 metres. Thence the boundary continues in a cut line in a south-westerly direction until it reaches Ulu Sungai Ngemah, thence it follows the true right bank of Sungai Ngemah downstream to the point of commencement.

**PART II. AREA WHERE THE NATIVE COMMUNITY OF ULU KANOWIT
IN THE SIXTH DIVISION MAY COLLECT FOREST PRODUCE:**

Boundaries:

Commencing at the confluence of Sungai Ensirieng and Sungai Jemarang, the boundary proceeds in a north-westerly direction for 1000 metres; thence in a south-easterly for 4400 metres, thence southerly for 1000 metres or until it reaches Sungai Ensirieng. The boundary then follows the true right bank of Sungai Ensirieng downstream to the point of commencement.

**PART III. AREA WHERE THE NATIVE COMMUNITY OF ULU KATIBAS
IN THE SEVENTH DIVISION MAY COLLECT FOREST
PRODUCE:**

Boundaries:

Commencing at Nanga Joh the boundary follows the true left bank of Sungai Bloh upstream until it reaches that confluence at Sungai Bloh (grid reference 642743); thence in a southerly direction for 1000 metres, thence the boundary proceeds in a cutline in a north-westerly direction for 8550 metres keeping a distance of 1000 metres from the true left bank of Sungai Bloh; thence in a northerly direction for 1000 metres to the point of commencement.

Note: The distances are approximate.

Made this 2nd day of February, 1983.

JOHN JEE,

Clerk to Majlis Mesyuarat Kerajaan Negeri

Swk. L.N. 20

THE LAND CODE

THE NIAH LAND DISTRICT (MIXED ZONE LAND)
DECLARATION ORDER, 1983

(Made under section 4(1))

In exercise of the powers conferred upon the Minister by sub-section (1) of section 4 of the Land Code, the following Order has been made: *Cap. 81.*

Citation.

1. This Order may be cited as the **Niah Land District (Mixed Zone Land) Declaration Order, 1983.**

Certain land in the Fourth Division to be Mixed Zone Land.

2. The area of land described in the Schedule is hereby declared to be Mixed Zone Land.

SCHEDULE

FOURTH DIVISION

NIAH LAND DISTRICT

All that land situated at Ladang Tiga, Miri/Bintulu Road, Miri, containing 7700 square metres, more or less, and described as Lot 10 Block 11 Niah Land District.

(The boundaries of the land described above are more particularly delineated on Land and Survey Department Miscellaneous Plan No. 4/44-135, deposited in the office of the Superintendent of Lands and Surveys, Fourth Division, Miri.)

Made this 16th day of February, 1983.

EMPENI LANG,

*Principal Assistant Secretary,
Ministry of Lands and Mineral Resources*

Swk. L.N. 21

THE PORT AUTHORITIES ORDINANCE, 1961

THE MIRI PORT AUTHORITY (AUTHORIZATION FOR TRANSFER OF PROPERTY) ORDER, 1983

(Made under section 13(1))

In exercise of the powers conferred upon the Yang di-Pertua Negeri in Council by section 13(1) of the Port Authorities Ordinance, 1961, the following Order has been made: *Ordinance No. 1/61.*

Citation and commencement.

1. This Order may be cited as the **Miri Port Authority (Authorization for Transfer of Property) Order, 1983**, and shall be deemed to have come into force on the 1st day of February, 1981.

Interpretation.

2. In this Order—

“the Port Authority” means the Miri Port Authority.

Authorization for transfer of property to the Miri Port Authority.

3. The transfer to the Port Authority under the Land Code *Cap. 81.* of the property described in the Schedule is hereby authorized.

SCHEDULE

All that parcel of land situated at Jalan River, Miri, containing 4552 square metres, more or less, and described as Lot 416 Block 9 Miri Concession Land District together with all the buildings and other fixtures thereon and appurtenances thereof.

(The boundaries of the land described above are more particularly delineated on Land and Survey Miscellaneous Plan No. 4/68-84, deposited in the office of the Superintendent of Lands and Surveys, Fourth Division, Miri.)

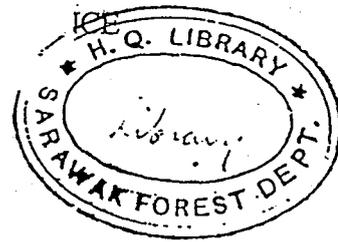
Made this 2nd day of February, 1983.

JOHN JEE,
Clerk to Majlis Mesyuarat Kerajaan Negeri

MCW/330/1

APPENDIX IIB

THE COMMISSIONS OF INQUIRY ORDINANCE



THE
SARAWAK GOVERNMENT GAZETTE
EXTRAORDINARY
PART V

Published by Authority

Vol. XXXV

11th January, 1980

No. 3

No. 157

THE COMMISSIONS OF INQUIRY ORDINANCE

COMMISSION

BY TUN DATUK PATINGGI ABANG HAJI MUHAMMAD SALAHUDDIN
YANG DI-PERTUA NEGERI, SARAWAK

LS

TUN DATUK PATINGGI ABANG HAJI
MUHAMMAD SALAHUDDIN
Yang di-Pertua Negeri, Sarawak

WHEREAS it is provided under Section 5 of the Wildlife Protection Ordinance (*Cap. 128*) that, when it is proposed to constitute a Wildlife Sanctuary, the Yang di-Pertua Negeri may issue a Commission under the Commissions of Inquiry Ordinance (*Cap. 6*):

AND WHEREAS it has been proposed that Lanjak-Entimau Protected Forest as described in the Appendix hereto should be constituted a Wildlife Sanctuary for the purpose of protecting all animals and in particular maias and hornbills living in the area:

AND WHEREAS I am of the opinion that it is in the public welfare that an inquiry should be made by Commissioners so appointed in accordance with the following terms of reference:—

- (a) to consider and recommend whether the proposed area is suitable for designation as a Wildlife Sanctuary with particular emphasis on the feasibility of a multi-use forest management for wildlife as well as timber production;
- (b) to inquire into:—
 - (i) any objections there may be to the constitution of a Wildlife Sanctuary within the proposed area;

SARAWAK GOVERNMENT GAZETTE

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[11th January, 1980

- (ii) the geographical limits proper to the Wildlife Sanctuary;
- (iii) any rights or privileges which may by customs or otherwise exist over, in or in respect of the proposed area;
- (iv) the commutation, whether for a money payment or for a similar right exercisable elsewhere or otherwise, of any such right or privilege; and
- (v) any other matter which the Commissioners may think relevant in considering whether the Wildlife Sanctuary should be constituted:

NOW, THEREFORE, I, TUN DATUK PATINGGI ABANG HAJI MUHAMMAD SALAHUDDIN, SERI MAHARAJA MANGKU NEGARA, PELINDUNG DARJAH YANG AMAT MULIA BINTANG KENYALANG SARAWAK dan PELINDUNG DARJAH AMAT MULIA BINTANG SARAWAK, YANG DI-PERTUA NEGERI, SARAWAK, appoint the following persons, namely:—

Resident, Second Division
Resident, Sixth Division
Curator of Sarawak Museum
Director of Forests

to be Commissioners and hereby authorised the Commissioners to conduct such inquiry in the manner hereinafter directed: AND I appoint National Park and Wildlife Officer to be Secretary to the Commission and to attend the sittings thereof and generally to exercise the powers and carry out the duties imposed upon such Secretary as are referred to in Section 6 of the Commissions of Inquiry Ordinance:

AND I DO HEREBY DIRECT—

1. That Resident, Second Division, shall be Chairman of the Commission of Inquiry.
2. That the Commission shall commence the Inquiry on the 14th day of January, 1980, or as soon thereafter as may be practicable.
3. That the Commission shall normally hold its sittings at the Resident's Office in Bandar Sri Aman or such other place as may seem to the Chairman of the Commission suitable for hearing evidence or for any other purpose connected with the Inquiry.
4. That the Inquiry shall be held in public.
5. That the Chairman and one other Commissioner shall form a quorum.
6. That any objection to the constitution of the Wildlife Sanctuary and claims to any right or privilege or compensation therefor shall be made in writing or orally to the Secretary of the Commission at the Resident's Office, Bandar Sri Aman or the District Office at Julau, Kanowit, Song or Lubok Antu, within forty-five days of the date of commencement of this Commission as specified in item 2 above.
7. Finally, that the Commissioners shall after completing the Inquiry submit to me their report and recommendations thereon together with any notes of any evidence taken in the course of the Inquiry and any memoranda submitted to the Commission.

AND I DO HEREBY confer on the Commissioners the rights, powers and privileges necessary for the full execution of this my Commission pursuant to the provisions of the Commissions of Inquiry Ordinance:

SARAWAK GOVERNMENT GAZETTE

11th January, 1980]

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AND I DO HEREBY enjoin all persons to assist the Commissioners in the furtherance of their Inquiry.

GIVEN under my hand and the Public Seal of Sarawak at Kuching this 27th day of December, 1979.

By Command,

DATUK AMAR SIM KHENG HONG,
Acting Chief Minister, Sarawak

GEOGRAPHICAL LIMITS OF THE PROPOSED LANJAK-ENTIMAU WILDLIFE SANCTUARY

The geographical limits of the proposed Wildlife Sanctuary coincide with the gazetted boundaries of the Lanjak-Entimau Protected Forest in the Second, Third, Sixth and Seventh Divisions.

Area: 455,900 acres approximately.

Boundaries

Commencing at Nanga Langau (ulu Lemanak) the boundary proceeds in a north-westerly direction for about 18,000 links to the summit of Bukit Bangai; it then proceeds generally northwards to the Bukit Krangas watershed and thence along the ridge to Nanga Semeruang. It continues northwards for about 8,000 links to the Second-Sixth divisional boundary which it follows eastwards to Bukit Sengkajar. It then follows the true left bank of Sungei Nassau to Nanga Nassau; thence in a northerly direction, in a straight line, for 45,000 links or until it reaches Nanga Jemarang. The boundary then proceeds on a straight line generally east for about 65,000 links until it reaches Nanga Sega in the Sungei Mujok; thence by a straight line in a north-westerly direction for about 56,000 links until it reaches Nanga Igan in the Sungei Sugai. It then proceeds in a north-easterly direction for 57,500 links to Nanga Poi Kiri, then roughly east for 35,000 links to Nanga Pungkang (both ulu Poi). The boundary now proceeds in a generally eastwards direction for 39,000 links until it reaches Nanga Sengkabang in the Sungei Junan. Thence proceeding in a south-westerly direction for 35,000 links to Nanga Tebalong in the Sungei Pang, and in a southerly direction for 24,500 links to Nanga Pedalai in the Sungei Ngemah.

From Nanga Pedalai the boundary follows a straight line in a north-easterly direction for about 40,000 links until it reaches Nanga Sebiru in the Sungei Tuang; thence in an easterly direction for about 17,500 links to Nanga Gerugo in the Sungei Semarjah, thence in a north-easterly direction for 27,500 links to Nanga Sebut in the Sungei Lakah. Thence the boundary proceeds south-east for about 30,000 links to Gunong Sepali and then follows the main north Katibas watershed (Second-Seventh divisional boundary) generally in a south-westerly direction to Bukit Tunggai (ulu Katibas). It then proceeds generally south-east for about 27,500 links to Nanga Takai; then north-easterly for about 34,500 links to Nanga Kelimau and generally east for about 19,000 links to Nanga Joh (all ulu Katibas). Thence it follows the true left bank of Sungei Bloh in a south-easterly direction until it reaches Nanga Bloh; thence in a southerly direction for 33,500 links to the Sarawak-Indonesian Kalimantan boundary which it follows in a generally south-westerly then southerly direction to Bukit Jako. Thence the boundary continues in a south-westerly direction for about 2,500 links until it meets the true right bank of the Sungei Wong (ulu Mujan); thence following Sungei Wong to Nanga Wong; thence following the true right bank of Sungei Mujan to Nanga Gelong; thence in a northerly direction for about 18,500 links until it meets Nanga Supa (ulu Ai); thence continuing northwards for about 24,500 links to Nanga Masum (ulu Sungei Gaong); thence westerly for 28,000 links to Nanga Giling and continues westwards for a further 55,500 links to Nanga Segrak and north-westerly for 7,500 links to Nanga Gerugang (both ulu Sungei Engkari); thence in a westerly direction for about 49,500 links to the point of commencement at Nanga Langau.

APPENDIX IIC

THE WILDLIFE PROTECTION ORDINANCE : LANJAK ENTIMAU WILDLIFE SANCTUARY ORDER, 1983

Swk. L.N.19

THE WILD LIFE PROTECTION ORDINANCE

The Lanjak-Entimau Wild Life Sanctuary Order, 1983

(Made under section 9)

Whereas on the 27th day of December, 1979, the Yang di-Pertua Negeri in pursuance of the provision of section 5 of the Wild Life Protection Ordinance issued a Commission under the Commission of Inquiry Ordinance (Cap. 6) to inquire into the proposal that the Lanjak-Entimau Protected Forest be constituted a Wild Life Sanctuary for the purpose of protecting all animals and in particular maias and hornbills living in the area.

AND WHEREAS after consideration of the report of the Commissioners, the Yang di-Pertua Negeri in Council has pursuant to the provisions of section 9 of the Wild Life Protection Ordinance (Cap. 128) made the following Order:-

1. This Order may be cited as the **Lanjak-Entimau Wild Life Sanctuary Order, 1983.**

2. It is hereby directed that, with effect from the 2nd day of February, 1983, the area of land described in the First Schedule shall be constituted a Wild Life Sanctuary to be known as the Lanjak-Entimau Wild Life Sanctuary.

3. Subject to and its accordance with any directions which may be issued by the Director of Forests, it is hereby established that the native community of Ulu Ngemah in the Third Division, as specified in Part I of the Second Schedule, may collect forest produce for their own consumption from an area specified in Part I of the Third Schedule. The native community of Ulu Kanowit in the Sixth Division, as specified in the Part II of the Second Schedule, may collect forest produce for their own consumption from an area specified in Part II of the Third Schedule. The native community of Ulu Katibas in the Seventh Division, as specified in Part III of the Second Schedule, may collect forest produce for their own consumption from an area specified in Part III of the Third Schedule.

FIRST SCHEDULE

(Article 2)

BOUNDARIES OF THE LANJAK-ENTIMAU WILD LIFE SANCTUARY

Boundaries;

Commencing at Nanga Langau (Ulu Lemanak) the boundary proceeds in a north-westerly direction for about 3622 metres to the summit of Bukit Bangai; it then proceeds generally northwards to the Bukit Kranggas watershed and thence along the ridge to Nanga Semeruang. It continues northwards for about 1610 metres

to the Second-Sixth divisional boundary which it follows eastwards to Bukit Sengkajang. It then follows the true left bank of Sungai Nassau to Nanga Nassau, thence in a northerly direction, in a straight line, for 9054 metres or until it reaches Nanga Jemarang. The boundary then proceeds on a straight line generally east for about 13 078 metres until it reaches Nanga Sega in the Sungai Mujok, thence by a straight line in a north-westerly direction for about 11 267 metres until it reaches Nanga Igan in the Sungai Sugai. It then proceeds in a north-easterly direction for 11 569 metres to Nanga Poi Kiri, then roughly east for 7042 metres to Nanga Pungkang (both Ulu Poi). The boundary now proceeds in a generally eastwards direction for 7847 metres until it reaches Nanga Sengkabang in the Sungai Junan. Thence proceeding in a south-westerly direction for 7042 metres to Nanga Tebalong in the Sungai Pang, and in a southerly direction for 4929 metres to Nanga Pedalai in the Sungai Ngemah.

From Nanga Pedalai the boundary follows a straight line in a north-easterly direction for about 8048 metres until it reaches Nanga Sebiru in the Sungai Tuang; thence in an easterly direction for about 3521 metres to Nanga Gerugo in the Sungai Semarjah; thence in a north-easterly direction for 5533 metres to Nanga Sebut in the Sungai Lakah. Thence the boundary proceeds south-east for about 6036 metres to Gunung Sepali and then follows the main north Katibas watershed (Second-Seventh divisional boundary) generally in a south-westerly direction to Bukit Tunggal (Ulu Katibas). It then proceeds generally south-east for about 5533 metres to Nanga Takai, then north-easterly for about 6941 metres to Nanga Kelimau and generally and generally east for about 3822 metres to Nanga Joh (all Ulu Katibas). Thence, it follows the true left bank of Sungai Bloh in a south-easterly direction until it reaches that confluence at Sungai Bloh at grid reference 742743; thence in a southerly direction for 6740 metres to the Sarawak-Indonesian Kalimantan boundary which it follows in a generally south-westerly then southerly direction to Bukit Jako.

Thence the boundary continues in a south-westerly direction for about 500 metres until it meets the true right bank of the Sungai Wong (Ulu Mujan); thence following Sungai Wong to Nanga Wong; thence following the true right bank of Sungai Mujan to Nanga Gelong; thence in a northerly direction for about 3722 metres until it meets Nanga Supa (Ulu Ai); thence continuing northwards for about 4929 metres to Nanga Masum (Ulu Sungai Gaong); thence westerly for 5634 metres to Nanga Giling and continues westwards for a further 11 167 metres to Nanga Segrak and north-westerly for 1509 metres to Nanga Gerugang (both Ulu Sungai Engkari); thence in a westerly direction for about 9959 metres to the point of commencement at Nanga Langau.

Note: The distances are approximate.

SECOND SCHEDULE
(Article 3)

PART I THE NATIVE COMMUNITY OF THE FOLLOWING LONGHOUSES IN ULU NGEMAH IN THE THIRD DIVISION MAY COLLECT FOREST PRODUCE:

Rumah Besi
Rumah Balan
Rumah Dingun
Rumah Sauh
Rumah Geraji
Rumah Lebi
Rumah Gimam
Rumah Ramping
Rumah Nanja
Rumah Manggau
Rumah Saging
Rumah Renga
Rumah Sigam

PART II THE NATIVE COMMUNITY OF THE FOLLOWING LONGHOUSES IN ULU KANOWIT IN THE SIXTH DIVISION MAY COLLECT FOREST PRODUCE:

Rumah Mengering
Rumah Taboh
Rumah Mading
Rumah Entili
Rumah Anthony Bau
Rumah Bunsu
Rumah Tubam
Rumah Jayan
Rumah Buda
Rumah Narau
Rumah Balai
Rumah Bagum

PART III THE NATIVE COMMUNITY OF THE FOLLOWING LONGHOUSES IN ULU KATIBAS IN THE SEVENTH DIVISION MAY COLLECT FOREST PRODUCE:

Rumah Api
Rumah Barang
Rumah Alom
Rumah Gerinang
Rumah Janting
Rumah Anjoh
Rumah Nyantau
Rumah Rambo
Rumah Jempai
Rumah Sumok

THIRD SCHEDULE
(Article 3)

PART I AREA WHERE THE NATIVE COMMUNITY OF ULU NGEMAH IN THE
THIRD DIVISION MAY COLLECT FOREST PRODUCE

Boundaries:

Commencing at the confluence of Ulu Sungai Ngemah and Sungai Pedalai the boundary follows a straight line in a north-easterly direction for about 8048 metres until it reaches Nanga Sebiru in the Sungai Tuang; thence in an easterly direction for about 3521 metres to Nanga Gerugo in the Sungai Semarjah; thence in north-easterly direction for 5533 metres to Nanga Sebut in the Sungai Lakah; thence in a south-easterly direction for 1000 metres. Thence the boundary continues in a cut line in a south-westerly direction until it reaches Ulu Sungai Ngemah, thence it follows the true right bank of Sungai Ngemah downstream to the point of commencement.

PART II AREA WHERE THE NATIVE COMMUNITY OF ULU KANOWIT IN THE
SIXTH DIVISION MAY COLLECT FOREST PRODUCE

Boundaries:

Commencing at the confluence of Sungai Ensirieng and Sungai Jemarang, the boundary proceeds in a north-westerly direction for 1000 metres; thence in a south-easterly for 4400 metres, thence southerly for 1000 metres or until it reaches Sungai Ensirieng. The boundary then follows the true right bank of Sungai Ensirieng downstream to the point of commencement.

PART III AREA WHERE THE NATIVE COMMUNITY OF ULU KATIBAS IN THE
SEVENTH DIVISION MAY COLLECT FOREST PRODUCE

Boundaries:

Commencing at Nanga Joh the boundary follows the true left bank of Sungai Bloh upstream until it reaches that confluence at Sungai Bloh (grid reference 642743); thence in a southerly direction for 1000 metres, thence the boundary proceeds in a cutline in a north-westerly direction for 8550 metres keeping a distance of 1000 metres from the true left bank of Sungai Bloh; thence in a northerly direction for 1000 metres to the point of commencement.

Note; The distances are approximate.

Made this 2nd day of February, 1983

APPENDIX III

Geographical limits of the Lanjak Entimau Wildlife Sanctuary (Ago, 1991)

Total Area : 167,200 Hectares

The new geographical limits of the Lanjak Entimau Wildlife Sanctuary as surveyed and demarcated on the ground during the month of March to July, 1991, are as follows:-

Boundaries

Commencing at Nanga Langau, Grid Ref: 117584, the boundary proceeds in a north-westerly direction by outline with a Forward Bearing of 319 deg 00 min for a distance of 181 chains to Bukit Bangai, Grid Ref: 092612. Then it proceeds generally northwards to Bukit Kerangas, Grid Ref: 090627, and then along the ridge to Nanga Semaruang (at Grid Ref: 133698), in Sungai Skrang. The boundary continues northward from Nanga Semaruang along the ridge to Bukit Pengakit (at Grid Ref: 131724), thence proceeds eastward by logging road, along the Sengkajang ridge (Second - Sixth Divisional Boundary) towards Bukit Sengkajang (at Grid Ref: 219726, and then to the source of Sungai Kaup (at Grid Ref: 234734). The boundary then follows the true right bank of Sungai Kaup to Nanga Kaup (at Grid Ref: 235768) at Ulu Sungai Kanowit.

From Nanga Kaup the boundary follows a outline in a north-easterly direction with a Forward Bearing of 30 deg 00 min for 444 chains to Nanga Jemarang (at Grid Ref: 292835), in Sungai Ensiring. The boundary then follows the true left bank of Sungai Jemarang to its source at Bukit Batu (Grid Ref: 283863). From Bukit Batu the boundary goes eastward along the ridge (dividing Sungai Ensiring and Sungai Mujok) towards the source of Sungai Nyamok (at Grid Ref: 330849), a tributary of Sg. Mujok. The boundary then continues as outline in an easterly direction with Forward Bearing of 84 deg 00 min for a distance of 330 chains to Nanga Sega (Grid Ref: 395855) in Ulu Sungai Mujok. From Nanga Sega, the boundary follows a outline with a Forward Bearing of 311 deg 30 min in a north-westerly direction for 434 chains to Nanga Igan (Grid Ref: 329913) in Sungai Sugai, a tributary of Sungai Mujok. Thence going in a north-westerly direction (boundary not yet demarcated on the ground) to Nanga Maong Langkau (Grid Ref: 262947) of Sungai Maong, a tributary of Sungai Mujok.

From Nanga Maong Langkau the boundary follows a outline in a north-easterly direction with a Forward Bearing of 40 deg 30 min for 576.5 chains to the junction of Sungai Poi Kanan and Sungai Poi Kiri (Grid Ref: 335032); thence with a Forward Bearing of 89 deg 00 min for 399.5 chains to Nanga Pungkang (Grid Ref: 410028), in Sungai Uka, a tributary of Sungai Poi.

From Nanga Pungkang the boundary further follows a outline in a south-westerly direction with a Forward Bearing of 115 deg 00 min for 378 chains to Nanga Saban (Grid Ref: 480004), in Sungai Sebiru, a tributary of Sungai Junan; thence in a southwards direction with a Forward Bearing of 183 deg 00 min for 57 chains to Nanga Sebiru (Grid Ref: 479991), in Sungai Junan, a tributary of Sungai Ngemah.

From Nanga Sebiru (of Sungai Junan), the boundary follows a outline in a south-westerly direction with a Forward Bearing of 223 deg 00 min for 314 chains to Nanga Mersala (Grid Ref: 346945), in Sungai Pang, a tributary of Sungai Ngemah; thence with a Forward Bearing of 162 deg 00 min for 261 chains to Nanga Pedalai (Grid Ref: 452898), in Ulu Sungai Ngemah.

From Nanga Pedalai the boundary follows a outline in a north-easterly direction with a Forward Bearing of 74 deg 00 min for a distance of 376.5 chains to Nanga Bilat (Grid Ref: 525915), in Sungai urie of Sungai Mujan, Ulu Ngemah; thence with a Forward Bearing of 30 deg 15 min for a distance of 224 chains to Nanga Melaban (Grid Ref: 549954), in Sungai Empurau, Ulu Ngemah; thence with a Forward Bearing of 51 deg 00 min for a distance of 276 chains to Nanga Sibat (Grid Ref: 593987), in Sungai Meluan of Sungai Lakah, Ulu Ngemah. The boundary further follows a outline from Nanga Sibat in a south-easterly direction with a Forward Bearing of 158 deg 00 min for a distance of 235 chains to Nanga Mesau (Grid Ref: 614930), in Ulu Sungai Spali; thence to Bukit Spali (Grid Ref: 614930).

From Bukit Spali, the boundary follows the ridge (Tinting Besar), dividing Sungai Ngemah and Sungai Katibas in a south-westerly direction to the source of Sungai Datai (Grid Ref: 501850), a tributary of Sungai Katibas; thence the boundary follows the true right bank of Sungai Datai to Nanga Datai (Grid Ref: 529820). From Nanga Datai the boundary follows the true left bank of Sungai Katibas to Nanga Bloh (Grid Ref: 527813); thence following the true left bank of Sungai Bloh to Nanga Bekato (Grid Ref: 642744); and then following the true left bank of Sungai Bekato to its source at the Sarawak-Kalimantan Indonesian Border (Grid Ref: 753735). From this Grid Reference, the boundary follows the Sarawak-Kalimantan Indonesian boundary to a south-westerly direction until Bukit Jako (Grid Ref: 474746).

From Bukit Jako, the boundary follows a outline in a south-westerly direction with a Forward Bearing of 252 deg 00 min for a distance of 114.5 chains to Nanga Wong (Grid Ref: 436469), in Sungai Mujan; a tributary of Batang Ai; thence the boundary follows the true right bank of Sungai Mujan to Nanga Gelong (Grid Ref: 395476), a tributary of Sungai Mujan. From Nanga Gelong the boundary follows a outline in a northerly direction with a Forward Bearing of 04 deg 30 min for a distance of 190 chains to Nanga Supa (Grid Ref: 397516), in Batang Ai; thence a outline with Forward Bearing of 356 deg 00 min for a distance of 258 chains to Nanga Masum (Grid Ref: 394565), in Sungai Gaong, a tributary of Batang Ai.

From Nanga Masum, the boundary follows a outline in a westerly direction with a Forward Bearing of 261 deg 30 min for a distance of 299 chains to Nanga Giling (Grid Ref: 335557), in Sungai Lobang baya; thence with a Forward Bearing of 271 deg 00 min for a distance of 312 chains to Bukit Tagom (Grid Ref: 275560), and then a further 272 chains to Nanga Segrak (Grid Ref: 221559), in Sungai Engkari. The boundary further follows a outline in a north-westerly with a Forward Bearing of 334 deg 00 min for a distance of 78 chains to Nanga Gerugang (Grid Ref: 214574), in Sungai Engkari; thence in a westerly direction with a Forward Bearing of 276 deg 30 min for a distance of 240 chains to Bukit Kerapa (Grid Ref: 16658), and then a further 253 chains to the point of commencement at Nanga Langau, in Sungai Lemanak.

APPENDIX IV

A LIST OF NATIVE MEDICINAL PLANTS COLLECTED FROM LANJAK-ENTIMAU WILDLIFE SANCTUARY, 1994 [Source : Kedayan Pakcik Kipli Kalong from Miri]

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
1.	Annonaceae	<i>Goniothalamus tapis</i> Miq.	To prevent cancer
2.	Annonaceae	<i>Goniothalamus velutinus</i> Airy Shaw	To prevent tumour or cancer
3.	Aquifoliaceae	<i>Ilex cissoidea</i> Loes	For aphrodisiac or to regain energy
4.	Araceae	<i>Alocasia regia</i> N.E. Brown	Swollen body and joints, sprains
5.	Araceae	<i>Amorphophallus cf. borneensis</i>	Blisters or ulcers in mouth and tongue
6.	Araceae	<i>Homalomena propinqua</i> Schoti	Vomiting blood, blood in stool or "pantan darah"
7.	Araliaceae	<i>Schefflera tetrandra</i> Merr.	
8.	Aspidaceae	<i>Tectaria lobbii</i> (Hook.) Copel	Convulsion
9.	Aspidaceae	<i>Tectaria pleiosora</i> (V.A.V.R.) C.Chr.	To treat difficulties in urination
10.	Aspleniaceae	<i>Asplenium salignum</i> Bl.	
11.	Aspleniaceae	<i>Asplenium scolopendroides</i> J. Sm.	
12.	Cyperaceae	<i>Mapania cuspidata</i> (Miq.) Uitt.	
13.	Cyperaceae	<i>Paramapania radians</i> (Cl.) Uitt.	Dye hairs and prevent baldness
14.	Dilleniaceae	<i>Tetracera korthalsii</i> Miq.	Cough
15.	Dipteridaceae	<i>Dipteris lobbiana</i> (H'K) Moore	As vitamins and aphrodisiac
16.	Euphorbiaceae	<i>Glochidion lutescens</i> Bl.	Swollen muscle
17.	Euphorbiaceae	<i>Macaranga gigantea</i> Muell-Arg	Blisters or fungus infection in mouth
18.	Flacourtiaceae	<i>Flacourtia rukam</i> Zoll et. Mor	Headache and gastric
19.	Gramineae	<i>Eriachne pallescens</i> Br.	

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
20.	Guttiferae	<i>Calophyllum soulattri</i> Burm. f.	Fungus infection on skin
21.	Hymenophyllaceae	<i>Trichomonas javanicum</i> Bl.	Part of ingredients for a health drink
22.	Hypoxidaceae	<i>Curculigo villosa</i> Wall.	Diarrhoea or watery and sticky stool
23.	Lauraceae	<i>Cinnamomum microcarpum</i>	To get rid of 'wind' in body. Boil roots to make a drink
24.	Leguminosae	<i>Bauhinia purpurea</i> L.	Watery stool and stomach pains
25.	Leguminosae	<i>Callerya nieuwenhuisii</i> (JJS) schott	Blood in stool
26.	Leguminosae	<i>Fordia coriacea</i> Dunn	
27.	Liliaceae	<i>Smilax cf. laevis</i>	To make a health drink
28.	Liliaceae	<i>Smilax odoratissima</i> Bl.	"
29.	Liliaceae	Unidentified	For headache
30.	Lindsaeaceae	<i>Lindsaea borneensis</i> Hook. ex. Bakh.	
31.	Lindsaeaceae	<i>Lindsaea parallelogramma</i> V.A.V.R	Severe headache or migraine
32.	Loganiaceae	<i>Fragraea racemosa</i> Wall.	Mouth ulcers or fungus infection in babies' mouths
33.	Lycopodiaceae	<i>Lycopodium cernuum</i> L.	To chase away evil spirits.
34.	Marantaceae	<i>Pachelophyrrnium maximum</i> (Bl.) K. Schum.	Skin diseases or 'seliut' (Ked)
35.	Marantaceae	<i>Phrynum capitatum</i> Willd	
36.	Melastomataceae	<i>Anerinckleistus grandiflorus</i> Ridley	
37.	Melastomataceae	<i>Memecylon longifolium</i> Cogn.	

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
38.	Menispermaceae	<i>Fibrauea tinctoria</i> Lour	To treat 'yellow body', probably jaundice
39.	Menispermaceae	<i>Tinomiscium</i> sp.	For jaundice
40.	Moraceae	<i>Artocarpus elasticus</i> Reinw. ex. Bl.	To help mother to recover after child birth
41.	Moraceae	<i>Ficus bruneiensis</i> Corner	Aphrodisiac or to regain energy
42.	Moraceae	<i>Ficus deltoidea</i> var. <i>deltoidea</i>	Convulsion in babies
43.	Moraceae	<i>Ficus obpyramidata</i> King	To treat infertility in women
44.	Myrtaceae	<i>Eugenia tawaensis</i> Merr.	Blood in stool and diarrhoea
45.	Myrtaceae	<i>Tristania beccarii</i> Ridl.	To ease labour pain
46.	Olacaceae	<i>Strombosia ceylanica</i> Gardn.	Rheumatism, swollen joints
47.	Orchidaceae	<i>Bulbophyllum</i> sp.	Diarrhoea with watery stool
48.	Orchidaceae	<i>Eria brookesii</i> Ridl.	Headache or migraine
49.	Palmae	<i>Pinanga</i> sp.	Headache or migraine
50.	Palmae	<i>Pinanga</i> sp.	Blood in stool
51.	Palmae	<i>Pinanga</i> sp.	Blood in stool
52.	Polypodiaceae	<i>Drynaria sparsisora</i> (Desr.) Moore	Contraceptive for women
53.	Polygalaceae	<i>Xanthophyllum ecarinatum</i> Chodt.	Ingredient for a health drink
54.	Polygalaceae	<i>Xanthophyllum macrophyllum</i> Bak.	"
55.	Rhizophoraceae	<i>Anisophyllea disticha</i> (Jack) Baill	"
56.	Rhmnaceae	<i>Zizyphus havilandii</i> Ridl.	Blood in stool
57.	Rosaceae	<i>Rubus glomeratus</i> Bl.	Diarrhoea
58.	Rubiaceae	Species unidentified	Burns caused by fire

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
59.	Sapindaceae	<i>Lepisanthes amoena</i> (Hassk.) Leenh.	To drive away evil spirits
60.	Schizaeaceae	<i>Lygodium scandens</i> (Linn.) Sw.	Ingredient for a health drink
61.	Selaginellaceae	<i>Selaginella lobbii</i> Veitch	"
62.	Selaginellaceae	<i>Selaginella rugulosa</i> Cesati	"
63.	Simaroubaceae	<i>Eurycoma longifolia</i> Jack	High blood pressure, diabetes and weak liver
64.	Sterculiaceae	<i>Sterculia stipulata</i> Korth.	Backache
65.	Urticaceae	<i>Poikilospermum suaveolens</i> (Bl.)	Blisters or ulcers in mouth and tongue
66.	Zingiberaceae	<i>Costus</i> sp.	For severe headache or migraine

**A LIST OF PLANTS FOR NATIVE MEDICINES AND OTHER USES
BY THE LUN BAWANG & IBAN COMMUNITIES**

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
1.	Amaryllidaceae	<i>Crinum asiaticum</i>	For treatment of sprains and bone fractures
2.	Annonaceae	<i>Annona muricata</i>	to treat cuts & stop bleeding, warm leaf over fire and bandage over wound
3.	Annonaceae	<i>Artabotrys suaveolens</i>	This plant is used as an antidote to cure the harm caused by <i>Uvaria</i> sp.
4.	Annonaceae	<i>Cyathocalyx havilandii</i>	Bark used as a rope in selabit making and for tying
5.	Annonaceae	<i>Goniothalamus roseus</i>	The bark is dried and burnt as a mosquito repellent and to scare off evil spirits
6.	Annonaceae	<i>Goniothalamus uvaroides</i>	Iban use the bark as a mosquito repellent and to scare off jungle spirits
7.	Annonaceae	<i>Mitrephora glabra</i>	For sore eyes
8.	Annonaceae	<i>Polyalthia flagellaris</i>	For sore eyes
9.	Annonaceae	<i>Orophea myriantha</i>	To prevent from getting drunk & to treat insect bite
10.	Annonaceae	<i>Uvaria</i> sp. 1	For treatment of swollen lymph node
11.	Annonaceae	<i>Uvaria</i> sp. 2	This plant is used to harm the enemy by causing pain or swelling
12.	Apocynaceae	<i>Alstonia scholaris</i>	The white latex is used externally to treat shingles
13.	Apocynaceae	<i>Tabernamontana macrocarpa</i>	Iban apply the white latex from the bark to treat leprosy, called "kusta" in Iban
14.	Araceae	<i>Acorus gramineus</i>	The leaves are used to treat stomach ache
15.	Araceae	<i>Homolomena propinqua</i>	Iban use this plant to treat wounds of pigs and dogs

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
16.	Araceae	<i>Homalomena sagittifolia</i>	To kill head lice
17.	Aristolochiaceae	<i>Thottea rhizantha</i>	As a tonic for women after delivery
18.	Blechnaceae	<i>Blechnum orientale</i>	For treatment of boils
19.	Celastraceae	<i>Salacia korthalsiana</i>	The bark burns easily and is used to start a fire while travelling in the forest
20.	Compositae	<i>Adenostemma lavenia</i>	For treatment of fever
21.	Cyperaceae	<i>Mapania cuspidata</i>	An ingredient for health tonic for women after delivery
22.	Dilleniaceae	<i>Dillenia excelsa</i>	For treatment of stomach ache
23.	Dilleniaceae	<i>Dillenia suffruticosa</i>	For cuts and wounds
24.	Dilleniaceae	<i>Tetracera fagifolia</i>	Species of <i>Tetracera</i> are used popularly for treatment of cough
25.	Dilleniaceae	<i>Tetracera macrophylla</i>	Iban use the plant to treat whooping cough particularly in children by boiling the stem in water to make a drink
26.	Euphorbiaceae	<i>Agrostistachys longifolia</i> var. <i>leptostachya</i>	To stop aching tooth with a cavity
27.	Euphorbiaceae	<i>Antidesma hosei</i>	Lun Bawang use this plant to stop the pain caused by another plant called Itak (not collected)
28.	Euphorbiaceae	<i>Baccaurea beccariana</i>	The fruits can protect one from being charmed by the enemy
29.	Gesneriaceae	<i>Cyrtandra</i> cf. <i>antuana</i>	The Iban believe that if this plant is potted and kept in the house, it will protect one from harm by the enemy
30.	Gramineae	<i>Lophaterum gracile</i>	Lun Bawang use the plant to treat difficult and painful urination and venereal disease
31.	Gramineae	<i>Schizostachyum hantu</i>	For curing whooping cough especially in babies
32.	Guttiferae	<i>Garcinia beccarii</i>	The fruits are used as a flavouring and are often cooked with fish

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
33.	Guttiferae	<i>Garcinia mangostana</i>	For treatment of skin disease like scabies
34.	Hymenophyllaceae	<i>Trichomonas javanicum</i>	For taming of fierce dogs
35.	Hymenophyllaceae	<i>Trichomonas saxifragoides</i>	For dry cough
36.	Hypoxidaceae	<i>Curculigo racemosa</i>	To get rid of buffalo leaches which are common in slow-flowing streams and stagnant pools
37.	Lauraceae	<i>Cinnamomum iners</i>	For gas in stomach or flatulence
38.	Lauraceae	<i>Eusideroxylon zwageri</i>	The bark is used for treating gastric
39.	Lauraceae	<i>Lindera pipericarpa</i>	Roots are used for flavouring food particularly fish and meat
40.	Lauraceae	<i>Litsea garciae</i>	For treatment of boils
41.	Leeaceae	<i>Leea gigantea</i>	A branch is planted in front of longhouse to remind visitors that they are prohibited from entering the longhouse because someone has just died
42.	Leguminosae	<i>Bauhinia semifida</i> var. <i>semifida</i>	For diarrhoea caused by food poisoning
43.	Leguminosae	<i>Cassia alata</i>	This shrub is a well-known cure for ringworm and white spots among many ethnic communities in Sarawak
44.	Leguminosae	<i>Derris malaccensis</i>	Iban use the roots as a "tubai" for stupefying fish
45.	Leguminosae	<i>Leucaena leucephala</i>	For fungal infection of the skin
46.	Leguminosae	<i>Parkia speciosa</i>	For treatment of high blood pressure and diabetes
47.	Leguminosae	<i>Saraca declinata</i>	Iban use the bark of this tree to treat diarrhoea
48.	Leguminosae	<i>Spatholobus ferrugineus</i>	For treatment of mouth sores and ulcer
49.	Leguminosae	<i>Spatholobus oblongifolius</i>	For treatment of persistent fever

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
50.	Marantaceae	<i>Phrynium capitatum</i>	The leaves are popularly used among many native tribes for wrapping lunch while working away from the longhouse
51.	Melastomataceae	<i>Dissochaeta cf. annulata</i>	Lun Bawang believe that miscarriage may be caused by parasitic worms in the womb. This plant gets rid of the worms
52.	Melastomataceae	<i>Melastoma malabathricum</i>	For toothache; To prevent and treat mouth sores, the ripe fruits are eaten; For diarrhoea; For inflamed eyes; For cuts and wounds; Chinese use the pound leaves as poultice to treat ankle sprains and stimulate blood circulation
53.	Melastomataceae	<i>Pachycentria microsperma</i>	For twisted ankles & wrists
54.	Meliaceae	<i>Aglaia domestica</i>	For treatment of dysentery and diarrhoea
55.	Menispermaceae	<i>Arcangelisia flava</i>	For treatment of conjunctivitis
56.	Menispermaceae	<i>Coscinium wallichianum</i>	To prevent one from getting drunk from alcoholic drink or as an antidote for alcohol intoxication
57.	Menispermaceae	<i>Fibrauea chloroleuca</i>	For stomach ache with diarrhoea; To prepare a tonic drink for women after delivery; To protect oneself from being bitten by snakes
58.	Menispermaceae	cf. <i>Pycnarrhena</i> sp.	The leaves are used as a flavouring in cooking
59.	Moraceae	<i>Artocarpus elasticus</i>	Bark used as a rope and for making a kind of mat called "tika bidai" in Iban
60.	Moraceae	<i>Ficus glossularioides</i>	The young leaves are cooked and eaten as a vegetable
61.	Moraceae	<i>Ficus punctata</i>	Lun Bawang use this plant to tame women who are fierce and hot-tempered

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
62.	Moraceae	<i>Ficus uncinata</i>	For treatment of centipede bite, rub fresh white latex on wound
63.	Myrsinaceae	<i>Ardisia copelandii</i>	The Iban believe that this plant can protect one from harm by one's enemy
64.	Myrsinaceae	<i>Labisia pumila</i>	One of the ingredients to prepare a tonic drink for women after delivery
65.	Myrtaceae	<i>Eugenia bankensis</i>	For vomiting blood and the disease called "sakang seribu" in Iban
66.	Myrtaceae	<i>Eugenia cephalanthum</i>	The young leaves are eaten as a vegetable after cooking
67.	Myrtaceae	<i>Psidium guajava</i>	For cuts & wounds & for diarrhoea
68.	Orchidaceae	<i>Dipodium sp.</i>	For disease of the pancreas which causes great pain
69.	Palmae	<i>Calamus sp.</i>	For sore throat
70.	Palmae	<i>Daemonorops sabut</i>	As an antidote for having wrongly taken poisonous mushroom
71.	Palmae	<i>Licuala cordata</i>	The leaves are used for hat-making, the shoots are taken as vegetables
72.	Pandanaceae	<i>Pandanus kamii</i>	The dry leaves burn easily and are used to start a fire for cooking in the forest
73.	Pandanaceae	<i>Pandanus vinaceus</i>	The leaves are used for making hats and mats
74.	Rubiaceae	<i>Chasalia curviflora</i>	For cuts and wounds & for stomach ache
75.	Rubiaceae	<i>Morinda citrifolia</i>	A solution from the bark is used for dyeing thread to produce a grey colour
76.	Rubiaceae	<i>Mycetia sp.</i>	For treating piles; The root bark is believed to have the same properties as ginseng and is cooked with meat
77.	Rubiaceae	<i>Nauclea myrmecodia</i>	Effective for treatment of wounds

<u>NO.</u>	<u>FAMILY</u>	<u>SPECIES</u>	<u>MEDICINAL USE</u>
78.	Rubiaceae	<i>Psychotria viridiflora</i>	For cuts and wounds & as a black dye
79.	Rubiaceae	<i>Timonius lasianthoides</i>	For cuts and wounds and skin diseases such as scabies
80.	Schizaeaceae	<i>Lygodium circinatum</i>	A good cure for venereal disease and diabetes
81.	Selaginellaceae	<i>Selaginella plana</i>	For migraine and facial stroke
82.	Solanaceae	<i>Solanum mammosum</i>	For treating sore eyes in children
83.	Theaceae	<i>Adinandra dumosa</i>	For cuts and wounds
84.	Verbenaceae	<i>Clerodendrum villosum</i>	For skin infection and itchy skin; To treat sprains and bruises
85.	Zingiberaceae	<i>Curcuma zedoaria</i>	To help mother to gain strength and recover after delivery
86.	Zingiberaceae	<i>Costus</i> sp.	Iban believe this plant possesses protective power
87.	Zingiberaceae	<i>Etilingera littoralis</i>	For mat making
88.	Zingiberaceae	<i>Etilingera punicea</i>	For flavouring food
89.	Zingiberaceae	<i>Globba atrosanguinea</i>	For bruises and injury caused by fall such as from a tree
90.	Zingiberaceae	<i>Hornstedtia magnifica</i>	The shoots are used as a flavouring and often cooked with fish and meat

APPENDIX V :
Mammals recorded in Batang Ai National Park by Meredith (1993)

Order and names follow Payme et. al. (1985)

Common treeshrew	<i>Tupaia glis</i>
Striped treeshrew	<i>Tupaia dorsalis</i>
Maroon langur	<i>Presbytis rubicunda signata</i>
White-fronted langur	<i>Presbytis frontata nudifrons</i>
Long-tailed macaque	<i>Macaca fascicularis</i>
Pig-tail macaque	<i>Macaca nemestrina</i>
Bornean gibbon	<i>Hylobates muelleri</i>
Orang-utan	<i>Pongo pygmaeus pygmaeus</i>
Giant squirrel	<i>Ratufa affinis cothurnata</i>
Prevost's squirrel	<i>Callosciurus prevostii atricapillus</i>
Plantain squirrel	<i>Callosciurus notatus dulitensis</i>
Horse-tailed squirrel	<i>Sundasciurus hippurus borneensis</i>
Low's squirrel	<i>Sundasciurus lowii lowii</i>
Slender squirrel	<i>Sundasciurus tenuis parvus</i>
Brooke's squirrel	<i>Sundasciurus brookei</i>
Three-striped ground squirrel	<i>Lariscus insignis diversus</i>
Shrew-faced ground squirrel	<i>Rhinosciurus laticaudatus laticaudatus</i>
Black-eared pigmy squirrel	<i>Nannosciurus melanotis borneanus</i>
Plain pigmy squirrel	<i>Exilisciurus exilis exilis</i>
Whitehead's pigmy squirrel	<i>Exilisciurus whiteheadi</i>
Tufted ground squirrel	<i>Rheithrosciurus macrotis</i>
Long-tailed porcupine	<i>Trichys fasciculata</i>
Common porcupine	<i>Hystrix brachyura longicauda</i>
Sun bear	<i>Helarctos malayanus eurispilus</i>
Yellow-throated marten	<i>Martes flavigula saba</i>
Malay weasel	<i>Mustella nudipes</i>
Oriental small-clawed otter	<i>Aonyx (Ambionyx) cinerea cinerea</i>
Malay civet	<i>Viverra zangalunga zangalunga</i>
Masked palm civet	<i>Paguma larvata ogilbyi</i>
Small-toothed palm civet	<i>Arctogalidia trivirgata stigmata</i>
Clouded leopard	<i>Neofelis nebulosa diardi</i>
Bearded pig	<i>Sus barbatus barbatus</i>
Red muntjac	<i>Muntiacos muntjak pleiharicus</i>
Bornean yellow muntjac	<i>Muntiacus atherodes</i>
Sambar deer	<i>Cervus unicolor brookei</i>

APPENDIX VI

PRIMATE POPULATION ESTIMATES IN REGIONS OF LANJAK ENTIMAU (Blouch, 1994)

		No. of Groups Seen	Average Group Size	Groups per Sq. Km.			Individuals per Sq. Km.			Area of Region (sq km)	Total Number of Individuals		
				Estimate	95% Conf. Interval		Estimate	95% Conf. Interval			Estimate	95% Conf. Interval	
ORANGUTAN	South	18	1.59	1.09	0.39	1.79	1.73	0.62	2.85	360	624	223	1025
	Central	8	1.59	0.20	0.02	0.37	0.31	0.03	0.59	810	251	21	482
	North	1	1.59	0.13	--	--	0.21	--	--	700	149	--	--
	TOTAL	27									1024		
BORNEAN GIBBON	South	296	3.08	10.20	8.50	11.89	31.42	26.18	36.62	360	11310	9425	13184
	Central	237	3.08	5.19	4.44	5.93	15.97	13.68	18.26	810	12938	11079	14794
	North	2	3.08	0.16	--	--	0.49	--	--	700	343	--	--
	TOTAL	535									24591		
WHITE-FRONTED LANGUR	South	62	4.23	2.10	1.48	2.73	8.88	6.24	11.53	360	3198	2246	4150
	Central	65	4.23	1.94	1.09	2.78	8.20	4.62	11.78	810	6640	3742	9539
	North	11	4.23	1.20	0.30	2.11	5.09	1.26	8.92	700	3562	880	6245
	TOTAL	138									13400	6868	19933
RED LANGUR	South	136	4.37	4.93	3.78	6.08	21.56	16.53	26.61	360	7761	5949	9578
	Central	189	4.37	4.77	3.87	5.68	20.86	16.93	24.82	810	16896	13715	20102
	North	13	4.37	1.23	0.36	2.10	5.37	1.57	9.17	700	3759	1101	6416
	TOTAL	338									28416	20765	36096
LONG-TAILED MACAQUE	South	2	6.24	0.02	--	--	0.14	--	--	360	52	--	--
	Central	16	6.24	0.20	0	0.38	1.24	0	2.34	810	1001	0	1899
	North	20	6.24	0.52	0	1.44	3.25	0	8.96	700	2276	0	6269
	TOTAL	38									3329		
PIG-TAILED MACAQUE	South	13	4.70	1.18	0.40	1.96	5.53	1.86	9.20	360	1990	669	3311
	Central	13	4.70	0.33	0.12	0.53	1.54	0.57	2.51	810	1248	464	2032
	North	7	4.70	0.82	--	--	3.85	--	--	700	2696	--	--
	TOTAL	33									5934		

APPENDIX VII
DENSITY OF TREES PRODUCING FRUIT AND MAST
EATEN BY ORANGUTANS (TREES PER HECTARE)

	CENTRAL			SOUTH		
	PANTU	TEBELLIAN	LATONG	MABAU	LELAP	BATANG AI
ALANGIACEAE						
<i>Alangium</i>	0.0	0.0	0.0	0.0	0.3	1.5
ANACARDIACEAE						
<i>Dracontomelon</i>	0.0	0.0	0.0	0.1	0.0	0.1
<i>Mangifera</i>	0.1	0.2	0.2	0.0	1.4	1.1
<i>Pentaspadon</i>	0.0	0.0	0.0	0.0	0.1	0.0
APOCYNACEAE						
<i>Willughbeia*</i>	0.2	0.0	0.1	0.1	0.0	0.3
AQUIFOLIACEAE						
<i>Ilex</i>	0.0	0.0	0.0	0.5	0.0	0.0
BOMBACACEAE						
<i>Durio**</i>	1.1	0.4	1.0	0.1	0.2	0.3
BURSERACEAE						
<i>Dacryodes</i>	1.0	1.6	4.6	0.0	0.7	2.2
EUPHORBIACEAE						
<i>Baccaurea**</i>	3.4	3.0	3.0	0.8	1.8	2.7
<i>Elateriospermum</i>	0.0	0.0	0.0	0.0	0.0	1.9
<i>Pimelodendron</i>	0.0	0.0	0.0	0.1	0.0	0.1
<i>Ptychopyxis</i>	0.1	0.0	0.1	0.0	0.0	0.2
FAGACEAE						
<i>Castanopsis**</i>	1.0	1.7	0.9	0.6	6.7	5.7
<i>Lithocarpus**</i>	3.7	5.5	9.4	10.4	12.9	13.9
GUTTIFERAE						
<i>Garcinia**</i>	0.9	1.0	1.1	10.8	4.3	7.8
LAURACEAE						
<i>Litsea</i>	0.0	0.1	0.0	7.0	0.0	1.0
LEGUMINOSAE						
<i>Dialium</i>	0.8	0.6	0.1	1.4	0.4	3.1
<i>Parkia</i>	0.1	0.2	0.3	0.1	0.1	0.3
<i>Pithecellobium</i>	0.0	0.0	0.0	0.4	0.0	0.0
MELIACEAE						
<i>Aglaia</i>	0.0	0.0	0.0	0.0	0.0	0.3
<i>Amoora</i>	0.0	0.0	0.0	0.1	0.0	0.7
<i>Sandoricum</i>	0.5	0.1	0.3	0.0	0.6	0.3
MORACEAE						
<i>Artocarpus**</i>	6.1	8.3	7.0	2.5	5.3	4.3
<i>Ficus**</i>	0.6	1.0	1.1	1.1	0.9	1.1
<i>Parartocarpus</i>	0.0	0.0	0.0	0.1	0.0	0.0
MYRISTICACEAE						
<i>Horsfieldia</i>	0.0	0.0	0.0	0.2	0.0	0.0
MYRTACEAE						
<i>Eugenia</i>	1.4	4.0	4.4	2.5	5.4	7.4
OLACACEAE						
<i>Scorodocarpus</i>	0.0	0.0	0.0	0.0	0.0	0.1
POLYGALACEAE						
<i>Xanthophyllum</i>	0.6	0.1	0.9	0.0	0.3	1.2
ROSACEAE						
<i>Prunus</i>	0.0	0.0	0.0	1.2	0.0	0.3
SAPINDACEAE						
<i>Arytera</i>	0.0	0.0	0.0	0.0	0.0	0.3
<i>Dimocarpus</i>	0.0	0.4	0.0	0.0	0.0	0.0
<i>Nephelium**</i>	2.0	4.6	5.3	3.8	3.5	6.1
<i>Pometia</i>	0.0	0.1	0.0	0.0	0.1	0.4
<i>Xerospermum</i>	0.6	0.2	0.5	0.0	0.3	1.9
STERCULIACEAE						
<i>Scaphium</i>	1.6	1.5	0.5	0.0	1.1	1.1
THYMELAEACEAE						
<i>Gonystylus</i>	0.0	0.0	0.0	0.0	0.0	0.1
TILIACEAE						
<i>Elaeocarpus</i>	0.0	0.0	0.1	0.0	0.1	0.6
<i>Grewia</i>	0.1	0.0	0.0	0.3	0.3	0.4
TOTAL	25.6	34.5	40.6	44.2	46.5	68.4

* Woody vine

** Genera most important to orangutans for fruit and mast production

(Blouch, 1994)

APPENDIX VIII

Check List of Birds of Lanjak Entimau Wildlife Sanctuary (Grubh, 1994)

	English Name	Scientific Name	
1	Darter	<i>Anhinga melanogaster</i>	*
2	Little Green Heron	<i>Butorides striatus</i>	
3	Changeable Hawk-Eagle	<i>Spizaetus cirrhatus</i>	*
4	Wallace's Hawk Eagle	<i>Spizaetus nanus</i>	*
5	Black Eagle	<i>Ictinaetus malayensis</i>	*
6	Greyheaded Fishing Eagle	<i>Ichthyophaga ichthyaetus</i>	*
7	Lesser Fishing Eagle	<i>Ichthyophaga nana</i>	
8	Crested Serpent Eagle	<i>Spilornis cheela</i>	
9	Blackthighed Falconet	<i>Microhierax fringillarius</i>	
10	Crested Green Wood Partridge	<i>Rollulus rouloul</i>	
11	Crimsonheaded Wood Partridge	<i>Haematortyx sanguiniceps</i>	*
12	Crested Fireback	<i>Lophura ignita</i>	
13	Bulwer's Pheasant	<i>Lophura bulweri</i>	
14	Great Argus Pheasant	<i>Argusianus argus</i>	
15	Common Sandpiper	<i>Tringa hypoleucos</i>	
16	Thickbilled Green Pigeon	<i>Treron curvirostra</i>	*
17	Cinnamonheaded Green Pigeon	<i>Treron fulvicollis</i>	*
18	Little Green Pigeon	<i>Treron olax</i>	*
19	Large Green Pigeon	<i>Treron capellei</i>	*
20	Jambu Fruit Pigeon	<i>Ptilinopus jambu</i>	
21	Emerald Dove	<i>Chalcophaps indica</i>	
22	Blue-rumped Parrot	<i>Psittinus cyanurus</i>	
23	Malay Lorikeet	<i>Loriculus galgulus</i>	*
24	Lesser Hawk-Cuckoo	<i>Cuculus vagans</i>	*
25	Indian Hawk-Cuckoo	<i>Cuculus micropterus</i>	*
26	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	
27	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	
28	Rufousbreasted Cuckoo	<i>Cacomantis variolosus</i>	
29	Violet Cuckoo	<i>Chalcites xanthorhynchus</i>	*
30	Drongo-Cuckoo	<i>Surniculus lugubris</i>	
31	Lesser Greenbilled Malkoha	<i>Phaenicophaeus diardi</i>	*
32	Raffles's Malkoha	<i>Phaenicophaeus chlorophaeus</i>	
33	Redbilled Malkoha	<i>Phaenicophaeus javanicus</i>	*
34	Chestnutbreasted Malkoha	<i>Phaenicophaeus curvirostris</i>	
35	Common Coucal	<i>Centropus sinensis</i>	
36	Bay Owl	<i>Phocodilus badius</i>	*
37	Reddish Scops Owl	<i>Otus rufescens</i>	*
38	Malaysian Eagle-Owl	<i>Bubo sumatrana</i>	*
39	Malaysian Fish Owl	<i>Ketupa ketupu</i>	*
40	Hawk-Owl	<i>Ninox scutulata</i>	*
41	Malaysian Eared Nightjar	<i>Eurostopodus temmincki</i>	
42	Low's Swiftlet	<i>Collocalia maxima</i>	*
43	Whitebellied Swiftlet	<i>Collocalia esculenta</i>	*
44	Malaysian Spinetailed Swift	<i>Chaetura gigantea</i>	*
45	Whiterumped Spinetailed Swift	<i>Chaetura leucopygialis</i>	
46	House swift	<i>Apus affinis</i>	*

	English Name	Scientific Name
47	Crested Tree Swift	<i>Hemiprocne longipennis</i>
48	Whitewiskered Tree Swift	<i>Hemiprocne comata</i>
49	Rednaped Trogon	<i>Harpactes kasumba</i>
50	Diard's Trogon	<i>Harpactes diardi</i>
51	Cinnamonrumped Trogon	<i>Harpactes orrophaeus</i> *
52	Scarletrumped Trogon	<i>Harpactes duvauceli</i>
53	Banded Kingfisher	<i>Lacedo pulchella</i>
54	Chesnutcollared Kingfisher	<i>Halcyon concreta</i>
55	Blackcapped Kingfisher	<i>Halcyon pileata</i> *
56	Storkbilled Kingfisher	<i>Pelargopsis capensis</i>
57	Common Kingfisher	<i>Alcedo atthis</i>
58	Deep Blue Kingfisher	<i>Alcedo meninting</i>
59	Bluebanded Kingfisher	<i>Alcedo euryzona</i>
60	Forest Kingfisher	<i>Ceyx erithacus</i>
61	Bluethroated Bee-Eater	<i>Merops viridis</i> *
62	Redbeared Bee-Eater	<i>Nyctornis amicta</i>
63	Whitecrested Hornbill	<i>Berenicornis comatus</i>
64	Bushycrested Hornbill	<i>Anorrhinus galeritus</i>
65	Wrinkled Hornbill	<i>Rhyticeros corrugatus</i>
66	Wreathed Hornbill	<i>Rhyticeros undulatus</i>
67	Black Hornbill	<i>Anthracoceros malayanus</i>
68	Rhinoceros Hornbill	<i>Buceros rhinoceros</i>
69	Helmeted Hornbill	<i>Rhinoplax vigil</i>
70	Brown Barbet	<i>Calorhamphus fuliginosus</i>
71	Goldwhiskered Barbet	<i>Megalaima chrysopogon</i>
72	Manycoloured Barbet	<i>Megalaima rafflesi</i>
73	Gaudy or Redthroated Barbet	<i>Megalaima mystacophanes</i>
74	Yellowcrowned Barbet	<i>Megalaima henrici</i>
75	Goldennaped Barbet	<i>Megalaima pulcherrima</i>
76	Blackthroated Barbet	<i>Megalaima eximia</i> *
77	Little Barbet	<i>Megalaima australis</i>
78	Malaysian Honeyguide	<i>Indicator archipelagicus</i>
79	Rufous Piculet	<i>Sasia abnormis</i>
80	Crimsonwinged Woodpecker	<i>Picus puniceus</i> *
81	Checkerthroated Woodpecker	<i>Picus mentalis</i>
82	Rufous Woodpecker	<i>Micropternus brachyurus</i>
83	Buffrumped Woodpecker	<i>Meiglyptes tristis</i>
84	Buffnecked Woodpecker	<i>Meiglyptes tukki</i>
85	Grey-and-buff Woodpecker	<i>Hemicircus concretus</i> *
86	Olivebacked Threetoed Woodpecker	<i>Dinopium rafflesi</i>
87	Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>
88	Maroon Woodpecker	<i>Blythipicus rubiginosus</i>

	English Name	Scientific Name
89	Orangebacked Woodpecker	<i>Chrysocolaptes validus</i>
90	Green Broadbill	<i>Calyptomena viridis</i>
91	Hose's Broadbill	<i>Calyptomena hosei</i>
92	Black-and-red Broadbill	<i>Cymbirhynchus macrorhynchus</i>
93	Black-and-yellow Broadbill	<i>Eurylaimus ochromalus</i>
94	Banded Broadbill	<i>Eurylaimus javanicus</i>
95	Dusky Broadbill	<i>Corydon sumatranus</i> *
96	Bluebanded Pitta	<i>Pitta arquata</i>
97	Garnet Pitta	<i>Pitta granatina</i> *
98	Blueheaded Pitta	<i>Pitta baudi</i>
99	Banded Pitta	<i>Pitta guajana</i>
100	Bluewinged Pitta	<i>Pitta brachyura</i>
101	Pacific Swallow	<i>Hirundo tahitica</i>
102	Common Swallow	<i>Hirundo rustica</i>
103	Blackwinged Flycatcher-Shrike	<i>Hemipus hirundinaceus</i> *
104	Barred Cuckoo-Shrike	<i>Coracina striata</i>
105	Mountain Minivet	<i>Pericrocotus solaris</i> *
106	Green Iora	<i>Aegithina viridissima</i>
107	Lesser Leafbird	<i>Chloropsis cyanopogon</i> *
108	Greater Leafbird	<i>Chloropsis sonnerati</i>
109	Bluewinged Leafbird	<i>Chloropsis cochinchinensis</i>
110	Fairy Bluebird	<i>Irena puella</i>
111	Puffbacked Bulbul	<i>Pycnonotus eutilotus</i>
112	Black-and-white Bulbul	<i>Pycnonotus melanoleucos</i>
113	Blackheaded Bulbul	<i>Pycnonotus atriceps</i>
114	Greybellied Bulbul	<i>Pycnonotus cyaniventris</i>
115	Yellowcrowned or Strawheaded Bulbul	<i>Pycnonotus zeylanicus</i>
116	Redeyed Bulbul	<i>Pycnonotus brunneus</i>
117	Creamvented Bulbul	<i>Pycnonotus simplex</i>
118	Spectacled Brown Bulbul	<i>Pycnonotus erythrophthalmos</i>
119	Olive Whitethroated Bulbul	<i>Criniger bres</i>
120	Ochraceous Bulbul	<i>Criniger ochraceus</i>
121	Yellowbellied Bulbul	<i>Criniger phaeocephalus</i>
122	Finsch's Bulbul	<i>Criniger finschi</i>
123	Hairybacked Bulbul	<i>Hypsipetes criniger</i>
124	Streaked Bulbul	<i>Hypsipetes malaccensis</i> *
125	Buffvented Bulbul	<i>Hypsipetes charlottae</i>
126	Ashy Bulbul (Yellow-winged)	<i>Hypsipetes flavalus</i>
127	Crowbilled Drongo	<i>Dicrurus annectans</i>
128	Bronzed Drongo	<i>Dicrurus aeneus</i>
129	Large Racket-tailed Drongo	<i>Dicrurus paradiseus</i>
130	Malaysian Blackheaded Oriole	<i>Oriolus xanthonotus</i>

	English Name	Scientific Name
131	Crested Jay	<i>Platylophus galericulatus</i>
132	Black Magpie	<i>Platysmurus leucopterus</i> *
133	Velvetfronted Nuthatch	<i>Sitta frontails</i> *
134	Blackcapped Jungle Babbler	<i>Pellorneum capistratum</i>
135	Temminck's Jungle Babbler	<i>Trichastoma pyrrhogenys</i>
136	Short-tailed Jungle Babbler	<i>Trichastoma malaccense</i>
137	Blyth's Jungle babbler	<i>Trichastoma rostratum</i>
138	Ferruginous Jungle Babbler	<i>Trichastoma bicolor</i>
139	Horsefield's Jungle Babbler	<i>Trichastoma sepiarium</i>
140	Greater Redheaded Babbler	<i>Malacopteron magnum</i>
141	Scaly crowned Babbler	<i>Malacopteron cinereum</i>
142	Moustached babbler	<i>Malacopteron magnirostre</i>
143	Plain Babbler	<i>Malacopteron affine</i>
144	Whitethroated Babbler	<i>Malacopteron albogulare</i>
145	Chestnutbacked Scimitar Babbler	<i>Pomatorhinus montanus</i>
146	Bornean Wren-Babbler	<i>Ptilocichla leucogrammica</i>
147	Striped Wren-Babbler	<i>Kenopia striata</i>
148	Blackthroated Wren-Babbler	<i>Napothera atrigularis</i>
149	Greyheaded Babbler	<i>Stachyris poliocephala</i>
150	Blacknecked Babbler	<i>Stachyris nigricollis</i> *
151	Whitenecked Babbler	<i>Stachyris leucotis</i>
152	Chestnutrumped Babbler	<i>Stachyris maculata</i>
153	Chestnutwinged Babbler	<i>Stachyris erythroptera</i>
154	Hume's Tree Babbler	<i>Stachyris rufifrons</i> *
155	Striped Tit-Babbler	<i>Macronous gularis</i> *
156	Fluffybacked Tit-Babbler	<i>Macronous ptilosus</i>
157	Whitebellied Yuhina	<i>Yuhina zantholeuca</i>
158	Chestnut-crested Yuhina	<i>Yuhina everetti</i>
159	Brown Quaker Babbler	<i>Alcippe brunneicauda</i>
160	Rail-Babbler	<i>Eupetes macrocerus</i> *
161	Orangetailed Shama	<i>Copsychus pyrrhopygus</i>
162	Magpie Robin	<i>Copsychus saularis</i>
163	Whiterumped Shama	<i>Copsychus malabaricus</i>
164	Whitecrowned Forktail	<i>Enicurus leschenaulti</i>
165	Chestnutnaped Forktail	<i>Enicurus ruficapillus</i>
166	Chestnutheaded Ground Thrush	<i>Zoothera interpres</i>
167	Whitethroated Flycatcher-Warbler	<i>Abroscopus superciliaris</i> *
168	Flyeater	<i>Gerygone sulphurea</i> *
169	Arctic Leaf Warbler	<i>Phylloscopus borealis</i>
170	Blacknecked Tailorbird	<i>Orthotomus atrogularis</i>
171	Redtailed Tailorbird	<i>Orthotomus sericeus</i> *
172	Yellowbellied Wren-Warbler	<i>Prinia flaviventris</i> *
173	Whitethroated Jungle Flycatcher	<i>Rhinomyias umbratilis</i>
174	Brown Flycatcher	<i>Muscicapa latirostris</i> *

	English Name	Scientific Name
175	Whitetailed Blue Flycatcher	<i>Muscicapa concreta</i>
176	Pale Blue Flycatcher	<i>Muscicapa unicolor</i>
177	Malaysian Blue Flycatcher	<i>Muscicapa turcosa</i>
178	Mangrove Blue Flycatcher	<i>Muscicapa rufigastra</i>
179	Largebilled Blue Flycatcher	<i>Muscicapa caerulata</i>
180	Bornean Blue Flycatcher	<i>Muscicapa superba</i>
181	Magimaki Flycatcher	<i>Muscicapa mugimaki</i> *
182	Rufouschested Flycatcher	<i>Muscicapa dumetoria</i>
183	Pygmy Blue Flycatcher	<i>Muscicapa hodgsoni</i> *
184	Greyheaded Flycatcher	<i>Culicicapa ceylonensis</i>
185	Whitethroated Fantail Flycatcher	<i>Rhipidura albicollis</i>
186	Spotted Fantail Flycatcher	<i>Rhipidura perlata</i>
187	Pied Fantail Flycatcher	<i>Rhipidura javanica</i> *
188	Blacknaped Blue Flycatcher	<i>Hypothymis azurea</i>
189	Chestnutwinged Flycatcher	<i>Philentoma pyrrhoptera</i>
190	Maroonbreasted Flycatcher	<i>Philentoma velata</i>
191	Paradise Flycatcher	<i>Terpsiphone paradisi</i>
192	Grey Wagtail	<i>Motacilla cinerea</i>
193	Yellow Wagtail	<i>Motacilla flava</i> *
194	Grackle or Hill Myna	<i>Gracula religiosa</i> *
195	Bornean Bristlehead	<i>Pityriasis gymnocephala</i>
196	Plaincoloured Sunbird	<i>Anthreptes simplex</i>
197	Rufousthroated Sunbird	<i>Anthreptes rhodolaema</i>
198	Rubycheeked Sunbird	<i>Anthreptes singalensis</i>
199	Purplenaped Sunbird	<i>Nectarinia hypogrammica</i>
200	Yellowbacked Sunbird	<i>Aethopyga siparaja</i> *
201	Scarlet Sunbird	<i>Aethopyga mystacalis</i>
202	Little Spiderhunter	<i>Arachnothera longirostris</i>
203	Thickbilled Spiderhunter	<i>Arachnothera crassirostris</i>
204	Longbilled Spiderhunter	<i>Arachnothera robusta</i>
205	Spectacled Spiderhunter	<i>Arachnothera flavigaster</i>
206	Yelloweared Spiderhunter	<i>Arachnothera chrysogenys</i>
207	Greybreasted Spiderhunter	<i>Arachnothera affinis</i>
208	Scarletbreasted Flowerpecker	<i>Prionochilus thoracicus</i> *
209	Yellowrumped Flowerpecker	<i>Prionochilus xanthopygius</i>
210	Yellowthroated Flowerpecker	<i>Prionochilus maculatus</i>
211	Plain Flowerpecker	<i>Dicaeum concolor</i>
212	Brownbacked Flowerpecker	<i>Dicaeum everetti</i> *
213	Dusky Munia	<i>Lonchura fuscans</i>

* Reported by Kavanagh and McCormic

APPENDIX IX

Fruit Trees preferred by seven Bornean hornbills namely,
Whitecrested, Bushycrested, Wrinkled, Wreathed, Black
Rhinoceros & Helmeted hornbill (adapted from Leighton 1982)

	Family	Genus	Number of species
1	Annonaceae	Xylopia and a few other genera	25
2	Apocynaceae	Tabernaemontana	1
3	Burseraceae	Canarium	7
4	Burseraceae	Dacryodes	2
5	Burseraceae	Santiria	2
6	Bombacaceae	Durio	5
7	Leguminosae	Sindora	2
8	Connaraceae	Connarus	3
9	Cornaceae	Mastixia	1
10	Ebenaceae	Diospiros	2
11	Euphorbiaceae	Aporusa	2
12	Euphorbiaceae	Baccaurea	5
13	Euphorbiaceae	Chaetocarpus	1
14	Euphorbiaceae	Macaranga	3
15	Euphorbiaceae	Pimelodendron	1
16	Euphorbiaceae	Suregada	1
17	Gnetaceae	Gnetum	1
18	Icacinaceae	Gonocaryum	1
19	Lauraceae	Cinnamomum	2
20	Lauraceae	Cryptocarya	2
21	Lauraceae	Dehaasia	1
22	Lauraceae	Endandara	1
23	Lauraceae	Lindera	1
24	Lauraceae	Litsea	26
25	Lauraceae	Neolitsea	0?
26	Magnoliaceae	Elmerrillia	1
27	Magnoliaceae	Talauma	2
28	Meliaceae	Aglaia	8
29	Meliaceae	Arnoora	4
30	Meliaceae	Chisocheton	3
31	Meliaceae	Dysoxylum	8
32	Meliaceae	Walsura	2
33	Moraceae	Ficus	39
34	Myristicaceae	Gymnocranthera	1
35	Myristicaceae	Horsfieldia	5
36	Myristicaceae	Knema	12
37	Myristicaceae	Myristica	7
38	Myristicaceae	Ardisia	2
39	Olacaceae	Scorodocarpus	1
40	Other families	8 genera	

APPENDIX X TERRESTRIAL AMPHIBIANS AND REPTILES OF SARAWAK FOUND IN LANJAK ENTIMAU

SPECIES	Status	SITE						HABITAT						
		I	II	III	IV	V	Total	1	2	3	4	5	6	7
AMPHIBIA / REPTILIA														
ANURA : PELOBATIDAE (Leaf litter frogs)														
1 <i>Leptobrachella baluensis</i> Smith														
2 <i>Leptobrachella brevicrus</i> + Dring														
3 <i>Leptobrachella mjobergi</i> + Smith	A	34*	20	8	44	19	125	■	■	■	■	■	■	■
4 <i>Leptobrachella parva</i> + Dring														
5 <i>Leptobrachella serasanae</i> + Dring														
6 <i>Leptobrachium hendricksoni</i> (Tschudi)														
7 <i>Leptobrachium montanum</i> + (Fisher)	U	2		2		3	7	■	■	■	■	■	■	■
8 <i>Leptobrachium nigrops</i> Berry & Hendrickson														
9 <i>Leptolalax gracilis</i> + (Guenther)	C	4	3	3	13	6	29	■	■	■	■	■	■	■
10 <i>Megophrys baluensis</i> (Boulenger)														
11 <i>Megophrys edwardinae</i> + Inger														
12 <i>Megophrys longipes</i> (Kuhl & van Hasselt)														
13 <i>Megophrys nasuta</i> + (Schlegel)	C	6	T		6	5	17	■	■	■	■	■	■	■
BUFONIDAE (Toads)														
14 <i>Bufo asper</i> + Gravenhorst	R					1	1			■				
15 <i>Bufo juxtasper</i> + Inger	A	14	22	9	4	4	54	■	■	■				
16 <i>Bufo divergens</i> + Peters														
17 <i>Bufo melanostictus</i> Schneider														
18 <i>Bufo quadriocatus</i> Boulenger														
19 <i>Ansonia albomaculata</i> + Inger	C	10		1	1		12	■	■	■				
20 <i>Ansonia hanitschi</i> Inger														
21 <i>Ansonia latidisca</i> Inger														
22 <i>Ansonia leptopus</i> + (Guenther)	C	3	7	6	12		28	■	■	■	■			
23 <i>Ansonia longidigita</i> + Inger	C	5	7	2	1		15	■	■	■	■	■	■	■
24 <i>Ansonia minuta</i> Inger														
25 <i>Ansonia platysoma</i> Inger														

- I Ng Segerak, ulu Engkari
- II Ng Serembuang, ulu Skrang
- III Ulu Serembuang/Bkt Lanjak
- IV Emperan Lalliang, ulu Engkari
- V Sg Melinau/Bedawak, ulu Katibas

- 1 River [w > 6m]
- 2 River [w = 2-6m]
- 3 Stream [w = 1-2m]
- 4 Stream [w = 0.5-1m]
- 5 Stream [w < 0.5m]
- 6 Forest Transect
- 7 Animal wallow/rain pool

- Abundant > 30 specimens
- Common 10 - 50 specimens
- Uncommon 5 - 10 specimens
- Rare < 5 specimens
- T Tadpole stage
- S Reported sighting or call
- K Reported by Kavanagh (1982)

- * Number of specimens collected
- ** New record for Sarawak
- *** New species (first discovered in LEWS)
- + Species of lowland dipterocarp forest
- Principal habitat

SPECIES	Status	SITE					Total	HABITAT								
		I	II	III	IV	V		1	2	3	4	5	6	7		
26 <i>Ansonia spinulifer</i> + (Mocquard)	R				2		2									
27 <i>Ansonia torrentis</i> Dring																
28 <i>Pedostibes hosei</i> + (Boulenger)	C	4	3	5	1	10	18									
29 <i>Pedostibes rugosus</i> + Inger																
30 <i>Pelophryne api</i> Dring																
31 <i>Pelophryne brevipes</i> + (Peters)	C	4	2	1	14		21									
32 <i>Pelophryne exigua</i>																
33 <i>Pelophryne guentheri</i> + (Boulenger)																
34 <i>Pelophryne macrotis</i> (Boulenger)																
35 <i>Pelophryne misera</i> (Tschudi)																
36 <i>Leptophryne borbonica</i> + (Tschudi)																
MICROHYLIDAE (Narrow-mouthed frogs)																
36 <i>Calluella brooksi</i> + (Boulenger)																
37 <i>Calluella flava</i> + Kiew																
38 <i>Calluella smithi</i> + (Barbour and Nobel)																
39 <i>Gastrophrynoides borneensis</i> + (Boulenger)																
40 <i>Kaloula pulchra</i> Gray																
41 <i>Kaloula baleata</i> (Mueller)																
42 <i>Kalophrynus bungaranum</i>																
43 <i>Kalophrynus heterochirus</i> + Boulenger																
44 <i>Kalophrynus intermedius</i> + Inger	R			1			1									
45 <i>Kalophrynus nubicola</i> -																
46 <i>Kalophrynus pleurostigma</i> + Tschudi																
47 <i>Kalophrynus punctatus</i> + Peters	K															
48 <i>Kalophrynus subterrestris</i> + Inger	C			5	3	5	13									
49 <i>Chaperina fusca</i> + Mocquard	R	1	1				3									
50 <i>Metaphrynella sundana</i> + (Peters)	U		1	3		1	5									
51 <i>Microhyla borneensis</i> + Parker	R						1	1								
52 <i>Microhyla perparva</i> + Inger																
53 <i>Microhyla petrigena</i> + Inger	C	T						T	-							

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 *** New species (first discovered in LEWS)
 + Species of lowland dipterocarp forest
 ■ Principal habitat

SPECIES	Status	SITE						Total	DISTRIBUTION									
		I	II	III	IV	V	1		2	3	4	5	6	7				
RANIDAE ("True" or riverine frogs)																		
54 <i>Rana baramica</i> Boettger																		
55 <i>Rana blythi</i> + Boulenger	A	5	10	8	2	9	34											
56 <i>Rana cancrivora</i> Gravenhorst																		
57 <i>Rana chalconota</i> + (Schlegel)	A	6	5	3	7	14	35											
58 <i>Rana erythraea</i> (Schlegel)																		
59 <i>Rana glandulosa</i> Boulenger																		
60 <i>Rana hosei</i> + Boulenger	A	13	25	7	3	8	56											
61 <i>Rana ibanorum</i> + Inger	A	5	6	7	16	17	51											
62 <i>Rana ingeri</i> Kiew																		
63 <i>Rana kuhli</i> + Dumeril & Bibron	A	42	36	8	33	21	140											
64 <i>Rana laticeps</i> + Boulenger	C	10	4	1	4	2	21											
65 <i>Rana limnocharis</i> Boie																		
66 <i>Rana luctuosa</i> + (Peters)	U			T	2		2											
67 <i>Rana malesiana</i> + Kiew	R		1		1	1	3											
68 <i>Rana nicobariensis</i> (Stoliczka)																		
69 <i>Rana palavanensis</i> + Boulenger	U	1			4	3	8											
70 <i>Rana paramacrodon</i> Inger																		
71 <i>Rana signata</i> + (Guenther)	C	6	1	3	6	14	27											
72 <i>Micrixalus baluensis</i> + (Boulenger)	R					1	1											
73 <i>Occidozyga baluensis</i> + (Boulenger)																		
74 <i>Occidozyga laevis</i> + (Guenther)																		
75 <i>Staurois latopalmatus</i> (Boulenger)	A	9	7	5	7	16	44											
76 <i>Staurois natator</i> + (Guenther)	A	16	12	3	3	15	49											
77 <i>Staurois tuberilinguis</i> Boulenger																		
78 <i>Huia cavitympanum</i> + (Boulenger)	U	1		3	1		5											
79 <i>Meristogenys "jerboa"</i> + (Guenther)																		
80 <i>Meristogenys kinabaluensis</i> (Inger)																		
81 <i>Meristogenys macrophthalmus</i> + Matsui																		
82 <i>Meristogenys poecilus</i> + (Inger & Gritis)	A	48	11	5	20	24	108											
83 <i>Meristogenys phaeomerus</i> + (Inger & Gritis)	A	17	T	21	13	9	60											

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		I	II	III	IV	V	Total	1	2	3	4	5	6	7
ICTHYOPHIDAE (Caecilians, or legless amphibians)														
112 <i>Icthyophis glutinosus</i> + (Linnaeus)	R			1	1		2							
113 <i>Icthyophis monochrous</i> Bleeker														
114 <i>Icthyophis nigroflava</i> (Taylor)														
CHELONIA : BATAGURIDAE (Basking turtles or terrapins)														
115 <i>Callagur borneensis</i> (Schlegel & Mueller)														
116 <i>Notochelys platynota</i> (Gray)														
TESTUDINIDAE (Tortoises)														
117 <i>Heosemys spinosa</i> (Gray)														
118 <i>Orlitia borneensis</i> Gray	R				1		1							
TRIONYCHIDAE (Softshelled turtles)														
119 <i>Dogania subplana</i> Geoffrey Saint-Hillaire	U	S												
120 <i>Trionyx cartilagineus</i> (Boddaert)														
121 <i>Trionyx hurum</i> Gray														
122 <i>Trionyx sinensis</i> Wiegmann														
LACERTILIA : HELODERMATIDAE (earless or beaded lizards)														
123 <i>Lanthonotus borneensis</i> (Steindachner)														
LACERTILIA : GEKKONIDAE														
124 <i>Aeluroscalabotes felinus</i> + (Guenther)	C	2	2	2	1	2	9							
125 <i>Cnemaspis nigridis</i> (Stoliczka)														
126 <i>Cnemaspis kendalli</i> (Gray)														
127 <i>Cosymbotus craspedotus</i> (Macguard)														

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RHACOPHORIDAE (Tree frogs)															
84	<i>Philautus acutus</i>	Dring													
85	<i>Philautus hosei</i>	(Boulenger)	C	5	2	2		1	10	■	■	■		■	
86	<i>Philautus ingeri</i>	Dring													
87	<i>Philautus kerangae</i>	Dring													
88	<i>Philautus longicrus</i> +	Dring	C			9	17		26					■	■
89	<i>Philautus mjobergi</i> +	Smith	R		1				1					■	
90	<i>Philautus petersi</i>	Dring													
91	<i>Philautus tectus</i> +	Dring	R	1					1		■				
92	<i>Philautus umbra</i>	Dring													
93	<i>Polypedates colletti</i> +	(Boulenger)													
94	<i>Polypedates leucomystax</i>	(Boie)													
95	<i>Polypedates macrotis</i> +	(Boulenger)	K												
96	<i>Polypedates otlophus</i> +		U			2	3		5						■
97	<i>Rhacophorus appendiculatus</i> +	(Guenther)	C					5, T	5						■
98	<i>Rhacophorus baluensis</i>	Inger													
99	<i>Rhacophorus bimaculatus</i> +	(Peters)				T?			-			■			
100	<i>Rhacophorus dulitensis</i> +	Boulenger													
101	<i>Rhacophorus everetti</i>	Boulenger													
102	<i>Rhacophorus fasciatus</i> +	Boulenger													
103	<i>Rhacophorus gauni</i> +	(Inger)					1		1	■					
104	<i>Rhacophorus harrisoni</i> +	Inger and Haile	R											■	
105	<i>Rhacophorus kajau</i> +	Dring													
106	<i>Rhacophorus nigropalmatus</i> +	Boulenger	K												
107	<i>Rhacophorus pardalis</i> +	Guenther	R		1				1			■			
108	<i>Rhacophorus reinwardti</i> ** +		U				6		6						■
109	<i>Rhacophorus robinsoni</i>														
110	<i>Rhacophorus rufipes</i> +	Inger	R					1	1						
111	<i>Nyctixalus pictus</i> +	(Peters)	R	1					1					■	

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154	<i>Draco cornutus</i> +	Guenther													
155	<i>Draco cristatellus</i> +	Guenther													
156	<i>Draco fimbriatus</i> +	Guenther													
157	<i>Draco formosus</i> +	Boulenger													
158	<i>Draco gracilis</i> +	Barbour													
159	<i>Draco haematopogon</i> +	Gray													
160	<i>Draco maximus</i> +	Boulenger													
161	<i>Draco microlepis</i> +	Boulenger													
162	<i>Draco melanopogon</i> +	Boulenger													
163	<i>Draco quinquefasciatus</i> +	Hardwicki & Gray	K												
164	<i>Draco taeniopterus</i> +	Guenther													
165	<i>Draco volans</i> +	Linnaeus													
166	<i>Gonocephalus bellii</i> +	(Dumeril & Bibron)													
167	<i>Gonocephalus doriae</i> +	Peters													
168	<i>Gonocephalus grandis</i> +	(Gray)	U	3	2			5	■		■	■			
169	<i>Gonocephalus liogaster</i> +	(Guenther)	R				1	1					■		
170	<i>Gonocephalus miotypanum</i> +	(Guenther)													
171	<i>Harpesaurus thescalorhinus</i>	-													
172	<i>Phoxophrys nigrilabris</i> +	(Peters)	U	1	1	2	2	6		■	■	■			■
173	<i>Pseudocalotes sp. nov.</i> *** +	(Inger & Stuebing)	R	1				1							■
SCINCIDAE (Skinks or smooth lizards)															
174	<i>Apterygodon vittatum</i> +	Edeling													
175	<i>Dasia grisea</i>														
176	<i>Dasia olivacea</i>	(Gray)													
177	<i>Dibamus alfredi</i> +	Taylor													
178	<i>Dibamus leucurus</i> +	(Blecker)													
179	<i>Dibamus novaguincae</i>														
180	<i>Emoie atrocostatum</i> +	(Lesson)													
181	<i>Emoie caeruleocauda</i> +	(de Vis)													
182	<i>Hinulia variegatum</i> +	(Peters)													
183	<i>Lamprolepis neuwenhysi</i> +	(Lidth)													

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		I	II	III	IV	V	Total	1	2	3	4	5	6	7	
128 <i>Cosymbotus platyurus</i> (Schneider)															
129 <i>Gecko monarchus</i> (Dumeril & Bibson)															
130 <i>Gecko stentor</i> + (Cantor)	U	S	S			S									
131 <i>Gehyra beebei</i> + Annandale															
132 <i>Gonydactylus baluensis</i> + (Mocquard)															
133 <i>Gonydactylus cavernicolus</i> (Inger & King)															
134 <i>Gonydactylus consobrinus</i> + (Peters)	R		1	1	1		3	■	■						
135 <i>Gonydactylus malayanus</i>															
136 <i>Gonydactylus ingeri</i> + (Hikida)															
137 <i>Gonydactylus marmoratus</i> (Kuhl)															
138 <i>Gonydactylus matsuii</i> + (Hikida)															
139 <i>Gonydactylus pubisulcus</i> + (Inger)	C	1	2	7	2	2	14	■	■	■	■	■	■	■	■
140 <i>Hemidactylus brooki</i> Gray															
141 <i>Hemidactylus frenatus</i> Dumaril & Bibson															
142 <i>Hemidactylus karenorum</i> (Theobald)															
143 <i>Hemidactylus nigriventris</i> Lidth															
144 <i>Hemiphyllodactylus typus</i> + Bleeker															
145 <i>Lepidodactylus ceylonensis</i> Boulenger															
146 <i>Lepidodactylus lugubris</i> + Dumeril & Bibron															
147 <i>Ptychozoon horsefieldii</i> + Gray															
148 <i>Ptychozoon kuhli</i> + Stejnejer															
149 <i>Ptychozoon rhacophorus</i> + (Boulenger)															
AGAMIDAE (Old world rough-scaled lizards)															
150 <i>Aphaniotis acutirostris</i> + Modigliani															
151 <i>Aphaniotis fusca</i> + (Peters)	K														
152 <i>Aphaniotis ornata</i> + (Lidth)	R					1?	1								■
153 <i>Bronchocela cristatella</i> (Kuhl)															

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184 <i>Lamprolepis smaragdina</i> + (Lesson)															
185 <i>Lamprolepis vyeri</i> + -															
186 <i>Lipinia quadrivittata</i> + (Peters)															
187 <i>Lipinia vittigerum</i> Boulenger															
188 <i>Lygosoma atrocostatum</i> (Lesson)															
189 <i>Lygosoma bowringi</i> (Guenther)															
190 <i>Lygosoma cyanurum</i> (Lesson)															
191 <i>Lygosoma nitens</i> Peters															
192 <i>Lygosoma shelfordi</i> + Boulenger															
193 <i>Lygosoma vittatum</i> + (Edeling)															
194 <i>Mabuya indepressa</i> + Brown & Alcalá															
195 <i>Mabuya multicarinata</i> + (Gray)															
196 <i>Mabuya multifasciata</i> + (Kuhl)															
197 <i>Mabuya rudis</i> + Boulenger	U	2	2				4	■	■						
198 <i>Mabuya rugifera</i> + (Stoliczka)															
199 <i>Ophisaurus buttikoferi</i> + Lidth	R	1					1					■			
200 <i>Siaphos kuhli</i> + (Guenther)															
201 <i>Siaphos quadrivittatum</i>															
202 <i>Sphenomorphus aesculeticola</i> + Inger															
203 <i>Sphenomorphus alfredi</i> + (Boulenger)															
204 <i>Sphenomorphus cyanolaemus</i> + Inger & Hosmer															
205 <i>Sphenomorphus haasi</i> + Inger & Hosmer															
206 <i>Sphenomorphus hallieri</i> + (Lidth)															
207 <i>Sphenomorphus kinabaluensis</i> (Bartlett)															
208 <i>Sphenomorphus maculicollis</i> + Bacon															
209 <i>Sphenomorphus modigliani</i> + (Boulenger)															
210 <i>Sphenomorphus multisquamatus</i> + Inger															
211 <i>Sphenomorphus sabanus</i> + Inger															
212 <i>Sphenomorphus stellatus</i>															
213 <i>Sphenomorphus tenuiculum</i> + (Macquard)															
214 <i>Tropidophorus beccari</i> + (Peters)	R		1		1		2				■	■			
215 <i>Tropidophorus brookei</i> + (Gray)	C	2	6	1	2	1	12	■	■	■	■	■	■	■	■
216 <i>Tropidophorus micropus</i> Lidth															
217 <i>Tropidophorus mocquardi</i> + Boulenger															
218 <i>Tropidophorus perplexus</i> + Barbour															

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SERPENTES

SPECIES	Status	SITE						HABITAT						
		I	II	III	IV	V	Total	1	2	3	4	5	6	7
VARANIDAE (Monitor lizards)														
219 <i>Varanus dumerilli</i> (Schlegel)														
220 <i>Varanus heteropholis</i> Boulenger														
221 <i>Varanus rudicollis</i> Gray														
222 <i>Varanus salvator</i> (Laurenti)	U	S	S	S	S		-	■						
LACERTIDAE (Wall lizards)														
223 <i>Tachydromus sexlineatus</i> Daudin														
TYPHLOPIDAE (Blind snakes)														
224 <i>Ramphotyphlops braminus</i> (Daudin)														
225 <i>Ramphotyphlops lineatus</i> + (Schlegel)														
226 <i>Ramphotyphlops olivaceus</i> (Gray)														
UROPELTIDAE (Pipe snakes)														
227 <i>Cylindrophis lineatus</i> Blanford														
228 <i>Cylindrophis rufus</i> + (Lamenti)														
229 <i>Cylindrophis sp. nov.</i> *** + Stuebing	R	1					1							■
BOIDAE (Pythons)														
230 <i>Python curtus</i> + Schlegel	U	S	S				S	-		■				
231 <i>Python reticulatus</i> + (Schneider)	U	S	S				S	-	■					■
XENOPELTIDAE (Earth snakes)														
232 <i>Xenopeltis unicolor</i> Reinwardt														
ACROCHORDIDIAE (File snakes)														
233 <i>Acrochordus javanicus</i> Hornstedt														

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COLUBRIDAE														
234 <i>Ahaetulla fasciolata</i> (Fisher)														
235 <i>Ahaetulla prasina</i> + (Boie)	R		1		1		2							
236 <i>Amphiesma flavifrons</i> + (Boulenger)	C	1	S		S	2	3							
237 <i>Amphiesma frenata</i> + (Dunn)														
238 <i>Amphiesma petersi</i> (Boulenger)														
239 <i>Amphiesma sarawacensis</i> + (Guenther)	R													
240 <i>Aplopeltura boa</i> + (Boie)														
241 <i>Boiga cynodon</i> + (Boie)														
242 <i>Boiga dendrophila</i> + (Boie)	U					S	-							
243 <i>Boiga drapiezii</i> + (Boie)														
244 <i>Boiga jaspidea</i> + (Dumeril, Bibron & Dumeril)														
245 <i>Boiga nigriceps</i> + (Guenther)														
246 <i>Calamaria bicolor</i> + Dumeril, Bibron & Dumeril														
247 <i>Calamaria borneensis</i> + Blecker														
248 <i>Calamaria everetti</i> Boulenger														
249 <i>Calamaria grabowskii</i> + Fisher														
250 <i>Calamaria gracillima</i> Guenther														
251 <i>Calamaria leucogaster</i> + Bleeker														
252 <i>Calamaria lovii</i> + Boulenger														
253 <i>Calamaria lumbricoidea</i> + H. Boie	R			1			1							
254 <i>Calamaria melanota</i> + Jan														
255 <i>Calamaria schlegeli</i> Dumeril, Bibron & Dumeril														
256 <i>Calamaria virgulata</i> + H. Boie														
257 <i>Cereberus rynchops</i> (Schneider)														
258 <i>Chrysopelea paradisi</i> + Boie	U													
259 <i>Chrysopelea pelias</i> + (Linnaeus)	K													

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260 <i>Dendrelaphis caudolineatus</i> (Gray)														
261 <i>Dendrelaphis formosus</i> + (Boie)														
262 <i>Dendrelaphis pictus</i> + (Gmelin)														
263 <i>Dryocalamus tristrigatus</i> + Guenther														
264 <i>Dryophiops rubescens</i> + (Gray)														
265 <i>Elaphe flavolineata</i> + (Schlegel)	K							?						
266 <i>Enhydris alternans</i> (Reuss)														
267 <i>Enhydris doriae</i> (Peters)														
268 <i>Enhydris enhydris</i> (Schneider)														
269 <i>Enhydris punctata</i> (Gray)														
270 <i>Gonyophis margaritatus</i> + (Peters)	R	1					1							
271 <i>Gonyosoma oxycephalum</i> + (Boie)														
272 <i>Homalopsis buccata</i> (Linnaeus)														
273 <i>Hydrablades periops</i> + (Guenther)	R		1				1							
274 <i>Lepturophis borneensis</i> + Boulenger														
275 <i>Liopeltis baliodeirus</i> + Boie	K													
276 <i>Liopeltis longicauda</i> + (Peters)	R						1							
277 <i>Liopeltis tricolor</i> + (Schlegel)							1							
278 <i>Lycodon aulicus</i>	K													
279 <i>Lycodon albofuscus</i> + (Dumeril, Bibron & Dumeril)														
280 <i>Lycodon effraenis</i> + Cantor														
281 <i>Lycodon subcinctus</i> + Boie														
282 <i>Macropisthodon flaviceps</i> + (Dumeril, Bibron & Dumeril)														
283 <i>Macropisthodon rhodomelas</i> + (Boie)														
284 <i>Macropopphis maculata</i> + (Edeling)														
285 <i>Oligodon octolineatus</i> + (Schneider)														
286 <i>Oligodon purpurascens</i> (Schlegel)														
287 <i>Oligodon subcarinatus</i> (Guenther)														
288 <i>Opisthotropis typica</i> + (Mocquard)														
289 <i>Oreocalamus hanitschi</i> Boulenger														
290 <i>Pareas laevis</i> + (Boie)	U													

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291 <i>Pareas malaccanus</i> (Peters)															
292 <i>Pareas nuchalis</i> (Boulenger)															
293 <i>Psammodynastes pictus</i> + Guenther															
294 <i>Psammodynastes pulverulentus</i> + (Boie)															
295 <i>Pseudorabdion albonuchalis</i> + (Guenther)															
296 <i>Pseudorabdion collaris</i> + (Mocquard)															
297 <i>Pseudorabdion longiceps</i> + (Cantor)															
298 <i>Pseudorabdion saravacensis</i> + (Shelford)															
299 <i>Pseudoxenodon baramensis</i> + (Smith)	R		1				1								
300 <i>Rhabdophis chrysarga</i> (Schlegel)	R		1				1								
301 <i>Rhabdophis conspicillatus</i> (Guenther)	R			1			1								
302 <i>Sibynophis melanocephalus</i> (Gray)															
303 <i>Sibynophis collaris</i>	K														
304 <i>Stegonotus borneensis</i> + Inger															
305 <i>Xenodermus javanicus</i> + Reinwardt															
306 <i>Xenelaphis ellipsifer</i> Boulenger															
307 <i>Xenelaphis hexagonotus</i> (Cantor)															
308 <i>Xenochrophis maculatus</i> + (Ediling)															
309 <i>Xenochrophis trianguligera</i> + (Boie)	U	2	S				S	2							
310 <i>Zaocys carinatus</i> + (Guenther)															
311 <i>Zaocys fuscus</i> + (Guenther)															
ELAPIDAE (NON-HYDROPHIINAE) (Cobras & Kraits)															
312 <i>Bungarus fasciatus</i> (Schneider)															
313 <i>Bungarus flaviceps</i> + Reinhardt	K														
314 <i>Maticora bivirgata</i> + (Boie)															
315 <i>Maticora intestinalis</i> + (Laurenti)	R		1				1								
316 <i>Naja sumatrana</i> Mueller															
317 <i>Ophiophagus hannah</i> + (Cantor)															

- I Ng Segerak, ulu Engkari
- II Ng Serembuang, ulu Skrang
- III Ulu Serembuang/Bkt Lanjak
- IV Emperan Lallang, ulu Engkari
- V Sg Melinau/Bedawak, ulu Katibas

- 1 River [w > 6m]
- 2 River [w = 2-6m]
- 3 Stream [w = 1-2m]
- 4 Stream [w = 0.5-1m]
- 5 Stream [w < 0.5m]
- 6 Forest Transect
- 7 Animal wallow/rain pool

- Abundant > 30 specimens
- Common 10 - 50 specimens
- Uncommon 5 - 10 specimens
- Rare < 5 specimens
- T Tadpole stage
- S Reported sighting or call
- K Reported by Kavanagh (1982)

- * Number of specimens collected
- ** New record for Sarawak
- *** New species (first discovered in LEWS)
- + Species of lowland dipterocarp forest
- Principal habitat

	Indet	267	74	125	23		20	4	24			537
		Sum-total:									4002	
Hemiptera	Pentatomidae						1					1
	Reduviidae								1			1
	Indet	87	95	55			7	2				246
		Sum-total:									248	
Neuroptera			1		10		1					12
		Sum-total:									12	
Isoptera		2	2	6								10
		Sum-total:									10	
Ephemeroptera	Indet		2	9	2							13
		Sum-total:									13	
Odonata							1					1
		Sum-total:									1	
Others		108			2							110
		Sum-total:									110	
												5927

Code

Location

SGK Sg. Segeruguk Ulu Katibas
 SGE Sg. Segerak, Ulu Engkari
 MAE Ng. Mabau ,Engkari
 AFE Alluvial Forest ,Ensiring
 KFE Kerangas Forest, Ensiring
 TNB Tg. Nyelutong,Lobang Baya

Code

Location

NLB Ng. Lelap, Lobang Baya
 BE1 Bkt. Entimau 390 m.a.s.l
 BE2 Bkt. Entimau 610 m.a.s.l
 URE Ubah Ribu, 720 m.a.s.l
 BLE Bkt. Lanjak , 1285 m.a.s.l

APPENDIX XIII

LIST OF ALL LONGHOUSES (VILLAGES) ADJACENT TO
THE LANJAK-ENTIMAU WILD LIFE SANCTUARY

AREA 1 – UPPER KANOWIT – MUJOK RIVERS,
UNDER PENGHULU DAU AK BUSAU, JULAU DISTRICT.

No.	Name of Longhouse	Headmen	No. H.H.	Total Pop.
MUJOK RIVER, UPPER KANOWIT				
1	Rh. Mengiring, Lepong Bilat	T.R. Mengiring ak Masil	20	115
2	Rh. Gerasi, Ng. Ju	T.R. Gerasi ak Kapi	37	223
3	Rh. Anthony Bau, Wong Kepayang	T.R. Anthony Bau ak Kasau	13	85
4	Rh. Jeffery Juing, Ng. Setusol	T.R. Jeffery Juing ak Mabong	13	82
5	Rh. Manding, Ng. Banyu	T.R. Manding/Mading ak Alop	14	79
6	Rh. Lalak, Ng. Melop	T.R. Lalak ak Unya	15	86
7	Rh. Bangom, Ng. Kesindu	T.R. Bangom/Bagum ak Empat	38	241
8	Rh. Kalai, Rantau Kuyang	T.R. Kalai ak Gerasi	28	163
9	Rh. Kelukut, Ng. Telesa	T.R. Kelukut ak Umping	24	162
10	Rh. Batik, Ng. Mujok	T.R. Batik ak Merayang	31	191
UPPER KANOWIT RIVER				
11	Rh. Sta, Punggang Batang	T.R. Sta ak Runa	17	95
12	Rh. Brayan, Rantau Rusa	T.R. Brayan ak Lanyau	18	82
13	Rh. Lani, Rantau Serau	T.R. Lani ak Bunsu	19	117
14	Rh. Jarau, Rantau Limau	T.R. Janau ak Junit	50	290
15	Rh. Ansat, Sg. Masit	T.R. Ansat ak Ladi	19	108
16	Rh. Lana, Sg. Masit	T.R. Lana ak Ramba	19	99
17	Rh. Janting, Bukit Seri	T.R. Janting ak Banyih	30	164
18	Rh. Lait, Ng. Selepong	T.R. Lait ak Sain	18	93
19	Rh. Kedu, Ng. Bilat	T.R. Kedu ak Belajak	10	54
20	Rh. Belawan, Ng. Apo	T.R. Belawan ak Rimban	23	118
21	Rh. Marau, Ng. Apo	T.R. Marau/Narau ak	18	83
22	Rh. Nyayang, Ng. Nilau, Sg Ensiring	T.R. Nyayang ak Angi	18	129
23	Rh. Jayan, Ng. Ensiring	T.R. Jayan ak Libau	21	135
24	Rh. Unjong, Ng Ensiring	T.R. Unjong Ak Paong	10	49
25	Rh. Belawan, Ng. Bekatan	T.R. Belawan ak Agit	24	140
26	Rh. Balai, Ng. Taba	T.R. Balai ak Abong	12	85
26		TOTAL	559	3,268

H.H. – Household or "Bilek – Family"

AREA 2 – UPPER NGEMAH RIVER,
UNDER PENGHULU LANGIT AK MASIL, KANOWIT DISTRICT

No.	Name of Longhouse	Headmen	No. H.H.	Total Pop.
<u>UPPER NGEMAH RIVER</u>				
1	Rh. Salang, Rantau Lugai (Rh Manggau)	T.R. Salang ak Manggau	16	131
2	Rh. Manja, Ng. Lakah	T.R. Manja ak Gayam	17	110
3	Rh. Magal, Lubok Tanjong (Rh Saging)	T.R. Magal Ak Tukau	6	50
4	Rh. Langga, Ng. Samak	T.R. Langga ak Melamun	27	201
5	Rh. Kanyan, Lubok Tutong	T.R. Kanyan	13	90
6	Rh. Sengalang, Jugo Embawang, Nirok	T.R. Sengalang	13	85
7	Rh. Addy, Tatai Piling, Nirok	T.R. Addy	9	201
8	Rh. Boniface Bangau, Ng Nirok	T.R. Boniface Bangau Ak Aji	32	225
9	Rh. Ulin, Ng Spru	T.R. Ulin ak Meluda	24	163
10	Rh. Nyipa, Ng. Bat	T.R. Nyipa ak Ranggau	18	94
11	Rh. Mukow, Ng Bat	T.R. Bat	14	102
			189	1452
12	Ng Jagau Resettlement Area (20 individual Longhouses with 7 – 15 households per Longhouse)	Under RASCOM	204	1,448
13	Ng Ngungun Resettlement Area (20 individual Longhouses with 8 – 33 households per Longhouse) (Rh Balan ak Jubin)	Under RASCOM	354	2,630
51		TOTAL	747	5,530

NOTE:

Most of the Longhouses which were located in the Upper Ngemah river have been resettled at Ng Jagau and Ng Ngungun Resettlement Areas respectively. They are the Rajang Security Command Authority (RASCOM)

AREA 3 – UPPER KATIBAS RIVER,
UNDER PENGHULU KALAT AK TABOH, SONG DISTRICT

No.	Name of Longhouse	Headmen	No. H.H.	Total Pop.
1	Rh. Enggong, Ng Ngeranau	T.R. Enggong Ak Juing	16	142
2	Rh. Api, Ng Terusak	T.R. Api Ak Janun	21	158
3	Rh. Utom, Ng Bulo	T.R. Utom Ak Pasang	7	69
4	Rh. Suning, Ng Nyayai	T.R. Suning Ak Sigon	13	111
5	Rh. Jumput, Ng Chemanong	T.R. Jumput Ak Belikau	25	166
6	Rh. Anjoh, Ng Mesau	T.R. Anjoh Ak Belaja	15	102
7	Rh. Nyantau, Ng Malai	T.R. Nyantau Ak Lapik	12	102
8	Rh. Tambok @ Rambo, Tapang Andau	T.R. Tambok Ak Tagon/Rambo	28	269
9	Rh. Jempai, Batu Lintang	T.R. Jempai Ak Lau	11	81
10	Rh. Ngadit, Rantau Entimau	T.R. Ngadit Ak Banta	15	106
11	Rh. Nuing, Emperan Rian	T.R. Nuing Ak Gani	27	216
12	Rh. Matan, Emperan Rian	T.R. Matan Ak Manja	10	63
13	Rh. Buda, Ng. Tala, Kerangan Langkang	T.R. Buda ak Janggok	12	82
14	Rh. Taboh, Ng. Kejekar	T.R. Taboh ak Sawing	12	112
15	Rh. Saong, Tapang Nawie, Ng Derap	T.R. Saong ak Angga	13	89
16	Rh. Enteba, Ng. Engkuah	T.R. Enteba ak Kok	22	138
17	Rh. Galau, Ng. Engkuah	T.R. Galau ak Undi	39	317
18	Rh. Lajong, Ng. Setuchok, Ng Engkuah	T.R. Albert Lajong ak Maja	27	219
19	Rh. Jingga, Ng. Ngeranchau	T.R. Jingga ak Antau	11	99
20	Rh. Jabat, Ng. Lian	T.R. Jabat ak Gasan	24	206
21	Rh. Ngelambong, Ng. Serau	T.R. Ngelambong ak Ujan	23	238
22	Rh. Tanjung, Ng Engkaroh	T.R. Tanjung ak Kasau	32	265
22		TOTAL	415	3,350

AREA 4 – UPPER SG. ENKGARI, LUBOK ANTU DISTRICT

No.	Name of Longhouse	Headmen	No. H.H.	Total Pop.
1	Rh. Linggang, Ng Talong	T.R. Linggang Ak Utau	22	151
2	Rh. Raba, Lubok Pantu	T.R. Raba Ak Mang	13	78
3	Rh. Bigut, Terembuai	T.R. Bigut Ak Jalok	5	21
3		TOTAL	40	250

GRAND TOTAL	1,761	12,398
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NOTE:

List of Longhouses in Ng. Jagau and Ng. Ngungun Resettlement Areas with admitted rights and under Socio-Economic Survey

No.	Name of Longhouse	Headmen	No. H.H.	Total Pop.
Ng. Jagau Resettlement Area				
1	Rh. Kesa	T.R. Kesa	15	95
2	Rh. Menua Ak Besi (Rh. Besi)	T.R. Menua Ak Besi	12	71
3	Rh. Ramping	T.R. Ramping	7	40
4	Rh. Sliong	T.R. Sliong	15	107
5	Rh. Mantok	T.R. Mantok	15	117
Ng. Ngungun Resettlement Area				
1	Rh. Embuas (Rh. Dingun)	T.R. Embuas Ak Braoh	18	101
2	Rh. Seli (Rh. Balan Ak Jubin)	T.R. Seli Ak Ukit	13	60
3	Rh. Sawing Ak Renga (Rh. Renga)	T.R. Sawing Ak Renga	12	109
4	Rh. Lakun (Rh. Sauh)	T.R. Lakun Ak Laga	11	96
5	Rh. Empawi (Rh. Pengiran)	T.R. Empawi Ak Geraji	23	153
6	Rh. Lebi	T.R. Lebi Ak Serukai	23	185
7	Rh. Balan (Rh. Gimán)	T.R. Balan Ak Tuan	16	100
8	Rh. Sigan	T.R. Sigan Ak Lunyong	16	113
9	Rh. Anyau	T.R. Anyau Ak Ujok	28	227
10	Rh. Ambau (Rh. Kirak)	T.R. Ambau Ak Kirak	26	199
11	Rh. Mujap	T.R. Mujap Ak Atok	33	231
12	Rh. Jabu (Rh. Garu)	T.R. Jabu Ak Tawai	26	240
13	Rh. Jawat (Rh. Bayang)	T.R. Jawat Ak Arah	33	267

Source:

Socio-Economic Survey of Lanjak-Entimau Wild Life Sanctuary Area (July 1994)

APPENDIX XIV

THE DISTANCE OF THE LONGHOUSES UNDER SURVEY TO THEIR RESPECTIVE DISTRICT TOWNS.

AREA 1 – LONGHOUSES ALONG UPPER KANOWIT/MUJOK RIVERS TO THE MAIN DISTRICT TOWN (JULAU)

No.	Name of Longhouse	Locality	Distance (Hrs/Mins.)	Petrol (Liters)
<u>MUJOK RIVER</u>				
1	Rh. Mengiring Ak Masil	Lepong Bilat, Ng Ju	6.00	60
2	Rh. Gerasi Ak Kapi	Nanga Ju	5.50	55
3	Rh. Anthony Bau Ak Kasau	Wong Kepayang	4.50	45
4	Rh. Jeffery Juing Ak Mabong	Ng. Setusol	4.50	45
5	Rh. Manding/Mading Ak Alop	Ng Banyu	4.30	43
6	Rh. Lalak Ak Unya	Ng Melop	4.00	40
7	Rh. Bangom/Bagum Ak Empati	Ng Kesindu	3.75	38
8	Rh. Kalai Ak Gerasi	Rantau Kuyang	3.50	35
9	Rh. Kelukut Ak Umping	Ng Telesa	3.25	33
10	Rh. Batik Ak Merayang	Nanga Mujok	3.00	30
<u>UPPER KANOWIT RIVER</u>				
11	Rh. Sta Ak Runa	Punggang Batang	3.25	33
12	Rh. Brayan Ak Lanyau	Rantau Rusa	3.50	35
13	Rh. Lani Ak Bunsu	Rantau Serau	3.75	38
14	Rh. Jarau Ak Junit	Rantau Limau	8.00	80
15	Rh. Ansat Ak Ladi	Sg Masit	7.30	73
16	Rh. Lana Ak Ramba	Sg Masit	7.30	73
17	Rh. Janting Ak Banyih	Bukit Seri #	4.30	
18	Rh. Lait Ak Sain	Ng Selepong	7.25	73
19	Rh. Kedu Ak Belaja	Ng Bilat	7.25	73
20	Rh. Belawan Ak Rimban	Ng Apo	5.30	53
21	Rh. Marau/Narau Ak Menyimbang	Ng Apo	5.30	53
22	Rh. Nyayang Ak Angi	Ng Nilau, Sg Ensiring	7.00	70
23	Rh. Jayan Ak Libau	Nanga Ensiring*	5.00	50
24	Rh. Unjong Ak Paong	Nanga Ensiring	5.00	50
25	Rh. Belawan Ak Agit	Ng Bekatan	4.30	43
26	Rh. Balai Ak Abong	Ng Taba	4.00	40
		Average	5.0	50
		Maximum	8.0	80
		Minimum	3.0	30

Time taken is by Landcruiser as the village is accessible through logging road in Pakan, another Sub-District of Julau.

AREA 2 – LONGHOUSES ALONG UPPER NGEMAH RIVER TO THE MAIN DISTRICT TOWN (KANOWIT)

No.	Name of Longhouse	Locality	Distance (Hrs/Mins.)	Petrol (Liters)
UPPER NGEMAH RIVER				
1	Rh. Salang Ak Manggau (Rh Manggau)	Rantau Lugai	6.00	60
2	Rh. Manja/Nanja Ak Gayam	Ng Lakah	5.30	53
3	Rh. Magal Ak Tukau (Rh Saging)	Lubok Tanjung	5.00	50
4	Rh. Langga Ak Melamun	Ng Samak	3.00	30
5	Rh. Kanyan	Lubok Tutong	3.00	30
6	Rh. Sengalang	Jugo Embawang, Nirok	2.30	23
7	Rh. Addy	Tatai Piling, Nirok	2.30	23
8	Rh. Boniface Bangau Ak Aji	Ng Nirok	2.30	23
9	Rh. Ulin Ak Meluda	Ng Spru	2.00	20
10	Rh. Nyipa Ak Ranggau	Ng Bat	2.00	20
11	Rh. Mukow	Ng Bat	2.00	20
12	Ng Jagau Resettlement Area (20 individual Longhouses with 7–15 households per Longhouse)	under RASCOM	5.00	50
13	Ng Ngungun Resettlement Area (20 individual Longhouses with 8–33 households per Longhouse)	under RASCOM	1.45	15
		Average	3.2	32
		Maximum	6.0	60
		Minimum	1.5	15

**AREA 3 – LONGHOUSES ALONG UPPER KATIBAS RIVER TO
THE MAIN DISTRICT TOWN (SONG)**

No.	Name of Longhouse	Locality	Distance (Hrs/Mins.)	Petrol (Liters)
1	Rh. Enggong Ak Juing	Ng Ngeranau	7.45	75
2	Rh. Api Ak Janun	Ng Terusak	7.45	75
3	Rh. Utom Ak Pasang	Ng Bulo	7.15	72
4	Rh. Suning Ak Sigon	Ng Nyayai	7.00	70
5	Rh. Jumput Ak Belikau	Ng Chemanong	6.30	63
6	Rh. Anjoh Ak Belaja	Ng Mesau	6.15	62
7	Rh. Nyantau Ak Lapik	Ng Malai	6.00	60
8	Rh. Tambok @ Rambo Ak Tagon	Tapang Andau	5.45	55
9	Rh. Jempai Ak Lau	Batu Lintang	5.30	53
10	Rh. Ngadit Ak Banta	Rantau Entimau	4.45	45
11	Rh. Nuing Ak Gani	Emperan Rian	4.30	43
12	Rh. Matan Ak Manja	Emperan Rian	4.30	43
13	Rh. Buda Ak Janggok	Ng Tala, Krg. Langkang	4.00	40
14	Rh. Taboh Ak Sawing	Ng Kejakar	2.30	23
15	Rh. Saong Ak Angga	Tapang Nawie, Ng Derap	3.15	32
16	Rh. Enteba Ak Kok	Ng Engkuah	3.30	33
17	Rh. Galau Ak Undi	Ng Engkuah	3.30	33
18	Rh. Albert Lajong Ak Maja	Ng Setuchok, Ng Engkuah	3.30	33
19	Rh. Jingga Ak Antau	Ng Ngeranchau	3.00	30
20	Rh. Jabat Ak Gasan	Ng Lian	3.00	30
21	Rh. Ngelambong Ak Ujan	Ng Serau	2.30	23
22	Rh. Tanjung Ak Kasau	Ng Engkaroh	2.30	23
		Average	4.60	46
		Maximum	7.45	75
		Minimum	2.30	23

**AREA 4 – LONGHOUSES ALONG UPPER ENKARI RIVER TO
THE MAIN DISTRICT TOWN (LUBOK ANTU)**

No.	Name of Longhouse	Locality	Distance (Hrs/Mins.)	Petrol (Liters)
1	Rh. Linggang Ak Utau	Ng Talong	5.00	50
2	Rh. Raba Ak Mang	Lubok Pantu	4.30	43
3	Rh. Bigut Ak Jalok	Terembuai	3.50	35
		Average	4.27	43
		Maximum	5.0	50
		Minimum	3.50	35

NOTE:

1. The main mode of transport in the whole area is by boat. As such, the distance here refer to an average time taken (Hours/Minutes) by boat based on 25 horse-power(h/p) outboard engines.
2. An average consumption of petrol for 25 h/p engine is 10 liters per hour.
3. Petrol prices ranged from RM6.50 to RM9.00 per gallon (4.5 liters).

Source:

Socio-Economic Survey of Lanjak-Entimau Wild Life Sanctuary, July 1994

APPENDIX XVI

TERMS OF REFERENCE

PROJECT LEADER

For the implementation of Phase II, the Project Leader will:-

- (i) Initiate and direct the implementation of the Lanjak Entimau Wildlife Sanctuary Entimau Management Plan in collaboration with the Sarawak Forest Department
- (ii) Oversee the construction of the Sanctuary facilities
- (iii) Recommend appropriate international experts to work in research and community development programmes
- (iv) Organise and implement a programme of community consultation for the Sanctuary
- (v) Oversee the production of a GIS data base for Project data
- (vi) Produce mid-term and final progress reports for Phase II
- (vii) Produce a Ten-Year Plan and vision statement for the development of Lanjak Entimau as a Totally Protected Area

Duration: 30 man-months, International

HYDROLOGIST

In the context of the construction and operation of the Hydrological/climatological stations in Lanjak Entimau, the Hydrologist will:-

- (i) Supervise construction and installation of climatological stations, and prepare instructions for data collection and ensure personnel are instructed in and available to make collection of data and its storage
- (ii) Supervise all data collection and be responsible for reporting the results, as well as instruct local staff in the writing of such reports
- (iii) Develop a format and operation manual for permanent data collection from the hydrological/climatological stations in Lanjak Entimau

Total duration: 3 man-months, International
 3 man-months, Local

FOREST ECOLOGIST

- (i) To set up permanent experimental plots in the major vegetational habitats of Lanjak, provide instructions for data acquisition and initiate permanent data/record keeping format
- (ii) Supervise all data gathering, and be responsible for reporting the results
- (iii) Identify seed bank areas for economically significant tree species and develop a monitoring and protection programme on the latter
- (iv) In collaboration with the local counterpart analyse all growth and other relevant data and report on the results
- (v) Interall data into the Project's GIS data base
- (vi) Provide interpretive information on selected communities for the Field Centre educational programme
- (vii) Make recommendations on the best methods to manage sensitive rare or important species and communities and discuss the importance to the ecosystem as a whole

ORANG UTAN - PRIMATOLOGIST

- (i) Set up permanent research transects for monitoring of orangutans
- (ii) Formulate a long-term research plan for the study of orangutan population dynamics in Lanjak Entimau
- (iii) Investigate the significance of fruit tree densities and any other factors affecting orangutan densities
- (iv) Prepare a data bank on the Lanjak Entimau orangutan, enter data into the Project GIS database and train local personnel in the use
- (v) Be responsible for reporting on the findings of all research work

Total Duration: man-months, International
 man-months, Local

GAME MANAGEMENT SPECIALIST

As part of the research programme for Lanjak Entimau, the Game Management Specialist will:-

- (i) Obtain estimates for densities of game species (*Cervus unicolor*, *Muntiacus* spp. and *Sus barbatus*), in specific areas of the reserve
- (ii) Determine through consultative discussions with local communities the rate of removal (harvest) of the most important game species in the buffer zone
- (iii) Be responsible for the report on the research findings
- (iv) Devise a basic game management (including a licensing) programme for the Buffer Zone areas on the periphery of Lanjak Entimau
- (v) Enter all relevant data into the Project GIS data base
- (vi) Provide on the job technical training local workers and Forest Department staff involved in the game management programme

Duration: 6 man-months, International

6 man-months, Local

MYCOLOGIST

In the context of furthering knowledge of biodiversity in the Sanctuary, the mycologist will:-

- (i) Conduct a general survey of the non-vascular plants (fungi and other lower plants) of the sanctuary
- (ii) In collaboration with the ethnobotanist and local traditional medicine practitioners produce a list of fungi with potential, re: advanced screening for bioactive compounds
- (iii) Be responsible for producing the report on the findings of the mycological inventory
- (iv) Enter all relevant data into the Project GIS data base

Duration: 7 man-months, International
6 man-months, Local

MAMMALOGIST (Small mammals)

In conjunction with the biodiversity inventory of Lanjak Entimau, the mammalogist will:

- (i) Conduct an inventory of the small scansorial and flying mammals of Lanjak Entimau
- (ii) Investigate the socio-economic importance of the small mammals of the Sanctuary
- (iii) Identify major seed predators and fruit dispersers among the small mammal community
- (iv) Train the local counterpart on the identification of small mammal species
- (v) Make a synoptic collection of the small mammals of Lanjak Entimau
- (vi) Enter all relevant data into the Project GIS data base
- (vii) Be responsible for writing the report on the findings of the survey (and a checklist of the small mammals of the Sanctuary)

Duration: 8 man-months, International
8 man-months, Local

ENTOMOLOGIST

In conjunction with the biodiversity inventory of Lanjak Entimau, the entomologist will:-

- (i) Continue and expand the surveys begun under Phase I of the project
- (ii) Survey canopy insects at a minimum of one site
- (iii) Make a reference collection of insects for Lanjak-Entimau and enter all relevant data into the Project GIS data base
- (iv) Train a local counterpart in identification techniques
- (v) Make a list of insects with potential for research into bioactive compounds
- (vi) Be responsible for the report on the findings of the surveys/inventory

Duration: 12 man-months, International
12 man-months, Local

HERPETOLOGIST

In the context of the biodiversity inventory of Lanjak Entimau, the herpetologist will:-

- (i) Continue and expand the inventory of the herpetofauna begun during Phase I, at new sites
- (ii) Make a reference collection of herpetofauna for Lanjak Entimau from specimens collected and enter all relevant data into the Project GIS data base
- (iii) Make a check list of the herpetofauna of Lanjak Entimau
- (iv) Make a list of herpetofaunal species with potential for research into bioactive compounds
- (v) Identify and initiate monitoring of populations of several key herpetofaunal species
- (vi) Be responsible for producing a report on the findings of the surveys

Duration: 12 man-months, International

12 man-months, Local

ICHTHYOLOGIST

In conjunction with the biodiversity inventory of Lanjak Entimau, the ichthyologist will:-

- (i) Conduct surveys of the fish fauna in rivers and streams of the Sanctuary
- (ii) Collaborate with the Project Herpetologist on the collection of amphibian larvae
- (iii) Make reference collections of the fish collected from Lanjak Entimau, produce a check-list of species and enter relevant data into the Project GIS data base
- (iv) Estimate fish stocks of major rivers of the Sanctuary via empirical sampling and consultative discussions with local residents
- (v) Produce a plan for sustainable use naturally occurring fish stocks, and advise on the local species appropriate for fish culture (in collaboration with Forestry and Agriculture Department officials)
- (vi) Be responsible for writing the report on the findings of the surveys

Duration: 6 man-months, International
12 man-months, Local

AUDIOVISUAL CONSULTANT

As a part of the documentation of Lanjak-Entimau's biodiversity, the audio-visual consultant will:-

- (i) As an audio-visual (e.g. film and sound recording) of selected species within the Sanctuary, in collaboration with the other consultants working in the Sanctuary
- (ii) Develop an archive of the Lanjak Entimau biodiversity while training local personnel in the technical aspects
- (iii) Train a local counterpart in technical aspects of audio-visual work and develop a programme for future work

Duration: 6 man-months, International
6 man-months, Local

ETHNOBOTANICAL-HORTICULTURALIST

In conjunction with the Lanjak Entimau community development programme, the Ethnobotanical-horticulturalist will:-

- (i) In collaboration with the ethnobotanist, identify plant species of traditional importance or medicinal value to be cultivated in the secondary forests of the buffer zone or within special plots adjacent to local settlements
- (ii) Assist in the development of ethno-botanical gardens of herbs and medicinal plants as a business venture for local communities
- (iii) Develop a manual for the cultivation of local herbs or medicinal plants with economic potential

Duration: 0 man-months, International
9 man-months, Local

FORESTER NON-TIMBER PRODUCTS SPECIALIST

In conjunction with the Lanjak Entimau Community development programme, the non-timber forest products specialist will:-

- (i) Assist to develop the cultivation of saleable non-timber products such as forest fruits, rattan and in the buffer zones surrounding the Sanctuary involving local communities
- (ii) Assist in the development of products derived or manufactured directly from non-timber raw materials from the forest
- (iii) Develop marketing strategies for such products in cooperation with community leaders and officers of the Sarawak Forest and Agriculture Departments

Duration: 0 man-months, International
9 man-months, Local

TRAINING CONSULTANT ; ECO-TOURISM

- (i) Develop and implement courses in ecotourism development for local communities, involving the Buffer Zone or designated areas on the periphery of the Sanctuary
- (ii) Produce a manual for the exploitation of eco-tourism opportunities by local communities
- (iii) Liaise with Lanjak Entimau scientific consultants for relevant interpretive materials

APPENDIX XV

A LIST OF FACILITIES IN LANJAK-ENTIMAU, THEIR JUSTIFICATION AND USES DEVELOPMENT OF LANJAK-ENTIMAU WILDLIFE SANCTUARY AS A TOTALLY PROTECTED AREA

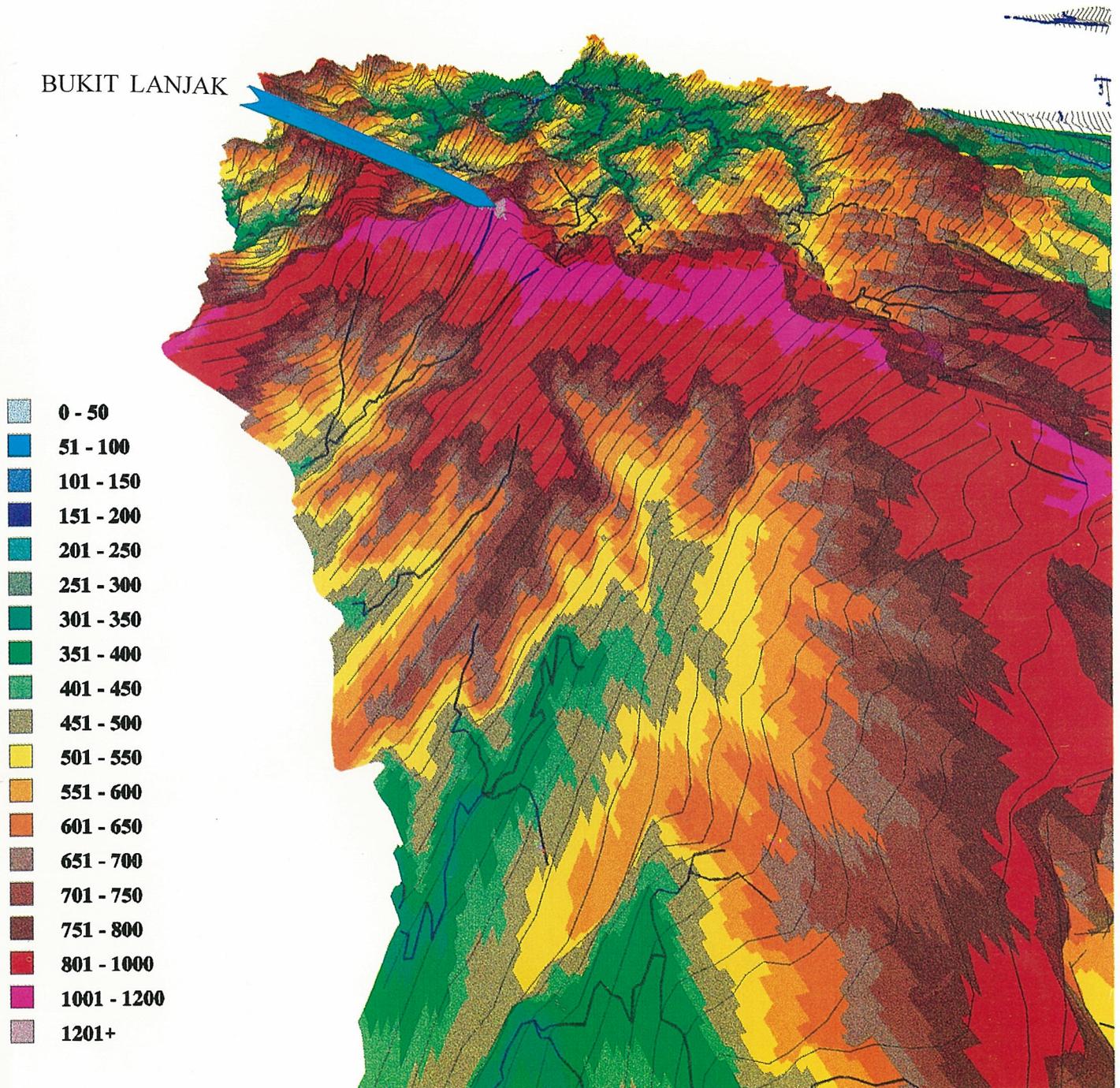
FACILITY	JUSTIFICATION	USES/BENEFITS
Headquarters, ulu Katibas (Ng Bloh)	<ul style="list-style-type: none"> - Entry point of most extensive watershed (Katibas River) - Crucial location for control of boundaries and protection - Substantial local human population 	<ul style="list-style-type: none"> - Convenient as staging point for protection and research programmes - Adjacent to areas suitable for ecotourism (in Buffer Zone) thus providing local employment - NPWO presence will reduce activities detrimental to the Sanctuary
Field Station Laboratory, ulu Engkari (Ng Segerak)	<ul style="list-style-type: none"> - Already existing Base Camp facilities - Access to Bukit Lanjak - Area of high biological diversity - Adequate and suitable manpower available 	<ul style="list-style-type: none"> - Most scientific research providing interpretive materials and local employment - Local community projects providing local employment
Ranger Stations (Ng Bloh, Ng Segerak, Ng Serembuang, Jemarang)	<ul style="list-style-type: none"> - Logistic centres for protection programmes - Education dispersal centres (community programmes) - Coverage of entire Sanctuary 	<ul style="list-style-type: none"> - Provide presence and community contact for protection programme - Easy access for Forest Department staff - Ongoing reading and maintenance of scientific equipment
Sub-Camps (12 locations)	<ul style="list-style-type: none"> - Permanent interior camps sites for monitoring and scientific studies to reduce destruction caused by numerous temporary camps - Strategic locations of facilities in sections of the Sanctuary providing direct access to monitored areas 	<ul style="list-style-type: none"> - Easy access to protection and research programmes - Savings in time and money devoted to camp construction - Reduces impact of repeated human visits

LANJAK ENTIMAU WILDLIFE SANCTUARY

3D SURFACE MODELLING

50 METER CONTOUR BANDS

SCALE - 1:50,000



MAP 14. VIEW TOWARDS BUKIT LANJAK (from Ng. Segerak)

SURFACE VIEWING PARAMETERS

AZIMUTH : 135 DEGREES

ALTITUDE : 25 DEGREES ABOVE HORIZONTAL

SURFACE EXAGGERATION : 3

