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Faunal and Floral Survey of Beutong, Aceh, Sumatra 1967

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In collaboration with: Lembaga Ilmu Pengetahuan Indonesia,
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ABSTRACT

A forested area of mixed protective status adjoining the northern boundary of the Leuser Ecosystem (Aceh, northern Sumatra, Indonesia) was studied. The land use of the 3240 km² study area was mapped, with seven study sites selected to investigate the fauna and flora of the region. Data were collected by sightings or indirect signs, and mapped using Global Positioning Systems and a Geographic Information System. It was found that although the area has suffered extensive human encroachment, which continued at a rapid rate during the study period, substantial areas of forest cover still remain.

*The faunal distribution surveys identified 27 mammal species, 14 of which are classified as threatened including the Sumatran tiger, Asian elephant and Orang-utan. Eight Red Data Book bird species were identified with a total bird list of 105 species being compiled. 5 species of snake, 1 tortoise and 4 lizards were identified, 3 of which hold a protective status. Localities of *Rafflesia arnoldii atjehensis* and *Amorphophallus gigas* were also identified.*

Suitable high altitude habitat for the Sumatran Rhinoceros, characterised by high, flat bottomed valleys containing mineral springs and an abundance of food plants were found during the habitat studies, however, no recent sign of rhino activity was observed.

It was concluded that the area has a rich biodiversity, but is under immediate threat of irreparable damage if current trends continue. A reassessment of the protective status and strict enforcement of the whole area is urgently required.

1.0

INTRODUCTION

1.1 PROJECT OUTLINE

Our project was initially set up to determine if a population of Sumatran rhinoceros (*Dicerorhinus sumatrensis*) survived in the Beutong forests. This region includes the Gunung Abong Abong area, which was identified by the International Union for the Conservation of Nature and Natural Resources (IUCN) Asian Rhino Conservation Action Plan (Mohd Kahn 1989, Foose and van Strien 1997) as potentially harbouring one of the last remaining populations of Sumatran Rhino outside a National Park in Sumatra. "Rapid Assessment of Suspected and Potential Rhino Populations in Sumatra" is stated as a high priority Sumatran Rhino Conservation Project, as proposed by the Asian Rhino Specialist Group (AsRSG) (Foose and van Strien 1997). This project fulfilled the aims of this proposal for the Gunung Abong Abong area. The advice of experts was also sought with regard to the location of the study, most notably Dr. Nico van Strien (AsRSG) and Drs. Widodo Romano (Minister of Forestry, Aceh Province).

The area covered by this study is within the Gayo Barat extension to the Leuser Ecosystem proposed by Griffiths and Wind (1996). On discussion with Dr. Yarrow Robertson of the Leuser Management Unit (LMU), the project was diversified to include land use mapping and distribution surveys of other mammals. These surveys focused on the flagship species of Taman Nasional Gunung Leuser; the Sumatran Rhinoceros (*Dicerorhinus sumatrensis*), Sumatran tiger (*Panthera tigris sumatrae*), Asian elephant (*Elephas maximus sumatranus*) and Orang-utan (*Pongo pygmaeus abelii*). As both the time and expertise were available, habitat surveys and bird studies were conducted along with opportunistic reptile and plant identifications to produce a more holistic representation of the region's biodiversity. This baseline data should provide enough information to enable an informed decision on the future of the Beutong region to be made.

In total 82 days of study in the field were undertaken between 20th July and 26th October 1997. 19 days being allocated to reconnaissance surveys and 63 days to forest surveys (see Section 2).

1.2 PROJECT MEMBERS AND AFFILIATES

The project was a collaboration between the University of Bristol (UOB), England, and Bogor Agricultural University (IPB), Indonesia. All work was done in affiliation with Lembaga Ilmu Pengetahuan Indonesia (LIPI), Pusat Penelitian dan Pengembangan Biologi (PHPA) and the Unit Manajemen Leuser (LMU).

Fieldwork was carried out by the following personnel:

James Burton BSc (Hons), UOB – Project leader

Ir. Kuswando, IPB

Catherine Bloxam BSc (Hons), UOB – Medical officer

Barney Long BSc (Hons), UOB

James McPherson BSc (Hons), UOB

Field assistants who were all normally employed by LMU as research assistants and rhino anti-poaching patrols, were kindly allowed to help with the project:

Pak Zulkarnain

Pak M. Denin

Pak M. Din

Pak M. Syah

Pak M. Yuni

Two plant identifiers normally working for Yayasan Leuser at Ketambe Research Station, were employed for the habitat studies:

Pak Usman

Pak Samsul

Our driver and reconnaissance survey field assistant was kindly loaned by LMU:

Pak Imran

1.3 AIM, STUDIES AND SUPPORTING OBJECTIVES

Aim

To assess the extent of forest cover within the Beutong region (Aceh, Northern Sumatra, Indonesia), investigate its present populations of mammals, birds and herpetofauna and study its floral composition so that informed decision on the future of the region can be made.

Studies and supporting objectives

1) Sumatran rhinoceros (*Dicerorhinus sumatrensis sumatrensis*) study:

- To determine presence/absence of a surviving population.

2) Land use, human encroachment and forest study:

- To map the extent of forest cover and other land use,
- To identify the location and extent of recent human activity with potentially long-term detrimental effects on the integrity of the Beutong forests,
- To describe the habitat, topography and features of interest in selected representative study sites,
- To investigate human traffic and activities within the forests.
- To produce a species list for the higher plants in the study area,
- To produce an overview of the forest vegetation in the region,
- To contribute quantitative vegetation data as part of the overall scientific effort of the study.

3) Mammal study:

- To produce a species list of the Beutong forests,
- To map large mammal distributions,
- To investigate potential elephant migration routes within the study area.

4) Bird diversity study:

- To produce a species list for the Beutong forests,
- To investigate species richness of the Beutong region,
- To collect data on the relative abundance, altitude range and basic ecology of the species seen.

5) Herpetology study.

- To produce a species list for the Beutong forests.

2.0

LAND USE, HUMAN ENCROACHMENT AND FOREST STUDY

Land use throughout the study area and human activities within the forest were investigated with a view to identifying the nature and significance of potential threats to the remaining forest. This was achieved by mapping the land use during reconnaissance surveys. A description of forest characteristics and encroachment was also undertaken during the forest surveys. GPS and a GIS were used to map the area. The main threat to the forests of the study area was found to be agricultural development, promoted by the increased access generated by logging concessions and new settlements. Recent forest developments were found along the Mengajah road, which bisects the forest as it runs between Takengon and Keude Seumot. Evidence of human presence recorded within study sites included hunting, fishing, rottan collecting and mining. Exploitation was found to be localised in easily accessible areas, beyond which disturbance was negligible.

Sampling of the vegetation was carried out in areas which were considered representative of the whole study site, i.e. sub-montane and montane forest types. Data were analysed to produce detailed information on the forest vegetation including its structure and species composition. The vegetation communities were compared using indices of species diversity, uniformity, and similarity.

The topography, river systems, intact canopy and abundance of mineral springs discovered, indicate the forests investigated to be capable of sustaining the complex communities of wildlife associated with the primary rain forests of Indonesia.

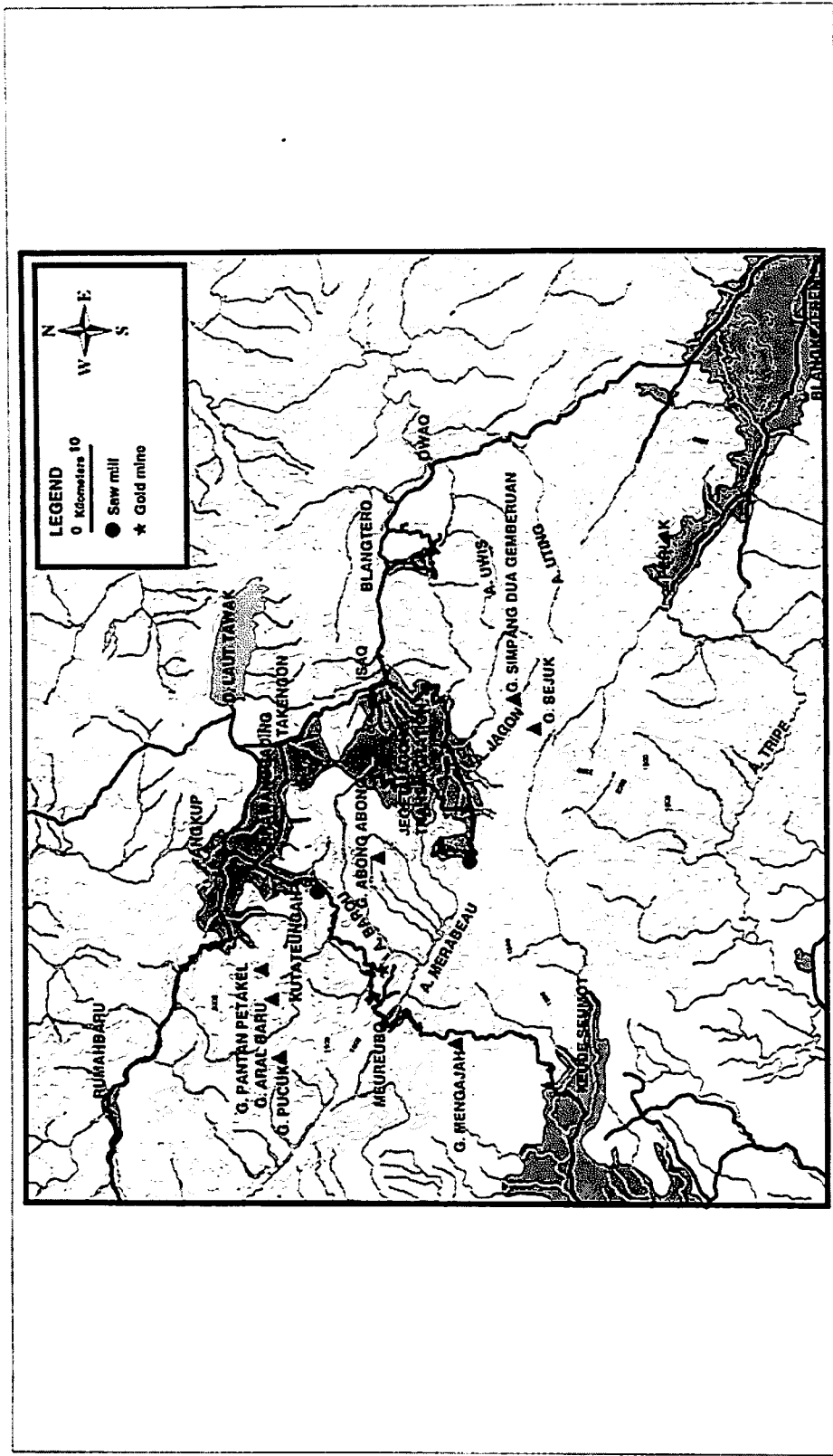
2.1 INTRODUCTION

An area of 3240 km² (N 04°00'000"; E 096°20'000" – N 04° 50'000"; E 097°20'000") within the Beutong region was chosen as the study area. It is centred between the towns of Blangkejeren, Keude Seumot, Rumahbaru and Takengon in the province of Aceh (See Fig 2.a).

The climate of the area is classified as Subgroup A_m of the Koppen-Geiger climate classification (Strahler 1969), that being a rain forest climate with monthly mean temperatures of over 18°C, but with a short dry season. At higher altitudes, classification would be type H where monthly mean temperatures fall below 18°C.

The study area forms part of the Gayo Barat region of the Barisan mountain range with an altitude range of 155 m to 2540 m above sea level (all further altitudes will be given in m, meaning m asl). The majority of the study area was evergreen tropical moist forest, comprising of Tropical (Colline subzone), Submontane, Montane and Subalpine zones (Van Steenis 1972, 1984). The area includes a proportion of the Lingga Isaq hunting reserve and the Leuser Ecosystem. Outside of these areas some forest was classified as Hutan Lindung, but much was completely unprotected.

Fig. 2.a: The study area.



Many settlements are present within the study area, some being long established farming communities such as Rumahbaru and Kutateungah, which mainly grow traditional padi in the flat, lower altitude valleys. Three more recently established settlements: Jeget-Jagong transmigrasi, Brawanggading and Perlak border the eastern edge of the forest, and mainly grow coffee. A large pine plantation (*Pinus merkusii*) was situated around the main Takengon-Kotacane road in the east of the study area.

Plans for a 15,600 ha area of forest between Angkup, Gunung Mengajah and Isaq have been proposed for conversion into pasture for livestock, agroforestry, arabica, coffee and banana plantations (Landstatus/Recommended Development Areas, Takengon, Sumatra, 0520 series RePPPProT 1988 Edisi kedua tahun 1990/1991, Departemen Transmigrasi).

Previously, little information was available for the Beutong Forest region, since the majority of studies of the Leuser ecosystem have been carried out within the Gunung Leuser National Park. The Beutong Forest region adjoins the Leuser ecosystem boundary and would be ideal as a buffer zone for the ecosystem. There is a possibility of the Leuser Ecosystem being developed in such a way that this region may be included in the 'Protected Forest' category of the conservation area. The production of a general vegetation description for this area is necessary in order to assess its potential for biodiversity conservation before the ecosystem becomes degraded. This process will also contribute baseline data that will be useful for assessing whether this region should be included in the Leuser ecosystem development.

2.1.1 OBJECTIVES

- To map the extent of forest cover and other land use,
- To identify the location and extent of recent human activity with potentially long-term detrimental effects on the integrity of the Beutong forests,
- To describe the habitat, topography and features of interest in selected representative study sites,
- To investigate human traffic and activities within the forests,
- To produce a species list for the higher plants in the study area,
- To produce an overview of the forest vegetation in the region,
- To contribute quantitative vegetation data as part of the overall scientific effort of the study.

2.2 METHODS

2.2.1 RECONNAISSANCE SURVEYS

Land use was investigated prior to forest surveys in order to update the information provided by 1:50,000 (Seri 50-0 Edisi I Lembar: 0520- Diterbitkan Oleh Badan Koordinasi Survey Dan Pemetaan Nasional [Bakosurtanal] TH. 1978) and 1:250 000 topographical maps (Peta Rupabumi Indonesia, Bakosurtanal, Bogor, 1986). Reconnaissance Surveys were undertaken by driving the roads, tracks and logging roads in the study area for a total of 19 days.

Mapping was achieved by driving slowly and taking co-ordinates every 500 m on a global positioning system, GPS, (Garmin 12XL Personal Navigator) using its trip counter. At each location (accurate to ± 20 m) recorded by the GPS (a "waypoint") the altitude was determined using a wrist altimeter with built in barometer (Casio 560). Altimeters were regularly re-calibrated at locations of known altitude and were accurate to ± 10 m (the altitude reading was not found to be satisfactory using the GPS). Information relating to land use was described at each waypoint. Additional waypoints and altitudes were recorded at each change in land use, with the type and depth (distance in meters extending away from the road) of encroachment being noted. Small trails leading into the forest, were investigated on foot to assess hidden land use, human activity and potential access for future forest surveys.

The following types of land use were identified:

- Settlements,
- Roads, tracks and logging roads,
- Ladang (slash-and-burn cultivation),
- Plantations,
- Logging concessions,
- Protected areas: Hutan Lindung, Lingga Isaq Hunting Reserve, Leuser Ecosystem,
- Gold mining,
- Sawmills.

The information obtained from the field was superimposed onto topographic maps. Daily modification of the maps and written records facilitated the identification of sites for further study.

2.2.2 GENERAL FOREST SURVEYS

Forest surveys were carried out at seven study sites. Although the total number of days in the field was 63, two groups going to different locations in the forest were counted as two 'field days', therefore making a total of 91 field days.

Study sites were chosen for their potential to support rhino (high altitude valleys in undisturbed forest) during discussions with Dr. Yarrow Robertson (LMU). These valleys were identified using topographical maps, a 3D-scale model and aerial photographs. During the reconnaissance surveys the presence of calling species of primate and hornbill were used as indicators of primary forest. This information, together with observations on forest cover, and the availability of suitable access points was utilised in the final choice of study site.

When undertaking the forest surveys, a general description of each study site was made, including topographical features, general habitat type, and characteristic features relevant to the study e.g. springs.

Human presence and activity within the forest was noted. The type, location, altitude, and description of all signs were recorded. Field assistants advised as to the approximate age of signs found within the forest.

The type of human activity was noted as follows:

- **Hunting:** Ungulate snare traps, hides and people seen with guns and catches,
- **Fishing:** Pondok with fish smoking stands and batteries for electrofishing,
- **Rottan collecting:** Parang cuts concentrated around rottan areas, evidence of removal, and rottan storage,
- **Mining activity:** Survey tags,
- **Miscellaneous:** Parang cuts, pondoks, motorbikes left by the roadside and litter,
- **Agriculture:** Ladang.

2.2.3 VEGETATION STUDY

2.2.3.1 Time and location

Quantitative vegetation sampling was carried out in two sites which were considered representative of the whole study area. This approach was chosen because the LDP staff who identified the plant species were only available for a limited period.

The first study area was at Site B (Barou) located at; N 04°28'123"; E 096°37'024", at 965-1100 m which is in the sub-montane zone (Van Steenis, 1972, 1984). Data collection began on the 27th August 1997 with Usman and Samsu (Yayasan Leuser staff) assisting in plant identification. A total of 700 m of transect was completed at this site.

The second study area was at Site C (Jagong) located at; N 04°21'459"; E 096°49'386", and between 1790 and 1820 m in the montane zone (Van Steenis, 1972, 1984). Data collection began on the 27th September 1997 with Samsu (Yayasan Leuser staff) assisting in plant identification. A total transect length of 800 m was completed in this location.

2.2.3.2 Data collection

Data were collected in quadrats systematically placed along a line transect. The line was started from a random point and was of known length. The area of the sample plots was dependent on the scale of the vegetation being sampled.

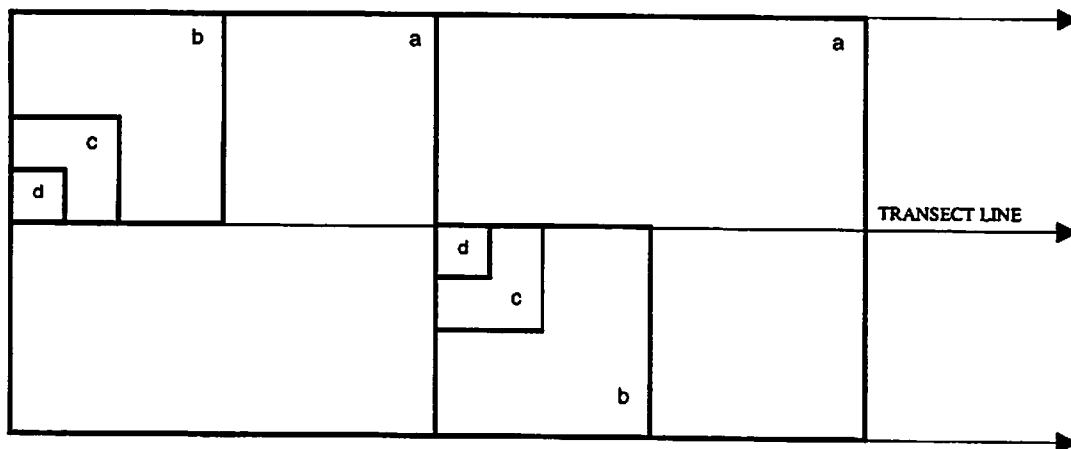
Vegetation was stratified into five classes during sampling, and for analysis, using the following criteria:

- **Tree (dbh >20 cm).** Trees with a diameter at breast height (dbh, measured 1.3 m above ground level) greater than 20 cm, or in the case of trees with buttress roots with a diameter greater than 20cm measured 20 cm above the buttress,
- **Pole (10 cm < dbh < 20 cm).** Trees with dbh or diameter 20 cm above the buttress of less than 20 cm but greater than 10 cm,
- **Sapling (Height (H) > 1.5 m, dbh < 10 cm).** Young trees or stems taller than 1.5 m and with a dbh of less than 10 cm,
- **Seedling (H < 1.5 m).** Young trees or stems which are shorter than 1.5 m in height,
- **Ground Cover.** Plants that are not young trees or stems (including shrubs, lianas, herbs and grasses).

Transect length varied between 500 m and 1000 m (representing 1-2 ha of quadrat area) depending on the terrain. The size of the quadrat used for data collection varied with the vegetation class being recorded. 20 m x 20 m quadrats were used for counting (and taking measurements of) trees; 10 m x 10 m for the pole class; 5 m x 5 m for saplings and 2 m x 2 m for recording seedlings and ground cover (Soerianegara and Indrawan, 1988). The layout and sizes of quadrats are shown in *Fig. 2.a*. The following information was recorded for each individual in the tree, pole and sapling classes: total number of individuals of each species, the number of quadrats containing a particular species and the dbh of each individual. For the seedling and ground cover vegetation classes, the number of individuals of each species and the total number of quadrats containing a particular species were recorded.

To produce a profile diagram for each of the sites a sampling plot measuring 20 m x 100 m was used. Only tree class individuals (dbh > 20 cm.) were recorded. The total height, the height from the ground to the first branch and the canopy closure were recorded for each tree.

Fig. 2.b: *Diagram showing sizes and layout of quadrats used during vegetation sampling*



Note:

- = Quadrat for tree measurement (20 x 20 m²)
- = Quadrat for pole measurement (10 x 10 m²)
- = Quadrat for sapling measurement (5 x 5 m²)
- = Quadrat for seedling and ground cover measurements (2 x 2 m²)

A sample was taken from each of the species encountered along the transects. These samples were stored and then taken to the Bogor Herbarium for identification to species.

For study areas other than sites B and C observations of the vegetation were made to establish the general type of the formations. Characteristics such as the dominant species, the general description of the vegetation (e.g. cleared forest, *Pinus* sp. plantation, etc.) and changes in the vegetation due to altitude were recorded.

2.2.3.3 Data processing

The data recorded in the vegetation sampling transects was used to calculate density (D), frequency (F) and dominance (DM) values for each species. The D, F, and DM values for each species were compared with the D, F, and DM values for all the species combined to produce measures of relative density (rD), relative frequency (rF) and relative dominance (rDM) for each species. Summing these relative measures produces the importance value index (IVI) for a given species. The size of the IVI for a given species is an important indicator of the dominance of that species in the vegetation community that has been studied. In addition, a number of other indices can be calculated to characterise the vegetation, such as: diversity index (DI), uniformity index (U) and a similarity index (SI). The equations used to calculate the indices are shown below (Soerianegara and Indrawan, 1988; Ludwig and Reynold, 1988; Mueller-Dumbois and Ellenberg, 1974):

$$D \text{ (Individuals/ha)} = \frac{\text{Number of individuals of each species}}{\text{Quadrat area (m}^2\text{)}} \times 10.000 \text{ m}^2$$

$$F = \frac{\text{Number of quadrats containing a particular species}}{\text{Total number of quadrats}}$$

$$DM \text{ (cm}^2\text{/ha)} = \frac{\text{Basal area of a particular species (cm}^2\text{)}}{\text{Total quadrat area (m}^2\text{)}} \times 10.000 \text{ m}^2$$

$$rD \text{ (\%)} = \frac{\text{Density of a particular species}}{\text{Density for all species combined}} \times 100 \text{ \%}$$

$$rF \text{ (\%)} = \frac{\text{Frequency of a particular species}}{\text{Frequency for all species combined}} \times 100 \text{ \%}$$

$$rDM \text{ (\%)} = \frac{\text{Dominance index for a species}}{\text{Dominance index for all species}} \times 100 \text{ \%}$$

$$IVI \text{ (\%)} = rD + rF + rDM$$

For seedling and ground vegetation, IVI is calculated using the equation:

$$IVI \text{ (\%)} = rD + rF$$

To calculate the diversity index (DI) the Shannon-Wiener equation was used (Magurran, 1988):

$$DI = -S (p_i \cdot \ln p_i),$$

where:

$$\begin{aligned} p_i &= N_i/N; \\ N_i &= \text{IVI of the } i\text{th species} \\ N &= \text{Total IVI from all species} \end{aligned}$$

To calculate the Uniformity Index the equation used was (Magurran, 1988):

$$U = \frac{DI}{DI^{\text{maks}}}$$

where:

$$\begin{aligned} DI &= \text{Shannon-Wiener diversity index} \\ DI^{\text{maks}} &= \ln S; S = \text{total number of species} \end{aligned}$$

To calculate the index of similarity (SI) this equation was used (Soerianegara dan Indrawan, 1988; Mueller-Dombois and Ellenberg, 1974):

$$SI = \frac{2w}{A + B} \quad \%$$

where:

$$\begin{aligned} w &= \text{Sum of the smaller value (either, if values are equal) of IVI for a particular species, for all plants which occur in both communities being compared (A \& B).} \\ A &= \text{Total IVI for community A} \\ B &= \text{Total IVI for community B} \end{aligned}$$

2.2.3.4 Data analysis and synthesis

Analysis and synthesis of data was directed towards determining the structure and species composition of the vegetation in the study areas. Differences in the species diversity (DI) and uniformity (U) of vegetation communities were analysed graphically.

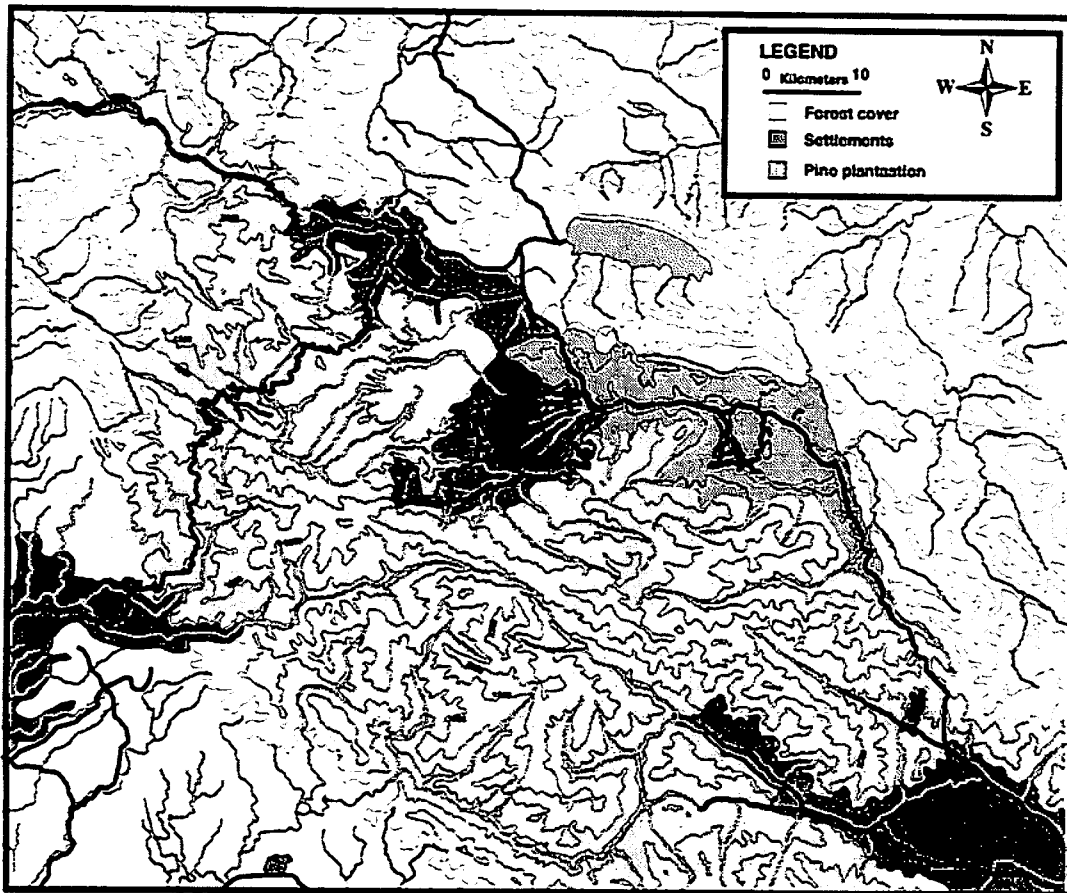
2.3 RESULTS

2.3.1 RECONNAISSANCE SURVEYS

2.3.1.1 Description of major roads and transmigration site Mengajah Road.

The Mengajah road runs from Brawanggading to Keude Seumot through Hutan Lindung, and allows access to the IPK and goldmine. Construction work was being carried out to improve the road from both ends. From Brawanggading to the sawmill (N 04°32'160"; E 096°40'622"), tarmac has been laid. For 10 km from Keude Seumot the road was being widened and prepared for tarmac. Where the road had not been improved it was a dirt track wide enough for two way traffic in all but a few places.

Fig.2.c Map of land use



There was a large sawmill operating south of the Kutateungah settlement; a well established gold mine was located on a tributary of A. Barou and a communications tower, located South of Gunung Mengajah. In the Meureubo valley there is an established settlement surrounded by padi fields. An information sign indicating a 400 ha IPK was found between the goldmine (N 04°27'349"; E 096°31'506") and the Meureubo settlement (N 04°28'264"; E 096°33'148"). The forest along the road was interspersed with small patches of new ladang. A dramatic increase in both the clearance of forest and the number of people using the road was observed over the duration of the study. Ladang concealed from the road by a curtain of trees was also found. The forest at Gunung Mengajah (near Mengajah Road and below to the valley) was categorised as sub-montane forest and montane forest above 1548 m.

Rumahbaru Road.

The Rumahbaru road runs from Angkup through Rumahbaru and continues to the Beungeuet valley. The final destination was not established. From Angkup to the location of a small settlement (N 04°39'000"; E 096°35'500") the road is tarmac and established padi fields and ladang were present. Beyond this, it becomes a track which was being

widened and prepared for tarmacing. Between these two settlements the road follows the Pameue valley bottom which supports many small areas of ladang.

Blangkejeren Road.

The Blangkejeren Road is the main road between Takengon and Blangkejeren, running through Isaq and Owaq. Hunting was commonly recorded between Takengon and Isaq where the road runs through primary forest. From Isaq to just north of the Aceh Tengah border, the road runs through a pine plantation. The road then passed through primary forest, until N 04°08'00" from which ladang stretches to Blangkejeren.

Perlak Road.

The Perlak Road runs from Blangkejeren to Perlak alongside the A. Tripe through many established settlements. The road was tarmac to Pasir. Padi and ladang dominated the bottom and lower slopes of the valley, with forest on the higher slopes. At Perlak the road was being extended and we were informed that there was currently access for a motorbike through the forest. The destination of this track was not established, but it was known that the track was being developed into a road.

Jeget-Jagong Transmigration site.

The Jeget-Jagong transmigration site covers 150 km², with the settlement being surrounded by ladang. There was a single main road which doubles back to Isaq. The road heading south from Isaq was mostly laid with tarmac (until N 04°24'60"; E 096°46'452"). The remaining dirt tracks were being improved. A sawmill was located at the most southwesterly point, from which a logging road entered the forest (N 04°22'487"; E 096°42'403").

2.3.1.2 Comparison of current land use with that of 1978 and 1986.

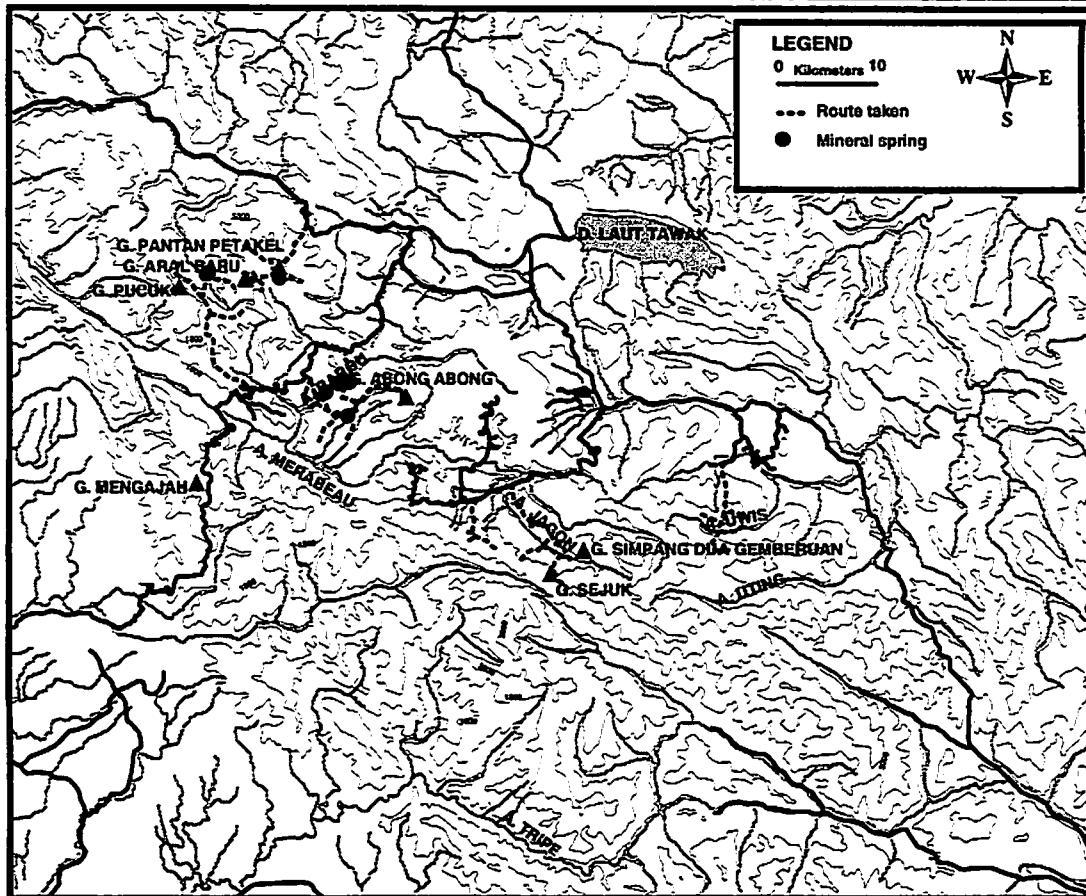
The results of the reconnaissance surveys were compared with the land use presented on the 1:50,000 maps which were produced in 1978, and 1:250,000 maps, produced in 1986.

The land area used for rice crops has not increased by any significant amount since 1978. No change in the area occupied by the pine plantation has occurred. The development of the Mengajah, Rumahbaru and Perlak roads, all of which were tracks or forest tails in 1978, has opened up the area, causing a vast increase in ladang, at the expense of forest. This effect is apparent throughout the study area, and it is this ubiquitous change in land use that is the largest threat to the integrity of the primary forest.

The Jeget-Jagong Transmigration Project was established in 1981. Initially, 500 families were settled, but the continuing patriation, has caused an area of approximately 150 km² of the surrounding conversion forest to be lost since 1978. This localised change in land use is however, an integral part of the population management plans for Indonesia and is seen as an inevitable land use change in an area such as Beutong.

2.3.2 FOREST SURVEYS

Fig.2.d Map to show the locations of study sites A-G



2.3.2.1 Descriptions of study sites and human activity

All forest surveyed was classed as primary forest unless otherwise stated. Signs of human activity within the forest were found in all areas investigated. The frequency of discovery generally decreased with distance from the nearest entry point into the forest. Throughout all study sites parang cuts and litter of many ages were found. This finding, combined with the general condition of the trails, gave an indication of frequency of use, which once again highlights specific areas of interest.

Study site A:	Uning
Co-ordinates:	N 04°25'100" - N 04°27'450" E 096°29'000" - E 096°39'200"
Location:	South east of the Mengajah road, north of A. Meureubo, centred around the A. Barou valley.
Altitude range:	900 m-1450 m
Dates visited:	20 th July -22 nd July 1997, 22 nd August-29 th August 1997

Description: The Barou is a fast, west flowing river, in a steep sided valley. The ridges are wide with open trails and thin ground cover. East of the Barou valley is a high plateau, containing a large warm mineral spring. The area between the Barou and Meureubo as it flows northwest is submontane, primarily rottan-dominated swamp. *Amorphophallus sp.* was found between the Mengajah road and the A. Barou. The forest was thinner and shorter on 2 sections of ridge. There were 2 areas of swampy ground covered with very thick spiky rattan and no trees. These were small waterlogged areas (100 x 500m²) in the bottom of shallow valleys.

Human activity: The access trail from the Mengajah road to the A. Barou was large and well worn with many parang cuts indicating frequent use. Numerous signs of fishing were found along the river. These included three pondoks, a fish smoking stand and a battery for electrofishing. Parang cuts were also present throughout the study site. In addition people were seen at the A. Barou and heard at A. Meureubo.

Study site B: Barou

Co-ordinates: N 04°27'450" - N 04°38'200"
E 096°30'600" - E 096°41'700"

Location: Headwaters of the Barou valley, southeast of the Mengajah road and west of Gunung Abong Abong.

Altitude range: 900 m-1800 m

Dates visited: 15th August – 19th August 1997

Description: The A. Barou, a fast river, flows west through study site B, and has a valley with moderately steep sides, and a narrow floodplain. Three mineral springs were found in the area. The tropical, submontane and montane forest had areas dominated with rottan and bamboo groves on steeper hillsides. The ridge trails to G. Abong Abong were found to be wide and free of encroaching vegetation. Numerous ridges converged at the summit of G. Abong Abong, creating a substantial flat area. A flowering *Amorphophallus sp.* was found between the Mengajah road and the A. Barou, at the northeast end of the study site. Sub-montane forest covered the valley sides and bottom with the following flora present: Geseng Tanduk (*Quercus gemelliflora* (Blume)) (Fagac.), Geseng Batu (Fagac.), Geseng Bunge (*Cryptocarya ferrea* Blume) (Laur.), *Cryptocarya sp.* (Laur.), Medang Sawa (unidentified), Jerik Jambu (*Syzygium racemosum* (Blume) DC.) (Myrtac.), and *Castanopsis sp.* (Fagac.).

Human activity: Three pondoks and a smoking stand for fish were found on the banks of A. Barou. A small patch of new ladang was found close to, but could not be seen from the Mengajah road. Parang cuts were found along the ridge trails to G. Abong Abong.

Study site C : Jagong

Co-ordinates: N 04°17'100" - N 04°48'500"
E 096°23'500" - E 096°52'500"

Location: The Jagong valley, southeast from the Jeget-Jagong Transmigration settlement and north of Gunung Sejuk. West of Gunung Simpang Dua Gembouan.

Altitude range: 1550 m-2540 m

Dates visited: 2nd September 1997 – 12th September 1997

Description: The A. Jagong flows northwest for 15 km. At the southeast of the valley the river is deep, narrow and fast flowing as it passes through the high steep sided valley. In the northwest it slows and widens as the valley flattens out. Large well-trodden trails were found on the ridges both sides of the Jagong. Montane moss forest was present on the southwest ridge. Pitcher plants (*Nepenthes gracilis* Korth.) and Kemenyan (*Styrax benzoin* Dryander) (Styrac.) were recorded throughout the montane forest. Patchy areas of pine (*Pinus merkusii*) (Conif.) were found on the Southwest ridge. Indicator species of montane forest were found: Sango Besar (*Dacrydium beccarii* Parlatores) (Podoc.), Kemuning Dewal (*Dacrycarpus imbricatus* (Blume) de Laub.) (Podoc.), Sango (*Dacrycarpus* sp.) (Podoc.), Kayu Rotan (*Nagein wallichiana* (Presl.) O.K.) (Podoc.), Kayu Sauh (*Symplocos* sp.) (Symploc.), Punti (*Palaquium rostratum* (Miquel.) Burck) (Sapot.), and Kayu Tiga Urat (*Cinnamomum iners* Reinw. ex Blume) (Laur.). At the ground cover grade Mberkeng (*Pinanga* sp.) (Arec.), an elephant food plant and Lumut Gambut (*Leucobryum* sp.) (Leucobrac.) were found.

Human activity: Locals farmers informed the project that one-day hunting trips were common in the area. This was confirmed with the numerous human signs found along the first seven kilometres of the ridge path from the settlement. Beyond this no recent signs were recorded. Two hunting hides were also found along this section of the ridge. Pondok with four associated areas of ladang at the Northwest end of the Jagong valley were found. People were heard in the small valley running between the main ridge and a smaller ridge north of the Jagong. Evidence of gold prospecting was found 12 km upstream from the transmigration site.

Study site D : Uwis

Co-ordinates: N 04°19'500" - N 04°24'500"
E 096°59'150" - E 096°60'600"

Location: The Uwis valley, south of Blangtero, north of the A. Uting.

Altitude range: 750 m-2310 m

Dates visited: 28th September – 7th October 1997

Description: A pine plantation extends from Blangtero towards the ridge north of A. Uwis. Beyond the pine there were areas of grassland leading up to the forest containing tropical, submontane and montane zones. The ridge trail leading to the Uwis ridge was wide and well trodden. The sides of the Uwis valley are very high and steep, with cliffs in many places. A. Uwis is a large river that flows east. To the east, the valley is wide and flat-bottomed, becoming narrow in the west, with cliffs where the two tributaries join to form A. Uwis. There are many tributaries and sandbanks around the river. The ridge between A. Uwis and A. Uting is both high and sheer, with a small trail running along the top. *Amorphophallus* sp. (Arac.) were found throughout the Uwis valley and Kemenyan (*Styrax benzoin* Dryander) (Styrac.) was recorded on the southern Uwis ridge. Moss forest occurred on both ridge tops either side of the Uwis valley with sub-montane forest covering the valley sides and bottom. Many orang utan nests were found on ridge sides and bottom, so it is possible that fig trees or another food plant would be found there.

Human activity: Ten pondoks were found in the Uwis valley, indicating heavy fishing of the river. Hunting hides were noted along the ridge path leading into the forest from the grassland.

Study site E : Jagong West

Co-ordinates: N 04°19'00" - N 04°22'50"
E 096°45'30" - E 096°47'850"

Location: South from the Jeget-Jagong Transmigration settlement along the southwest ridge of the A. Jagong.

Altitude range: 1500 m-2360 m

Dates visited: 3rd October –8th October 1997

Description: The path leading to the main ridge passes mainly through secondary forest and ladang. Much of the understorey has been cut with only the tall trees remaining. The ridge was open with moderate slopes. The vegetation cover was predominately montane with patches of subalpine vegetation situated on flat marshy ground (N 04°19'731"; E 096°46'871"- N 04°19'556"; E 096°47'128"). Moss forest occurred on both ridge tops either side of the Jagong South valley. Valley sides and bottom were sub-montane forest. Species found in the sub-montane forest include: Geseng Tanduk (*Quercus gemelliflora* (Blume)) (Fagac.), Geseng Batu (Fagac.), Geseng Bunge (*Cryptocarya ferrea* Blume) (Laur.), *Cryptocarya* sp. (Laur.), *Dehaasia* sp. (Laur.), Medang Sawa (unidentified), Jerik Jambu (*Syzygium racemosum* (Blume) DC.) (Myrtac.), Kayu Kelumit/Munel (*Castanopsis acuminatissima* (Blume) A.DC.) (Fagac.) and *Castanopsis* sp. (Fagac.). Many indicator species of montane forest were found: *Diplycosia brachyantha* Sleum. (Eric.), Sango Besar (*Dacrydium beccarii* Parlatore) (Podoc.), Kemuning Dewal (*Dacrycarpus imbricatus* (Blume) de Laub.) (Podoc.), Sango (*Dacrycarpus* sp.) (Podoc.), Kayu Rotan (*Nagein wallichiana* (Presl.) O.K.) (Podoc.), Kayu Sauh (*Symplocos* sp.) (Symploc.), Punti (*Palaquium rostratum* (Miquel.) Burck) (Sapot.), *Litsea* sp. (Laur.) and Kayu Tiga Urat (*Cinnamomum iners* Reinw. ex Blume) (Laur.). At the ground cover grade, species identified included: Mberkeng (*Pinanga* sp.) (Arec.), Picher plants (*Nepenthes gracilis* Korth.) (Nepenthac.) and Lumut Gambut (*Leucobryum* sp.) (Leucobrac.). Kemenyan (*Styrax benzoin* Dryander) (Styrac.) was also identified from this site. There was a flat area with no tall trees (less than 10 m tall) at the highest ridge (2330 m) (N 04°19'731"; E 096°46'871" - N 04°19'556"; E 096°47'128"). Vegetation here was dominated by *Diplycosia brachyantha* Sleum. (Eric.) and *Vaccinium lucidum* (Blume) Miq. (Eric.). There was also an area (N 04°19'731" E 096°46'871") of swampy ground covered with tall grass (Rosaceae), *Neprolepis* sp. (Oleandrac.) and *Dipteris conjugata* Reinw and no trees. *Vaccinium lucidum* (Blume) Miq. (Eric.), *Dacrydium beccarii* Parlatore (Podoc.) and *Cinnamomum iners* Reinw. ex Blume) (Laur.) surrounded this area. This small area (100 x 200 m²) was water logged.

Human activity: Hunting was common throughout the secondary forest; with evidence predominantly of snare traps. One pondok was found on the main ridge.

Study site F: Gunung Pucuk

Co-ordinates: N 04°28'600" - N 04°29'100"
E 096°35'500" - E 096°32'800"

Location: Northwest from the Mengajah road along the ridge system running to G. Pucuk.

Altitude range: 1110 m-1820 m

Dates visited: 11th October – 18th October 1997

Description: The Gunung Pucuk ridge runs northnorthwest. Secondary forest extends 1 km north of the Mengajah road. The ridge path passed through thinner montane forest which was open with little ground cover. The river east of G. Pucuk runs Northwest through the very steep and narrow valley. The narrow floodplain on the north bank of the river was marshy, with a spring near the river towards the north end of the valley. The valley bottom was very wet and lush.

Human activity: Two pondoks were found in the secondary forest. Gold prospecting tags were found along the ridge system (N 04°31'370"; E 096°30'726"). There was evidence of rottan collecting along first part of the ridge. Parang cuts were common along the ridge path for the first 10 km, after this no recent human signs were found. An area of approximately 500 x 100 m² was found which had probably been cut for agriculture in the past.

Study site G : Gunung Petukel

Co-ordinates: N 04°34'500" - N 04°37'750"

E 096°32'700" - E 096°36'200"

Location: South from the Rumah Baru road along the Gunung Pantan Petukel and Gunung Aralbaru ridge system.

Altitude range: 1500 m-2177 m

Dates visited: 9th October – 18th October 1997

Description: Many well worn interconnected trails cover the narrow ridges of both the G. Aralbaru and G. Pantan Pekutel. The small ridge between G. Aralbaru and G. Pantan Pekutel has no trail and is bisected by a small fast flowing stream running east. In areas of montane forest there was marshy ground with large areas of rottan on G. Aralbaru. The forest was not as short and less moss was present on the ridge to the west. A *Rafflesia* sp. (could be *R. micropyllum* (Raffl.)) species was found (N 04°36'420"; E 096°33'050") in an area with little ground vegetation, mainly large trees and few saplings (poles). This was found at 1800 m.

Human activity: Ladang stretched up into moss forest on the ridge top. Paths led from the ladang adjacent to the road into the forest. One snare trap was found just beyond the ladang.

Table 2.a: Summary of human activity in each study site

Study site	Hunting	Fishing	Rottan collecting	Parang cuts	Pondoks	Gold prospecting	Ladang
A		✓		✓	✓		
B		✓	✓	✓	✓		✓
C	✓			✓	✓	✓	✓
D	✓	✓		✓	✓		
E	✓			✓	✓		
F			✓	✓	✓	✓	✓
G	✓			✓			

2.3.3 VEGETATION STUDY

2.3.3.1 Vegetation Diversity and Uniformity

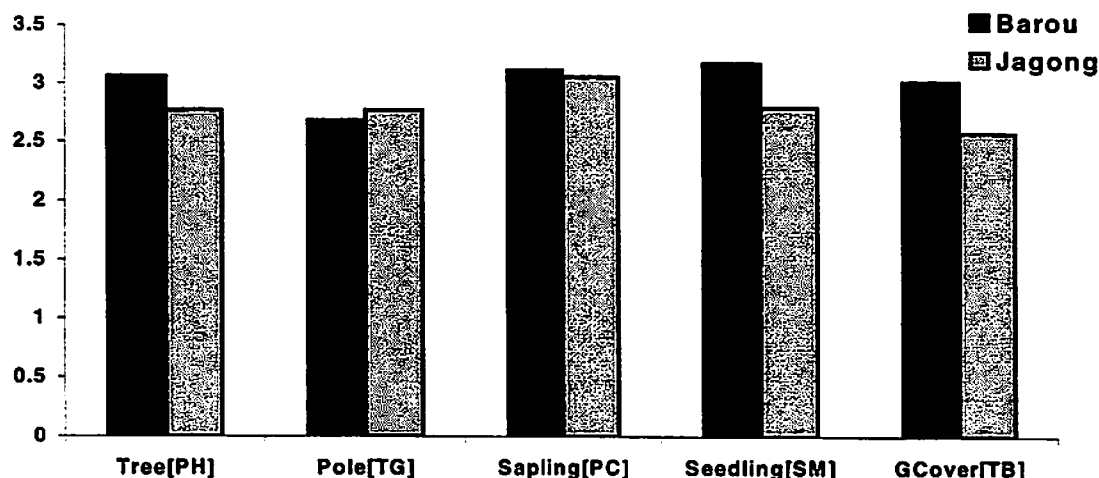
Species diversity was generally higher for the Barou site when compared with the Jagong site (Table 2.b). Species diversity indices for the Tree (3.06), Sapling (3.11), Seedling (3.17) and Ground Cover (3.01) vegetation categories at the Barou site were all higher than for the equivalent category at the Jagong site. The Pole category at the Jagong, however, showed a higher species diversity than at the Barou.

Table 2.b: Diversity Indices for all vegetation classes at the two study sites (Barou and Jagong)

	Tree	Pole	Sapling	Seedling	Ground Cover
Barou	3.06	2.68	3.11	3.17	3.01
Jagong	2.77	2.77	3.05	2.79	2.57

A histogram of the diversity indices for all vegetation classes in the two study areas is shown in Fig. 2.e.

Fig. 2.e: Diversity Indices for all vegetation classes in two study sites (Barou and Jagong)



Uniformity indices are shown in Table 2.c. The distribution of species abundance in the Barou site tends to be more even in comparison to that of Jagong. Inspection of the table will show that the Tree, Seedling and Ground Cover classes ($U=0.82, 0.84$ and 0.87 respectively) at the Barou site are higher than those at Jagong. There was no difference in the species abundance distribution for the sapling class between the two sites. The species abundance distribution in the pole class was more even in the Jagong site. The

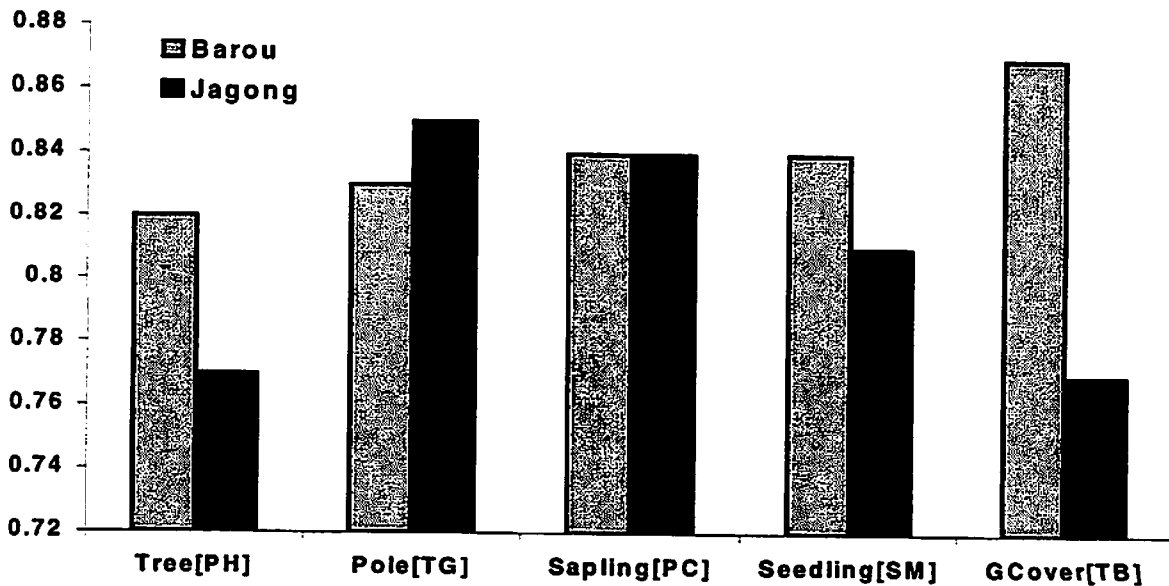
high values of the uniformity index indicate that no particular species is dominant in the study locations.

Table 2.c: Uniformity indices for all vegetation classes in two study sites (Barou and Jagong)

	Tree	Pole	Sapling	Seedling	Ground Cover
Barou	0.82	0.83	0.84	0.84	0.87
Jagong	0.77	0.85	0.84	0.81	0.77

A histogram of the uniformity indices for all vegetation classes in the two study sites is shown in Fig. 2.f.

Fig. 2.f: Uniformity Indices for all vegetation classes in two study sites (Barou and Jagong)



2.3.3.2 Index of Similarity

The Community Similarity indices for the vegetation classes: tree; pole; sapling; seedling and ground cover sampled in the two sites (Barou and Jagong) are shown in Table 2.d.

Table 2.d: Community Similarity Indices for all vegetation classes at the two study sites (Barou and Jagong) compared.

	Tree	Pole	Sapling	Seedling	Ground Cover
SI (%)	47	46	39	30	37
ID (%)	53	54	61	70	63

From the results above it is clear that there is a degree of variation in the Community Similarity indices. Barbour *et. al.* (1987) in Haryanto (1993) note that, as a practical guideline, similarity indices (unspecified) which are greater than 50% (SI >50%) suggest that the communities or units sampled share the same vegetation associations. Clearly it can be seen (Table 2.d) that none of the vegetation classes is the same (SI < 50%) and it is apparent that the vegetation communities of the two study sites (Barou and Jagong) are different.

2.3.3.3 Structure and composition of vegetation species

The profile diagrams for the Tree class in Barou and Jagong study sites are shown in Fig 2.g and Fig 2.h. A list of species found in the study sites appears in Appendix II (Table 9.2.).

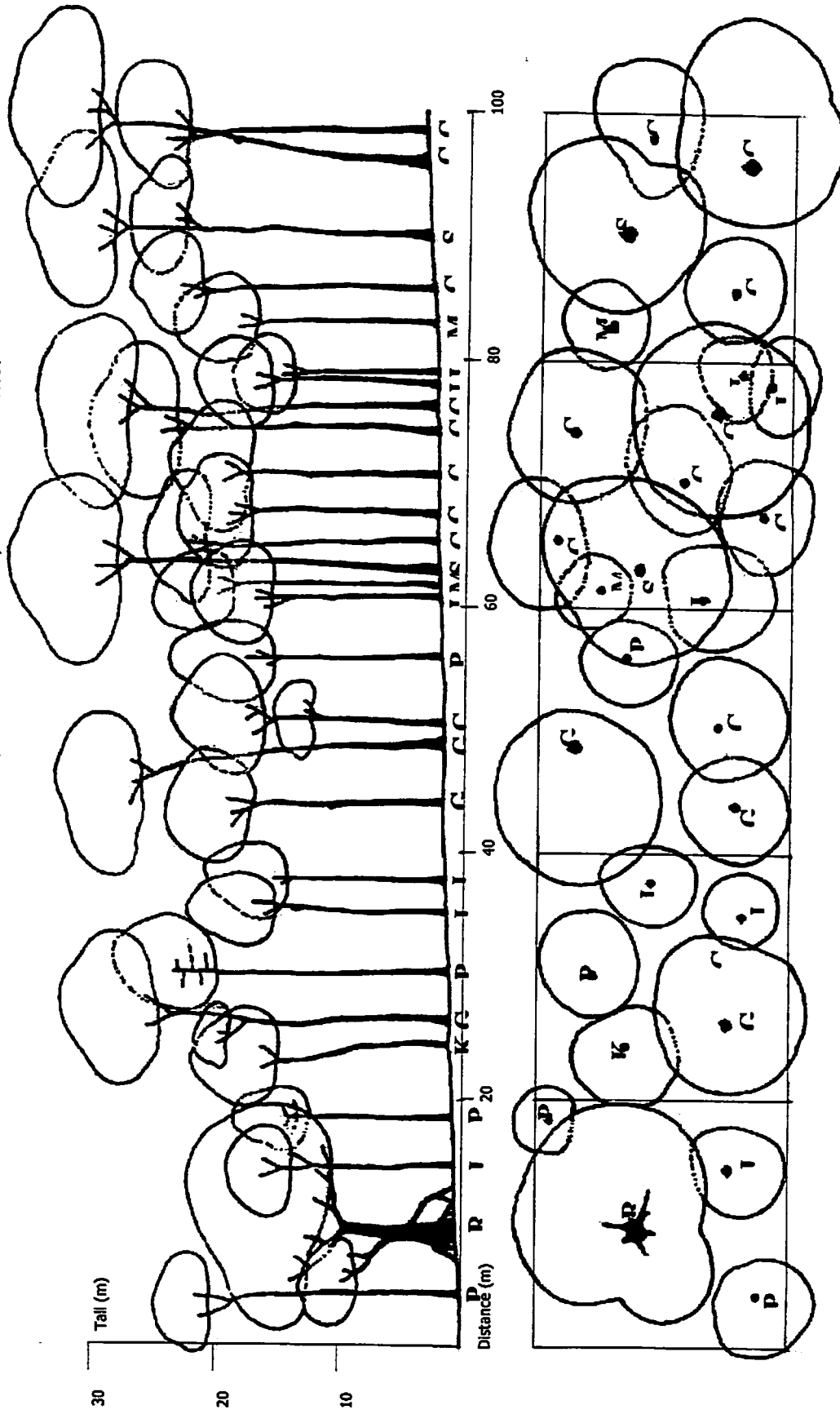
Study Site B (Barou)

The importance value indices (IVI) for the Barou indicate the dominant species in this area. The dominant species for all vegetation classes in the Barou are shown in Table 2.e.

Table 2.e: Dominant species in the Barou site.

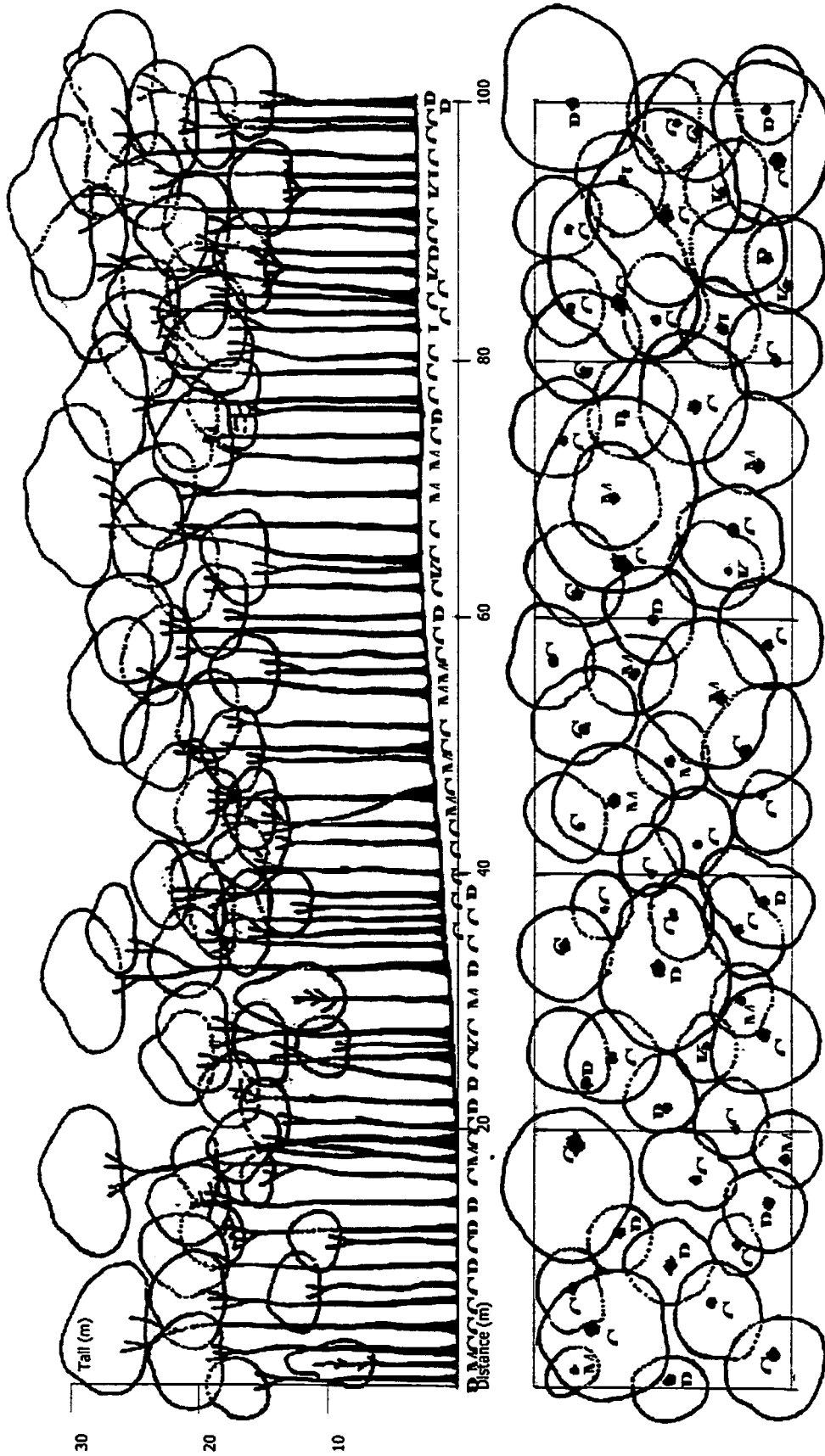
Vegetation class	SPECIES		Important Value Index (%)
	Local Name	Latin Name	
Tree	1. Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	57.72
	2. Medang Sawa	unidentified	31.72
	3. Geseng Batu	Fagaceae	25.20
Pole	1. Medang Sawa	unidentified	57.25
	2. Jerik Jambu	<i>Syzygium racemosum</i> (Blume) DC.	50.15
	3. Geseng Bunge	<i>Cryptocarya ferrea</i> Blume	38.21
Sapling	1. Jerik Jambu	<i>Syzygium racemosum</i> (Blume) DC.	49.79
	2. Medang Sawa	unidentified	43.95
	3. Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	24.45
Seedling	1. Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	26.96
	2. Jejarum Merah	<i>Ixora coccinea</i> L.	22.91
	3. Jerik Jambu	<i>Syzygium racemosum</i> (Blume) DC.	20.12
Ground Cover	1. Karisnakang	<i>Selaginella plana</i> Hieron	31.32
	2. Bayam Kurik	<i>Amaranthus</i> sp.	21.86
	3. Uwi Sabut	<i>Calamus</i> sp.	20.33

Fig 2.g: Vegetation Profile Diagram of Trees ($\phi > 20$ cm) at the Barou site.



Forest profile diagram and canopy projection. Only trees ($\phi > 20$ cm) shown. **Notes:** PR - Pradah (*Garcinia forbesii* King); PU - Puntl (*Palaquium rostratum* (Miquel.) Burck.); RK - Rambung Kraping (*Ficus* sp.); JH - Jambu Hutan (*Syzygium pycnathum* Merr. & Perry); GT - Geseng Tanduk (*Quercus gemelliflora* Blume); KS - Kesebeh (*Ardisia fuliginosa* Blume); JR - Jerik (*Drypetes neglecta* (Kds) Pax & K.Hoffm.); JJ - Jerik Jambu (*Syzygium racemosum* (Blume) DC.); PD - Pepadi (*Cleistanthus sumatranus* (Miquel) Muell. Arg.); GB - Geseng Batu (unidentified); CR - Cempedak Rawan (*Artocarpus rigidus* Blume); SM - Semaram (*Prunus arborea* Kalkm.); MC - Medang Licin (*Litsea robusta* Blume); MD - Medang Ledeu (*Cleistanthus macrophyllus* Hook. f.).

Fig 2.h: Vegetation Profile Diagram of Trees ($\varnothing > 20$ cm) at the Jagong site



Forest profile diagram and canopy projection. Only trees ($\varnothing > 20$ cm) shown. **Note:** GB - Geseng Batu (unidentified); MN - Munel (*Castanopsis acuminatissima* (Blume) A.DC.); GG - Geseng Bunge (*Cryptocarya ferrea* Blume); PR - Pradah (*Garcinia forbesii* King); MB - Medang Beberong (*Meliosma simplicifolia* (Roxb.) Walp.); GP - Grupel (*Cryptocarya densiflora* Blume); GT - Geseng Tanduk (*Quercus gemelliflora* Blume); BD - Bedarah (*Knema chinera* (Poir.) Warb.); KL - Kayu Kelat (*Cryptocarya* sp.); BT - Bintangur (*Gulua diplopetala* (Hassk.) Radlk.); RS - Risung (*Canarium littorale* Blume); MD - Medang Ledeu (*Cleistanthus macrophyllus* Hook. f.); MK - Medang Kambang (unidentified); KS - Kayu Sauh (*Symplocos* sp.); JJ - Jerik Jambu (*Syzygium racemosum* (Blume) DC.); KM - Kayu Kelumit (*Castanopsis acuminatissima* (Blume) A.DC.).

From the above results it is apparent that several dominant species are sub-montane species, including: Geseng Tanduk (*Quercus gemelliflora* (Blume)) (Fagac.), Geseng Batu (Fagac.), Geseng Bunge (*Cryptocarya ferrea* Blume) (Laur.), Medang Sawa (unidentified) and Jerik Jambu (*Syzygium racemosum* (Blume) DC.) (Myrtac.). In addition, other sub-montane species were found – although not dominant – these included: Kayu Kelumit/Munel (*Castanopsis acuminatissima* (Blume) A.DC.) (Fagac.), *Castanopsis* sp. (Fagac.), *Cryptocarya* sp. (Laur.) and *Dehaasia* sp. (Laur.).

Study Site C (Jagong)

The dominant species for all vegetation classes in the Jagong are shown in Table 2.f

Table 2.f: Dominant species in the Jagong site.

Vegetation Class	SPECIES		Important Value Index (%)
	Local Name	Latin Name	
Tree	1. Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	37.32
	2. Punti	<i>Palaquium rostratum</i> (Miquel.) Burck	37.27
	3. Geseng Bunge	<i>Cryptocarya ferrea</i> Blume	35.64
Pole	1. Punti	<i>Palaquium rostratum</i> (Miquel.) Burck	52.00
	2. Kayu Sauh	<i>Symplocos</i> sp.	41.85
	3. Jerik Jambu	<i>Syzygium racemosum</i> (Blume) DC.	26.48
Sapling	1. Punti	<i>Palaquium rostratum</i> (Miquel.) Burck	44.29
	2. Kayu Sauh	<i>Symplocos</i> sp.	27.89
	3. Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	25.13
Seedling	1. Geseng Bunge	<i>Cryptocarya ferrea</i> Blume	30.34
	2. Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	23.25
	3. Kayu Kelumit	<i>Castanopsis acuminatissima</i> (Blume) A.DC.	22.70
Ground	1. Mberkeng	<i>Pinanga</i> sp.	57.00
Cover	2. Rumput Urip-urip	<i>Lasianthus stercocarius</i> Blume	27.95
	3. Lumut Gambut	<i>Leucobryum</i> sp.	17.64

From the above results it is apparent that several dominant species are montane species, including: Punti (*Palaquium rostratum* (Miquel.) Burck) (Sapot.) and Kayu Sauh (*Symplocos* sp.) (Symploc.). In addition, other montane species were found – although not dominant – these included: *Diplycosia brachyantha* Sleum. (Eric.), Sango Besar (*Dacrydium beccarii* Parlatores) (Podoc.), Kemuning Dewal (*Dacrycarpus imbricatus* (Blume) de Laub.) (Podoc.), Sango (*Dacrycarpus* sp.) (Pod.), Kay Rotten (*Nagano wallichiana* (Presl.) O.K.) (Podoc.), *Litsea* sp. (Laur.) and Kayu Tiga Urat (*Cinnamomum iners* Reinw. ex Blume) (Laur.). The ground cover category included Mberkeng (*Pinanga* sp.) (Arec.) and Lumut Gambut (*Leucobryum* sp.) (Leucobrac.).

In this site a number of the dominant species are considered to be sub-montane species including; Geseng Tanduk (*Quercus gemelliflora* (Blume)) (Fagac.), Geseng Bunge (*Cryptocarya ferrea* Blume) (Laur.), Jerik Jambu (*Syzygium racemosum* (Blume) DC.) (Myrtac.) and Kayu Kelumit/Munel (*Castanopsis acuminatissima* (Blume) A.DC.) (Fagac.). This is probably because the sampling transect passed through both the montane and sub-montane zones.

2.4 DISCUSSION

2.4.1 Reconnaissance Surveys

Comparisons made between the land use map produced by this study and the information presented on the topographical maps, show that the area of settlement within the study area has dramatically increased since 1978. The most extensive increase of settlement has centred on the Jeget-Jagong Transmigration, with this expansion still continuing at the time of the study. The forest west of the transmigration is a proposed conversion area for plantation. If implemented this will significantly decrease the amount of forest cover in the study area.

Kutatenugah and Rumahbaru, in 1978, were established settlements situated in forested areas accessible only by forest tracks, which now are Mengajah and Rumahbaru roads respectively. The settlements and surrounding farmland have not noticeably increased since 1978. Previously, the access roads to these villages have not seemed to threaten the integrity of the forest, but recent improvements to the roads have facilitated development of agriculture. This clearance is now in danger of fragmenting the forest cover, reducing its capability to support viable populations of large mammals. We believe that the development of the Mengajah and Rumahbaru roads poses the most serious and immediate threat to the continuity of the forest. Development of the Perlak road, which is currently underway could pose similar problems, and should be documented by further study.

Although the threat of forest fragmentation by these roads is substantial, protective measures to limit further development along them could be implemented with minimum enforcement due to the presence of restricted entry points onto these roads.

2.4.2 Forest Surveys

The vegetation in the study area comprises tropical forest at altitudes between 153 m and 2540 m. According to van Steenis (1972, 1984) the study sites include three altitudinal zones, namely: (1) Tropical Zone (0-1000 m); (2) Sub-montane Zone (1000-1500 m) and (3) montane Zone (1500-2000 m). Many indicator species of montane forest were found and the structure and composition of the two sites studied in detail show the forest to be little affected by human interference.

Hutan Lindung signs were found along the Mengajah road and in the Jagong valley. The extent of this protection forest was not established in the field, but the land use map indicated most of the study area to be Hutan Lindung. It therefore follows that all ladang and human activity within the forest in these areas is illegal. Although evidence of much harvesting of forest products was recorded in most sites studied, the impact of such activities such as rotan collecting and prospecting appeared to have little impact on the ecosystem. The exceptions to

this may be fishing and hunting. Many rivers appeared to be over-fished and there was evidence that electrofishing was being used. Harvesting by electrofishing cannot be sustainable, because it allows almost complete extraction of both juvenile and mature individuals of all fish and crustacean species.

In order to maintain the sustainable extraction of forest resources effective quota and monitoring systems must be implemented. Such a system could be applied for control of fishing, hunting and the collection of kemenyan and rottan. Initiatives such as these are already underway in Ketambe, and have met with a great deal of success (Wind 1996).

The descriptions of the study sites show the forest over the study area to be of mainly primary submontane and montane forest. Mineral springs, river systems, plateaux and continuous forest cover were located, providing habitat ranges suitable for a large variety of species.

Despite the threats to the area, vast expanses of primary forest still remain. The study area includes the northern edge of the Leuser Ecosystem and the western boundary of Lingga Isaq hunting reserve. Extensions to either of these protected areas to include more of the study area, and/or the implementation of a suitable management plan would prove valuable to both the protected areas and the conservation effort in Aceh.

3.0

LARGE MAMMAL STUDY

*The mammalian fauna of the Beutong region was investigated during 107 field days to produce distribution data for all species encountered. Work was primarily aimed at identifying the presence of the Sumatran rhinoceros (*Dicerorhinus sumatrensis sumatrensis*), Sumatran tiger (*Panthera tigris sumatrensis*), Asian elephant (*Elephas maximus sumatrensis*) and Orang-utan (*Pongo pygmaeus abelii*). Presence was established by direct sightings, calls or spoor, and localities were recorded using Global Positioning Systems, and later mapped with a Geographical Information System. No fresh signs of rhino were encountered, but data on the presence of tiger, elephant and orang-utan was obtained. In total, 27 species of mammal were recorded, 14 of which are classified as threatened by IUCN and 16 of which are protected by CITES. The large number of threatened mammals recorded in this study show the area to be an important site for the conservation of these species. As such, it deserves consideration for an increased level of protection.*

3.1 INTRODUCTION

There have been no previous expeditions focusing on mammals within the Beutong region. Van Steenis and Hoogerworth carried out small collections around the Gunung Leuser area, concentrating on high altitude areas. Other expeditions to Aceh have investigated the lowlands. With the establishment of the Ketambe research station and Bohorok orang-utan rehabilitation centre, knowledge of the mammals from this region has increased dramatically, but the mid altitude forests of Aceh (1000-2000 m) are still poorly known. This pioneering study focused on species presence and distribution in an attempt to aid evaluation in the status of mammalian communities within Aceh.

One of the mammals considered to be critically endangered in Sumatra is the Sumatran rhino (*Dicerorhinus sumatrensis*) (IUCN 1996). Numbers have fallen dramatically over the last few years, and as a result only a few isolated populations now remain. The total population estimate for Sumatra stood at between 39 and 151 individuals in 1995 (Foose and van Strien 1997). One of the objectives of the Asian Rhinos Status Survey and Conservation Action Plan (Foose and van Strien 1997) was to identify any viable populations of Sumatran rhino that were not situated in National Parks. The Abong Abong area was cited as a potential area where residual populations of rhino may still exist.

Nowell and Jackson (1996) states the Priority Project for Cat Conservation No.53 as identifying "Current Distribution of Tiger Populations in East and South East Asia". Data on the distribution of tigers outside the protected areas of Aceh is limited to reports from local people. Thus although it was presumed tigers were still present in the Beutong region, this had not been confirmed by field studies. The study area lies within a Level 1 Tiger Conservation Unit (TCU), this being categorised as "an area which offers the highest probability of persistence of tiger populations over the long term, and is considered essential for a global tiger conservation strategy" (Dinerstein *et al.* 1997). Information obtained by this study will contribute to the database on the tigers of Aceh; baseline data that is required to implement conservation strategies.

The current literature suggests that there are four distinct populations of elephants in Aceh (Blouch and Simbolon 1985 and Santiapillai and Jackson 1990). Population estimates have been extremely variable, the latest being 200-300 elephants in Aceh (Santiapillai and Jackson 1990). The general consensus is that the elephant population of Aceh is in decline mainly due to the destruction of its ideal habitat of lowland and hill forest. One of the populations was assumed to migrate through the study area, traversing the northern part of the Barisan range (Blouch and Simbolon 1985). Migration routes are traditionally between an area of lowland and highland forest (Santiapillai and Jackson 1990). This study aimed to investigate both the possibility of the existence of a migration route and elephant distributions within the study area.

No confirmed reports of orang-utan from the study area were found, although two reports from the Mengajah road remain unconfirmed (Herman Rijkssen pers. comm.). Orang-utan populations are known to be decreasing rapidly in many areas of their range. It is therefore, important to locate and protect all remaining populations.

3.1.1 OBJECTIVES

- To determine presence/absence of a surviving population,
- To produce a species list of the Beutong forests,
- To map large mammal distributions,
- To investigate potential elephant migration routes within the study area.

3.2 METHODS

Ten forest surveys were carried out in the seven study sites described above between 20th July and the 26th October 1997, each lasting between 4 and 17 field days. Trails walked were mapped using a GPS system. Co-ordinates were taken where gaps in the canopy allowed for sufficient satellite coverage to obtain a fix. GPS waypoints, altitudes, topographical features and triangulations were used to aid in the plotting of data onto 1:50,000 maps.

A reconnaissance of each study site was undertaken to allow assessment of the terrain and to locate a suitable initial camp. If Sumatran rhinoceros was present, it would be situated deep within the forest away from human activity, thus the surveys involved long walks deep into the forest for a minimum of two days, except for site A. In order to achieve a balance between finding rhino and surveying as much of the area as possible, a system of walking days and survey days was established. Day surveys were undertaken in two groups (one of which served as a reconnaissance for the next campsite). Up to four camps were made in each study, each being inhabited for up to three nights. Surveys concentrated on searching for mammals and their secondary signs. Ridge paths, elephant trails and animal paths were followed as they allowed ease of movement, as well as the increased likelihood of finding signs such as footprints and faeces on the more open ground. During the mapping of the study area and the human encroachment studies, mammals encountered and heard were recorded; these results are also presented here.

Once a mammal was encountered the following data was recorded:

- 1) Date and weather conditions,
- 2) Time,
- 3) Altitude,
- 4) Location (GPS fix where possible),

5) Type of sign:

- **Sighting** Full description (including approximate size, shape, coloration and distinguishing features) or identification, sex, group composition, height in the canopy and behaviour,
- **Calling** Identification of species, bearing, distance, and number of Individuals,
- **Prints** Measurements (foot length, foot width, plantar length, plantar width, toe length, toe width and stride length) species identification, drawing, photographic record, plaster cast (if suitable substrate),
- **Scat** Measurements, description, photographic record, content investigation to aid identification,
- **Rub/scrape** Height, length, description, photographic record,
- **Miscellaneous** All other information aiding the mammal distribution survey was recorded.

The experience and knowledge of the field assistants (six years as field assistants and rhino anti-poaching personnel) were indispensable during the identification of signs. An identification guide (van Strien 1983) aided footprint identification. Identifications of mammal remains and photographs were aided by Dr. Daphne Hills at the British Museum of Natural History.

3.3 RESULTS AND DISCUSSION

3.3.1 DATA HANDLING

The data collected for each mammal is presented below in order of taxon. The English common name is provided with the local name in brackets. Where appropriate, summary tables have been used to show the average number of records per day for each study. This provides an indication of relative abundance, but it should be noted that relative abundance of calling species does not account for variation in the number of calling days during each study, or give an indication of density.

Scats were attributed to a taxon based on size and contents, prints by size and shape, scrapes by size and shape, feeding by food type, size and position and rubs by height. The advice of field assistants was intrinsic to such identifications.

A key to the Conservation status may be found in Appendix VI.

3.3.2 ORDER PERISSODACTYLA FAMILY RHINOCEROTIDAE

Dicerorhinus sumatrensis (Fisher 1814)

D. s. sumatrensis

Asian two horned, Sumatran rhinoceros (Badak Sumatera)

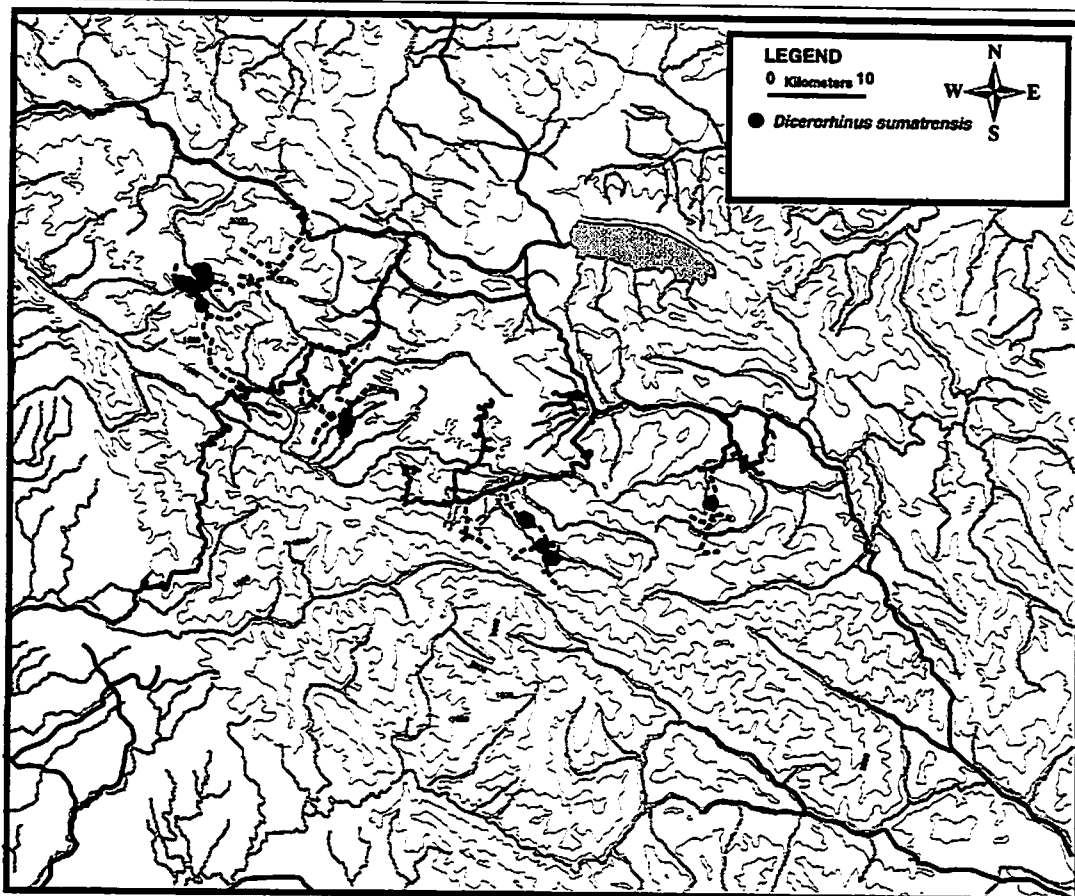
IUCN: CR A1bcd, C2a

CITES: Appendix I

Status in Indonesia: Protected

Distribution: Sumatra, Borneo, Malaysia, possibly Thailand, Myanmar and Indochina.

Fig. 3.a: *Distribution of old Dicerorhinus sumatrensis signs*



No fresh signs of rhino were recorded in the study area. Trails, rubs and wallows were identified and aged by the field assistants in study sites A, C and F using their expert knowledge of this species. The most recent signs were classed as approximately two years old, although the majority were over five years old.

It was known that prior to the study poaching had occurred within the study area, but its extent was not fully known. The data collected indicates, but does not conclusively prove, that rhino have been eradicated from the study area.

Localities with the potential to support rhino were recorded in study sites A, C and F. These were identified by the field assistants due to the presence of suitable topography, mineral springs (van Strien 1986) and vegetation types (see section 6).

3.3.3 ORDER PROBOSCIDAEE FAMILY ELEPHANTIDAE

Elephas maximus (Linnaeus 1758)

E. m. sumatranus

Asian elephant (Gajah)

IUCN: EN A1cd

CITES: Appendix I

Status in Indonesia: Protected

Distribution: Indochinese Subregion through South East Asia to Borneo and Sumatra.

Identification of elephant signs was by:

- Footprints: size and shape,
- Feeding: large areas of uprooted and damaged vegetation with associated signs,
- Wallows: presence of spoor at large wallows,
- Resting sites: large areas of flattened vegetation with associated spoor,
- Rubs: height,
- Dung: large size and distinctive boli.

Elephant trails were identified by their large size and the presence of footprints, and dung. The relative state of dung decay was recorded using the grading system devised by Dawson and Dekker (1992) indicating the relative age of the material:

- A: All boli intact, fresh and moist, with odour,
- B: All boli intact, no odour,
- C₁: More than 50% of all boli intact,
- C₂: Less than 50% of all boli intact ,
- D: All boli broken up and/or flat mass.

The frequency of trail use can be estimated from the number of dung grades present. Trails could therefore be graded in terms of activity (see Fig. 3.b) using the following guidelines:

- Major: Over 2 m in width at ground level, no encroaching vegetation and three or more dung grades present,
- Medium: Over 1 m in width at ground level, with encroaching vegetation and two dung grades present,
- Minor: Under 1 m in width at ground level, with encroaching vegetation and either one dung grade present, or in the absence of dung, the presence of spoor of one individual.

Fig. 3.b: *Elephas maximus* trails

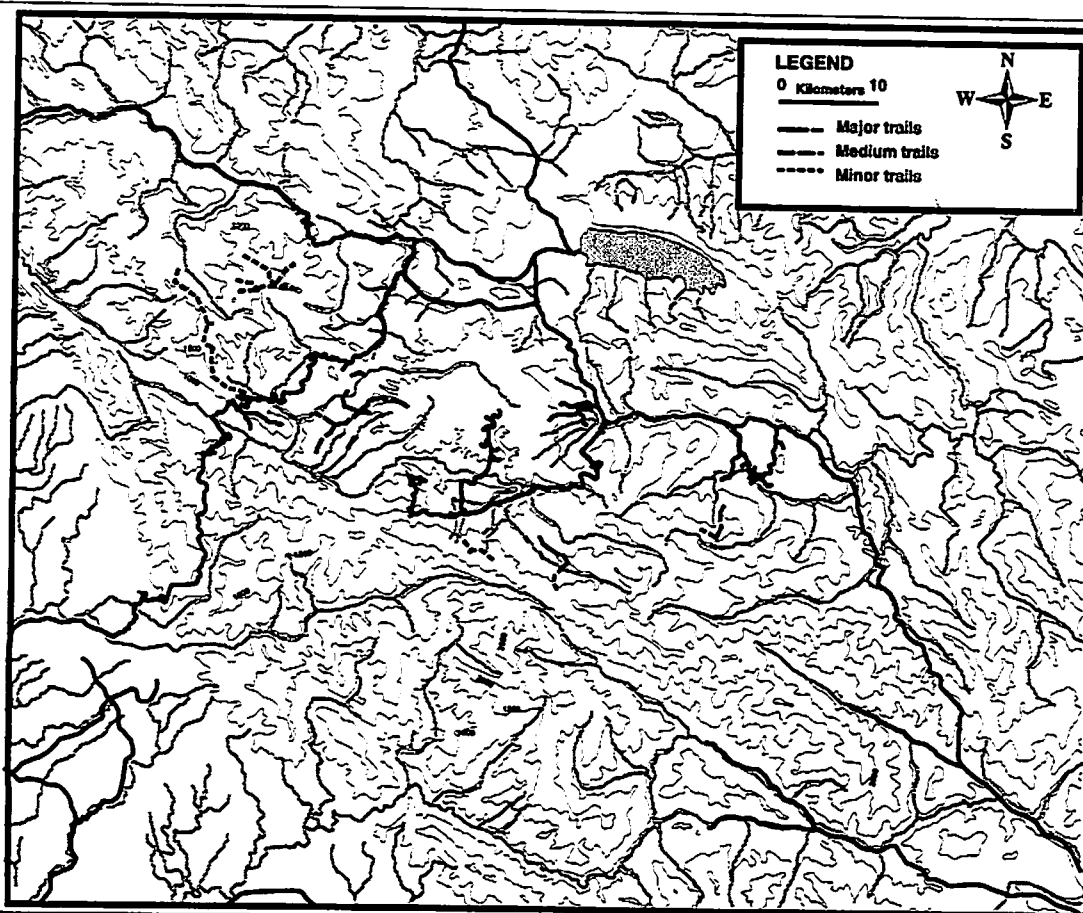


Table 3.a: Summary data for distribution of *Elephas maximus* signs

Study site	Number of spoor type				Total per site
	Feeding	Resting	Rubs	Dung	
A	5	4	10	46	65
B	8	2	2	147	159
C	18	18	18	119	173
D	6	8	8	14	36
E	2	11	6	25	44
F	6	6	21	18	51
G	1	6	1	7	15
Mengajah Road	9	0	0	10	19

Elephants were identified in all study sites and along the Mengajah Road with an altitude range from 1000 m to 2400 m. Although all sites contain at least two grades of dung, Table 3.b highlights sites B and C as important localities for elephants. Study sites A, B, C and D contained major trails.

The small number of feeding signs recorded in study sites A and B do not reflect the observed level of activity as each record corresponds to an extensive feeding area. Trails converged on the seven mineral springs located in these study sites. Mineral springs are known to be valuable to elephants (Griffiths 1996) so their presence, combined with the high level of feeding activity, highlights the significance of the Barou and Uning areas.

There was no general trend in either direction or grade of trails that suggested a major migration route. A high level of elephant activity was also noted on the Jagong ridge system. The Major trail found indicates a frequent movement of elephants, although it was not established where elephants were moving to or from. PHPA officials indicated that the establishment of the Jeget-Jagong transmigration area to the north had blocked the passage of elephants through the lowland areas, with elephants last observed trying to cross this area in 1994.

Evidence of elephants crossing the Mengajah Road was recorded on several occasions. This indicates that thus far the road is not acting as a barrier to elephant movement, although it is notable that no resting or rub sights were observed here. The continued establishment of ladang in the area may, in future, cause the development of a more substantial barrier to movement and fragment the existing population.

3.3.4 ORDER ARTIODACTYLA FAMILY BOVIDAE

Naemorhedus sumatrensis (Bechstein 1799)

N.s. sumatrensis

Southern serow (Kambing hutan, Kambing batu)

IUCN: VU A2cd (*N.s. sumatrensis*: EN A2cd)

CITES: Appendix I

Status in Indonesia: Protected

Distribution: South China, Himalayas west to Kashmir, south to Malaysia and Sumatra.

Table 3.b: Distribution of *Naemorhedus sumatrensis* signs

Study Site	Date	Altitude	Location	Observer	Sign
D	4.10.97	1185	N04°20'595" E096°59'235"	JM,JB	Print
D	6.10.97	1400	N04°20'900" E096°59'850"	JM,JB	Print
F	15.10.97	1120	N04°35'380" E096°30'180"	CB	Print
F	16.10.97	1110	N04°35'400" E096°30'200"	JB	Skull & horns

Serow was positively identified in study sites D and F from prints and remains. Droppings, suggested to be serow by the field assistants, were found in study site C.

Kambing batu was often regarded by the field assistants as belonging to a species distinct from Kambing hutan (believed to be *N. sumatrensis*). The field assistants described Kambing batu as

being larger than *N. sumatrensis*, having a dark "beard" and inhabiting only steep and rocky mountainous areas. This difference was taken by us to be a form of sexual dimorphism, but Lekagul and McNeely (1977) describe differences between the sexes as slight and hard to distinguish in the field. It is recommended that the degree of sexual dimorphism in *N. s. sumatrensis* be investigated.

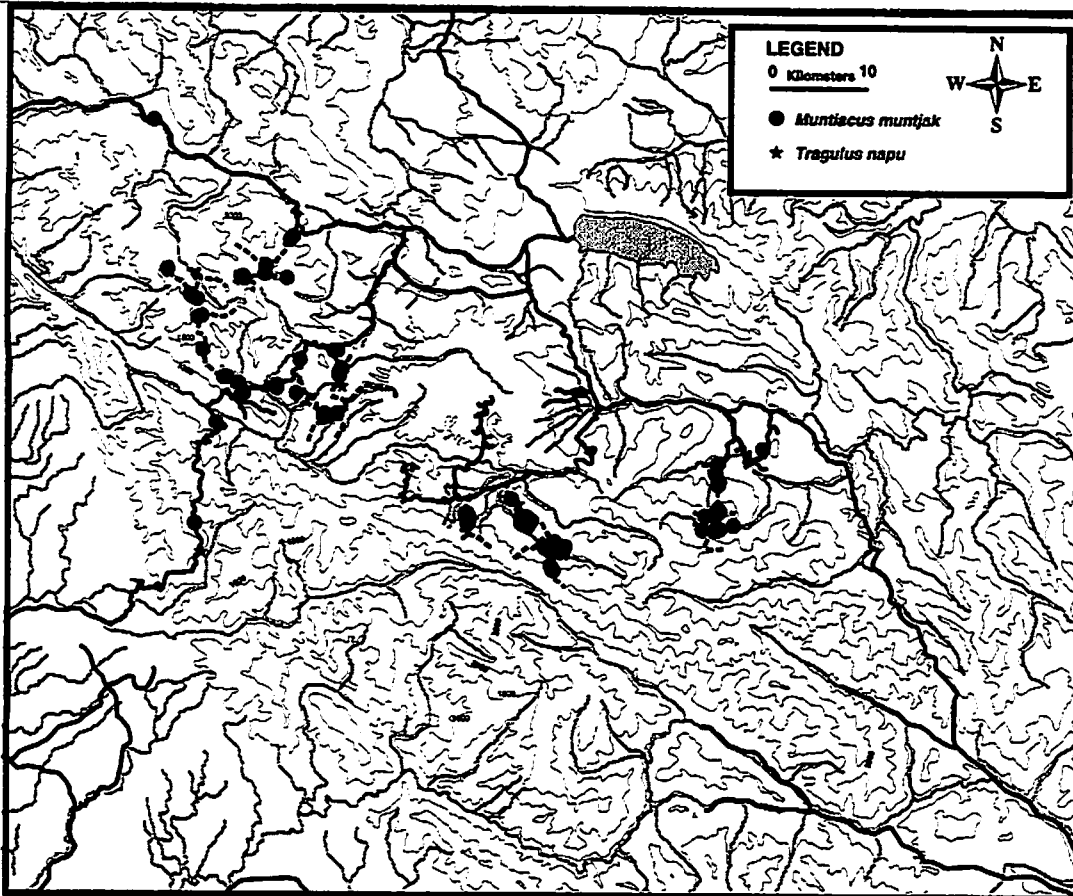
FAMILY TRAGULIDAE

Tragulus napu (Cuvier 1822)

Greater Mouse Deer (Napu)

Distribution: South Vietnam and Thailand, south to Malaysia, Borneo and Sumatra.

Fig. 3.c: Map to show distribution of *Muntiacus muntjak* and *Tragulus napu* signs



Due to their small size, mouse deer rarely leave discernible prints in forest substrates. The record of only four prints in the study area (in study sites B, C and along the Mengajah road) does not, therefore, necessarily indicate a small population.

FAMILY CERVIDAE

Muntiacus muntjak (Zimmermann 1780)

Muntjak/Common Barking Deer (Kijang)

Distribution: Indian subcontinent through South East Asia and the Greater Sunda Islands.

Muntjak were found ubiquitously throughout the surveyed forest (See Fig. 3.c and Table 3.c). Evidence included footprints, faeces and one sighting in both study site C and E.

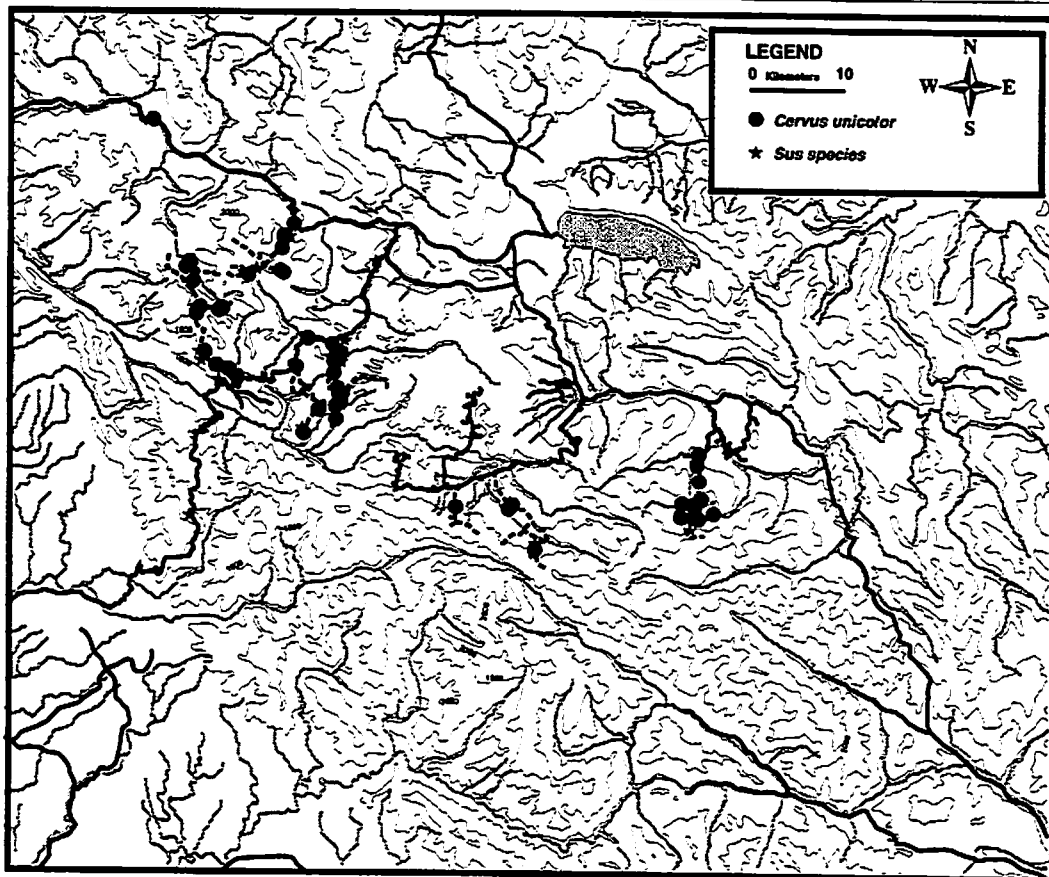
Cervus unicolor (Kerr 1792)

Sambar (Rusa)

Distribution: India east to South China and south to Malaysia, Borneo and Sumatra.

C. unicolor was widely distributed in the study area; being positively identified from footprints in all study sites (see Fig. 3.d. for its distribution). Rubs were characteristically approximately 120 cm in height. (see Table 3.c for a summary of presence throughout the study area).

Fig. 3.d: A map to show the distribution of *Cervus unicolor* and *Sus spp.* signs



FAMILY SUIDAE

Sus species

Either *S. scrofa* or *S. barbatus* (Linnaeus 1758, Muller 1838)

Wild boar, Bearded pig (Babi alang-alang/Babi putih)

Distribution: *S. scrofa*: Throughout Europe and Asia.

S. barbatus: Malaysia, Borneo, Philippines and Sumatra.

Pig species were found in all study sites (See Fig. 3.c and Table 3.c) except for study site E. Footprints were often accompanied by feeding signs, which were characterised by large areas of digging and uprooting of vegetation. An individual *S. scrofa* was seen the Mengajah road.

Table 3.c: Summary data for the distribution of the common ungulates

	<i>Tragulus napu</i>	<i>Cervus unicolor</i>	<i>Muntiacus muntjak</i>	<i>Sus</i> species
A		✓	✓	✓
B	✓	✓	✓	✓
C	✓	✓	✓	✓
D		✓	✓	✓
E		✓	✓	
F		✓	✓	✓
G		✓	✓	✓
Mengajah Road	✓	✓	✓	✓
Altitude range	1000-1550	935-2195	835-2300	900-2300

3.3.5 ORDER CARNIVORA FAMILY FELIDAE

Panthera tigris (Linnaeus 1758)

P. t. sumatrae (Pocock 1929)

Sumatran tiger (Harimau)

IUCN: EN A1cd

CITES: Appendix I

Status in Indonesia: Protected

Distribution: East Russia, China, Through South East Asia and Sumatra.

Tiger signs were found in study sites A, F and G as well as on the Mengajah Road. Large carnivore scats were also found in sites B, C and D, but confident identification to species level could not be established. To estimate the minimum number of individuals present in the study area, the home range size of both sexes at low density was used (Tilson *et al.* 1992). This report cites home range size at low density as 380 km² and 190 km² for males and females respectively. This produces a circular home range of 22.0 km diameter for males and 15.6 km for females. By assuming each tiger sign identified was on the periphery of its home range, it was inferred that a minimum of between four and six individual tigers were present.

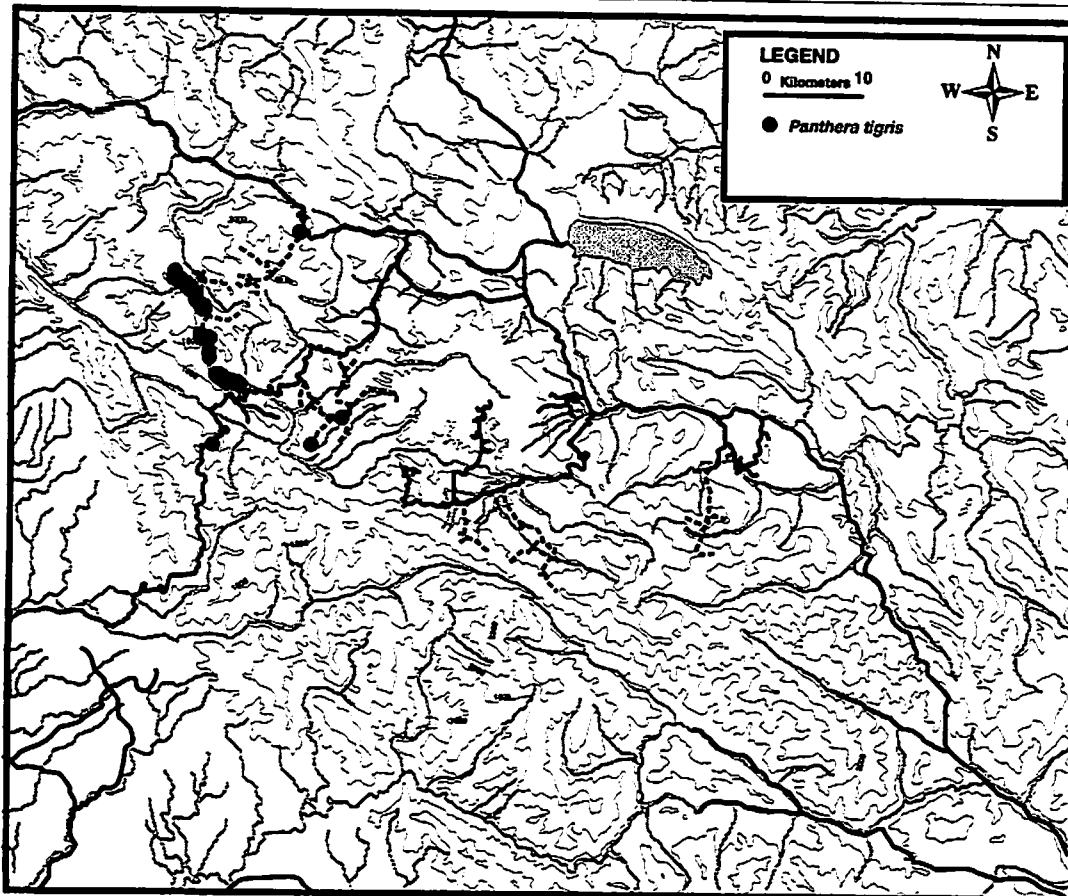
The ubiquitous distribution of ungulates throughout the forest suggests a prey base with the potential to support a tiger population. The study area essentially spans the width of the Level 1 TCU. If the forest within the study area continues to be removed, the TCU will be split in two, severely compromising its viability.

Local PHPA officials informed us that the number of tigers being hunted in the area was uncertain. We did, however, receive reports that poaching does occur in Aceh.

Table 3.d: Distribution of Panthera tigris signs

Survey	Date	Altitude	Location	Observer	Sign	Notes
A	25.8.97	1300	N04°27'244" E096°38'508"	JM, JB, CB	Heard	Heard growling
A	27.8.97	1350	N04°25'465" E096°36'924"	JM, JB, CB	Print	
F	11.10.97	1830	N04°21'971" E096°49'465"	JM,JB	Print	FL: 80, FW: 115
F	11.10.97	1390-1570	No waypoint	JB, CB	Scrape	16 fresh scrapes
F	11.10.97	1390-1460	No waypoint	JB, CB	Print	2 Prints
F	11.10.97	1475-1570	No waypoint	JB, CB	Scat	2 Scats, one containing hooves of a young Pig (species unidentified)
F	12.10.97	1510-1675	No waypoint	JB, CB	Scrape	3 scrapes all fresh
F	12.10.97	1525-1755	N04°31'359" E096°31'054"	JB, CB	Print	
F	13.10.97	1580	N04°34'100" E096°30'300"	JB	Print	FL:109 , PL: 57 , PW:65, TL:35:
F	14.10.97	1575	N04°33'994" E096°30'309"	JB, CB	Scrape	
F	14.10.97	1565-1595	No waypoint	JB, CB	Print	4 Prints, Cast taken:
F	15.10.97	1455-1575	No waypoint	JB	Print	6 Prints
F	15.10.97	1490-1570	No waypoint	JB	Scrape	6 Scrapes
G	21.10.97	1650	N04°37'400" E096°36'100"	JB,CB,JM	Print	PL: 60 PW: 100, TL: 30mm
Mengajah Road	10.8.97	1081	N04°16'916" E096°27'082"	All	Print	FL: 114, FW: 98, PL: 80 PW: 67, S: 594

Fig. 3.e: A map to show the distribution of *Panthera tigris* signs



Neofelis nebulosa (Griffith 1821)

N. n. diardi (Cuvier 1823)

Clouded leopard (Macan dahan)

IUCN: VU A1cd

CITES: Appendix I

Status in Indonesia: Protected

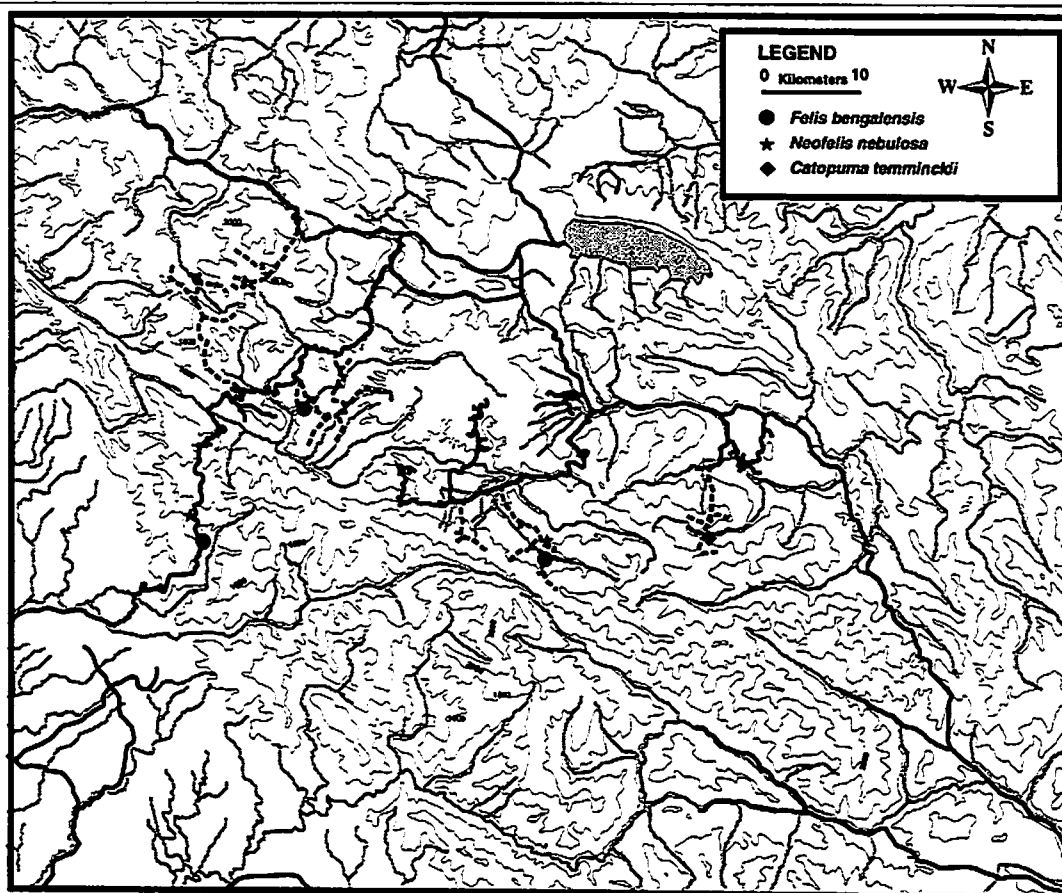
Distribution: Nepal and India through to the Malay peninsular, Borneo and Sumatra.

Table 3.e: Distribution of *Neofelis nebulosa* signs

Study Site	Date	Altitude	Location	Observer	Sign	Notes
C	10.9.97	2070	N04°19'50" E096°50'850"	BL, JM	Print	Cast taken
Mengajah Road	10.8.97	1290	N04°21'529" E096°30'520"	All	Print	

Clouded leopard prints were positively identified in on the ridge path to the east of the A. Jagon (site C) and on the Mengajah road, a few kilometres south of G. Mengajah.

Fig. 3.f: A map to show the distribution of *Pardofelis nebulosa*, *Catopuma temminckii* and *Prionailurus bengalensis* signs



Catopuma temminckii (Vigors & Horsfield, 1827)

C. t. temminckii

Golden cat (Kucing emas)

IUCN: Lower risk: near threatened

CITES: Appendix I

Status in Indonesia: Protected

Distribution: China, through South East Asia to Sumatra.

See Fig. 3.f for distribution.

Table 3.f: *Distribution of Catopuma temminckii data*

Study Site	Date	Altitude	Location	Observer	Sign	Notes
D	4.10.97	1140	N04°20'600" E096°59'500"	JM,JB	Print	Transparency drawn

A golden cat print was identified in site D 50 cm from the edge of the A. Uwis in soft sand. Heavy rain the previous night resulted in this sand being covered, therefore, the print must have been less than 12 hours old.

***Prionailurus bengelensis* (Kerr 1792)**

Leopard cat (Kucing batu)

P. b. sumatrana (Horsfield 1821)

CITES: Appendix II (Appendix I Bangladesh, India and Thailand)

Distribution: East Russia throughout Asia, to Sumatra and Java.

Table 3.g: Distribution of *Prionailurus bengelensis* signs

Study Site	Date	Altitude	Location	Observer	Sign	Notes
B	26.8.97	925	N04°27'593" E096°36'481"	BL,K	Print	
C	8.9.97	2275	N04°18'100" E096°51'600"	JM,JB	Print	
Mengajah Road	10.8.97	1295	N04°20'052" E096°30'962"	All	Print	Photograph taken S: 163, FL: 143, FW:48

Three clear leopard cat prints were identified: one in the sand by the edge of the A. Baru, one on the ridge path to the west of the A. Jagon, and another along the Mengajah road approximately half way between Keude Seumot and G. Mengajah. See Fig. 3.f for distribution.

FAMILY CANIDAE

***Cuon alpinus* (Pallas 1811)**

Asian wild dog (Ajak)

IUCN: VU C2a

CITES: Appendix II

Status in Indonesia: Protected

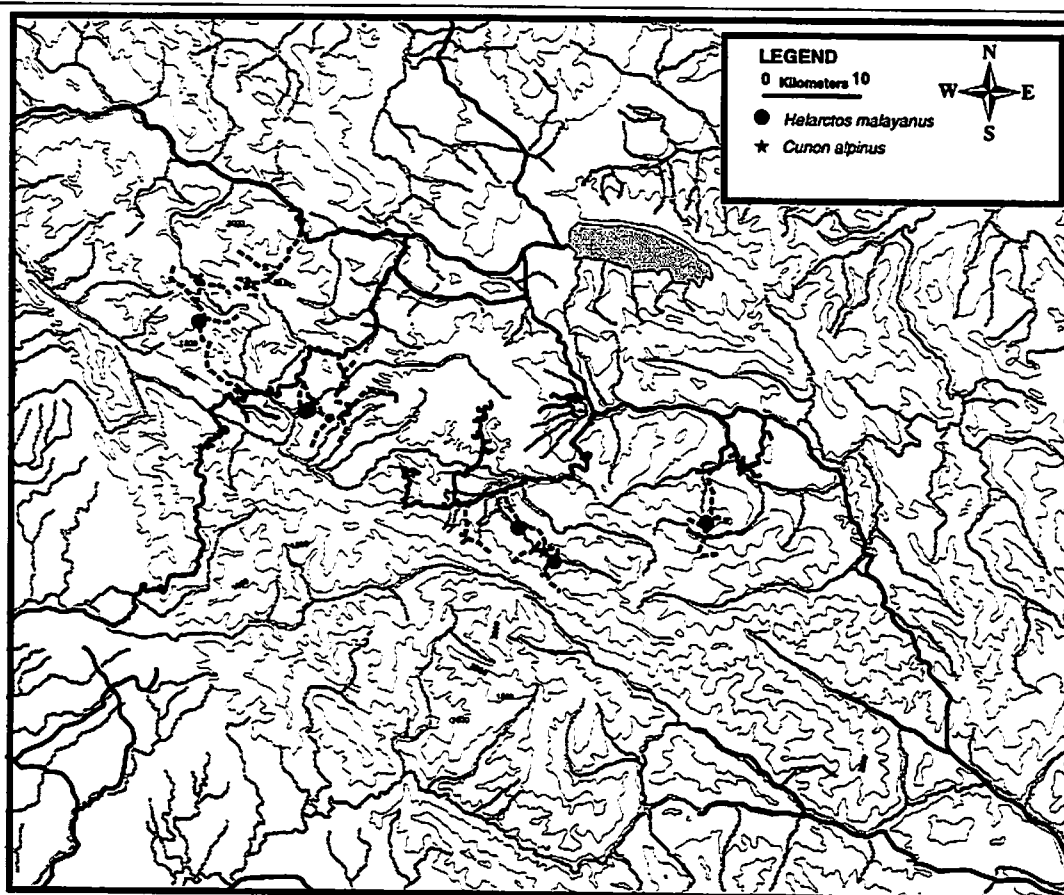
Distribution: Siberia through South East Asia, Sumatra and Java.

Prints were found in the soft mud at the mouth of a small tributary to the A. Jagong. The prints were justified as being from the Asian wild dog and not from a domestic dog due to the shape of the print, the distance from the nearest settlement (3 days walk), and the lack of fresh human signs found in the area. See Fig. 3.g for the location of the print.

Table 3.h: Distribution of *Cuon alpinus* signs

Study Site	Date	Altitude	Location	Observer	Sign	Notes
C	4.9.97	1650	N04°19'400" E096°50'620"	BL,K	2 Prints: Left front, Left hind	Cast taken FL: 78,70 FW: 55,58 PL: 28,27 PW: 34,34 S: 420

Fig. 3.g: A map to show the distribution of *Cuon alpinus* and *Ursus malayanus* signs



FAMILY URSIDAE

Ursus malayanus (Raffles 1821)

Sun bear (Beruang)

IUCN: DD

CITES: Appendix I

Status in Indonesia: Protected

Distribution: Southwest China, Assam, Burma, Vietnam, Malaysia, Borneo and Sumatra.

Sunbears were positively identified from signs in study sites A, B, C, D and F, reaching an altitude of 2405 m in site C. Putative feeding signs of sunbear were present in all study sites. See Fig. 3.g for distribution.

Table 3.i: Distribution of *Ursus malayanus* signs

Study Site	Date	Altitude	Location	Observer	Sign
A	27.8.97	900	N04°27'502" E096°36'401"	BL,K	Claw marks
A	28.8.97	900	N04°27'502" E096°36'401"	BL,K	Feeding & Claw marks
C	7.9.97	2020	N04°18'700" E096°51'800"	All	Claw marks
C	12.9.97	1650	N04°21'350" E096°48'850"	BL,JM,JB	Claw marks
D	30.9.97	1355	N04°21'003" E096°59'503"	JM,JB	Claw marks on tree & Feeding
F	13.10.97	1770	N04°32'500" E096°30'500"	JB	Claw marks

FAMILY MUSTELIDAE

SUBFAMILY MELINAE

Arctonyx collaris (F. Cuvier 1825)

Hog-nosed badger (babi batang)

Distribution: Sikkim Terai, Assam, southern China, Indochina, Burma, Thailand and Sumatra.

Table 3.j: Distribution of *Arctonyx collaris* signs

Study Site	Date	Altitude	Location	Observer	Sign	Notes
F	13.10.97	1770	N04°33'100" E096°30'900"	JB	Skull	MB: 65.8, ZB: 73.3, CL: 130.8
G	21.10.97	1650	N04°37'400" E096°36'100"	JB,JM	Skull	MB: 59.7, ZB: 65.2, CL: 124.6

The Hog-nosed badger skull found in study site F was situated on the ridge path leading north, away from Gunung Pucuk. The skull found in study site G was in dense vegetation on the ridge path leading to Gunung Pantan Petukel from the Rumahbaru road.

SUBFAMILY LUTRINAE

Lutra lutra (Linnaeus 1758)

Common Otter (berang berang utara)

L. l. berang (Cuvier 1823)

CITES: Appendix I

Distribution: Europe and Asia including Japan, Sumatra and Java.

Table 3.k: A table to show *Lutra lutra* data

Study Site	Date	Altitude	Location	Observer	Sign	Notes
C	12.9.97	1520	N04°20'827" E096°48'865"	BL,JM,JB	Print	Photograph and cast taken LF: FL: 49, FW: 45, PL: 25, PW: 19, S: 420

The only record of this species was from the lower reaches of the Jagong Valley. The unsustainable fishing methods used in this region may have resulted in a depleted prey base for semi-aquatic carnivores. This may be the reason for the lack of otter signs found, although the substrate along riverbanks was often not suitable for footprints.

FAMILY VIVERRIDAE

Arctictis binturong (Raffles 1821)

Binturong (binturong)

CITES: Appendix III

Distribution: Myanmar, Thailand, Indochina, Malaya, Borneo, Sumatra and Java.

Table 3.l: A table to show *Arctictis binturong* data

Study Site	Date	Altitude	Location	Observer	Sign	Notes
A	22.7.97	875	N04°28'525" E096°34'805"	BL,JB,K	Sighting	Photograph taken
D	7.10.97	1290	N04°23'000" E096°59'650"	JM,JB	Sighting	Photograph taken

Two individuals were observed, one was feeding in a fruiting tree overhanging the A. Baru and the other was 100 m onto the forest above the path into the Uwis valley.

Paradoxurus hermaphroditus (Pallas, in Schreber 1777)

Common palm civet (luwak biasa)

P. l. leucomystax (Grey 1837)

CITES: Appendix III

Distribution: The Indian sub-continent through South East Asia to Philippines, Borneo, Sumatra, Java, Celebes, and Timor.

Table 3.m: Distribution of *Paradoxurus hermaphroditus* signs

Study Site	Date	Altitude	Location	Observer	Sign	Notes
A	28.8.97	1320	N04°27'244" E096°38'508"	JM,JB,CB	Print	
B	19.8.97	1500	N04°30'745" E096°38'338"	All	Print	
C	3.9.97	1665	N04°19'500" E096°50'400"	All	Print	Cast and Photograph taken. LH: FL: 46, FW: 43, PL: 26, PW: 36, S: 282

The print found in study site A was located by the mineral spring, with the others being found on an old, overgrown logging road and a marshy area by the edge of the A. Jagong.

Paguma larvata (Hamilton-Smith 1827)

Masked palm civet (musang mera)

Distribution: Himilayas, southern China, Taiwan, South East Asia, Borneo and Sumatra.

The sighting in study site G was in primary forest on a ridge path leading away from Gunung Petukel in a southwesterly direction. The Isaq road sighting was from the vehicle, late at night; the animal crossed the road, climbing a small, but steep bank to reach the forest on the other side.

Table 3.n: *Distribution of Paguma larvata signs*

Study Site	Date	Altitude	Location	Observer	Sign
G	24.10.97	2010	N04°34'750" E096°33'400"	JM	Sighting
Isaq Road	5.8.97	1865	N04°30'200" E096°51'500"	All	Sighting

3.3.6 ORDER PRIMATES FAMILY HOMINIDAE SUBFAMILY PONGINAE

Pongo pygmaeus (Linnaeus 1760)

P. p. abelii

Orang-utan (Mawas)

Proposed subspecies *P. s. abangensis* (Selenka, 1886) from around Abong Abong.

IUCN: VU A1cd, C1

CITES: Appendix I

Status in Indonesia: Protected

Distribution: Borneo and Sumatra.

Nests were identified by the characteristic construction involving bending and breaking branches to form a large platform in the crown of a tree. Van Schaik *et al.* (1995) draw attention to the difficulty of locating nests. Therefore, only presence, not absence, can be concluded by this study.

The stage of nest decay was graded using the system devised by van Schaik *et al.* (1995):

- A: Fresh, leaves are still green.
- B: Older, leaves may still be attached and the nest is still firm and solid.
- C: Old, leaves are gone and holes are visible in the nests.
- D: Very old, twigs and branches are still present but no longer in the original shape of the nest.

One individual was seen in the Uwis valley (study site D). The long-call was heard once in the Jagong valley (study site C) and four times in the Uwis valley. In the Uwis valley 47 nests were identified in small aggregations, within an area of approximately 6 km². The Barou (study site A) and Jagong valleys contained two and three nests respectively.

These findings indicate that orang-utans are present in the Beutong forests and that a stable population (represented by the range of nest ages) is present in the Uwis valley. Given the

current status of the orang-utan, any population surviving outside a protected area warrants further investigation.

Fig. 3.h: A map to show the distribution of *Pongo pygmaeus* signs

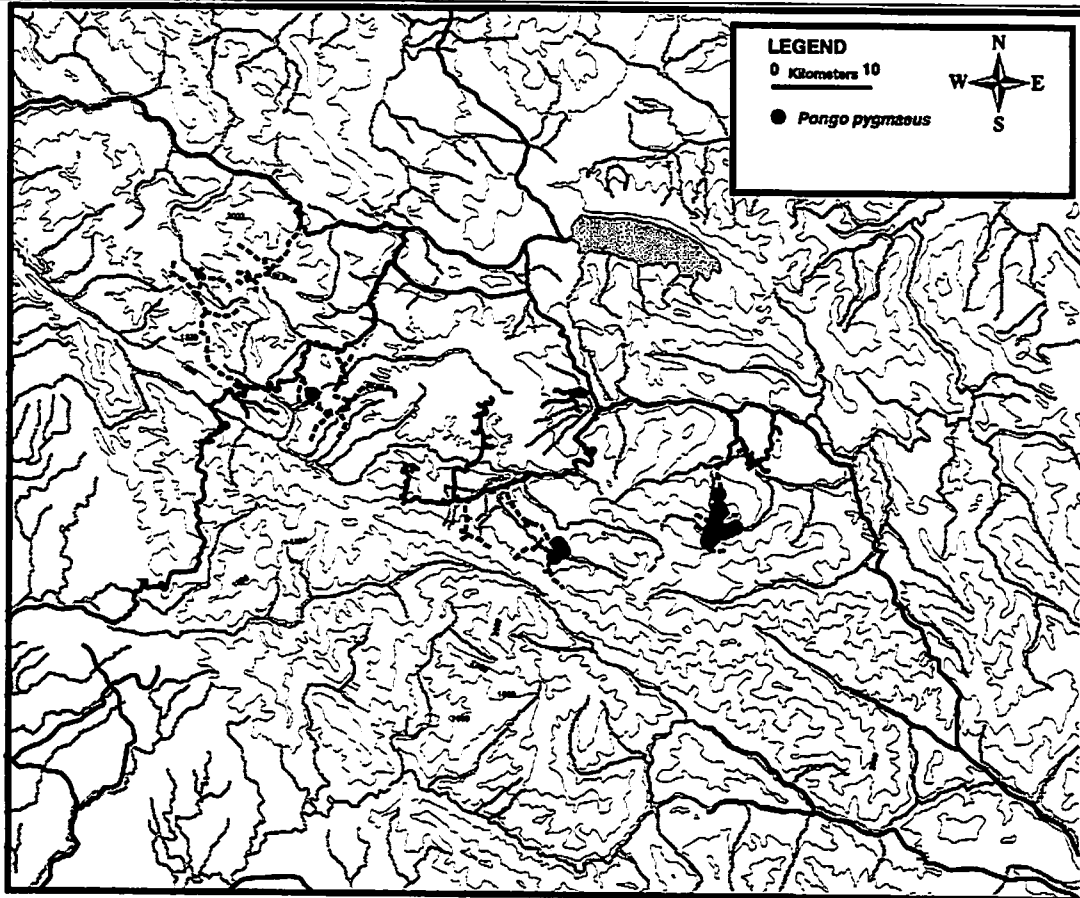


Table 3.o: Distribution of *Pongo pygmaeus* signs

Survey	Date	Altitude	Location	Observer	Sign	Grade
A	28.8.97	925	N04°27'593" E096°36'481"	JM,JB,CB	2 Nests	D
C	5.9.97	1825	N04°18'932" E096°51'269"	All	Nest	B
C	8.9.97	2205	N04°18'425" E096°51'620"	BL,K	Call	
C	10.9.97	2155		All	Nests	B
C	10.9.97	2405		All	Nests	B
D	29.9.97	1510	N04°21'187" E096°59'491"	JM,JB	2 Heard	
D	30.9.97	1155	N04°20'600" E096°59'500"	JM,JB	Nest	A
D	30.9.97	1355-1510		JM,JB	3 Nests	C

D	1.10.97	1100		JM,JB	2 Nests	A
D	1.10.97	1100		JM,JB	3 Nests	B
D	1.10.97	1100-1120		JM,JB	3 Nests	C
D	1.10.97	1100-1120		JM,JB	2 Nests	D
D	2.10.97	1590	N04°20'200" E096°59'300"	JB	Call	
D	2.10.97	1155-1620		JB	3 Nests	A
D	2.10.97	1465	N04°20'300" E096°59'500"	JM	2 Nests	B
D	2.10.97	1510-1520	N04°20'240" E096°59'300"	JB	3 Nests	C
D	2.10.97	1520-1620		JB	2 Nests	D
D	3.10.97	1185-1620		JM,JB	Nest	A
D	3.10.97	1140-1295		JM,JB	Nest	B
D	3.10.97	1140-1445		JM,JB	Nest	C
D	3.10.97	1295-1445		JM,JB	Nest	D
D	4.10.97	1185	N04°20'595" E096°59'235"	JM,JB	Nest	B
D	5.10.97	1140	N04°20'600" E096°59'900"	JM,JB	Nest	A
D	5.10.97	1075-1115		JM,JB	Nest	B
D	5.10.97	1070-1115		JM,JB	Nest	C
D	7.10.97	1665	N04°21'800" E096°59'800"	JM,JB	1 Sighting	
D	7.10.97	1680	N04°21'800" E096°59'750"	JM,JB	call	
D	7.10.97	1665	N04°21'800" E096°59'800"	JM,JB	Nest	A
D	7.10.97	1665-1725	N04°21'550" E096°59'500"	JM,JB	2 Nests	B
D	7.10.97	1290-1620		JM,JB	2 Nests	C

FAMILY HYLOBATIDAE

Hylobates syndactylus (Raffles 1821)

Siamang (Siamang)

IUCN: Lower risk: near threatened

CITES: Appendix I

Distribution: Malay Peninsular, Sumatra.

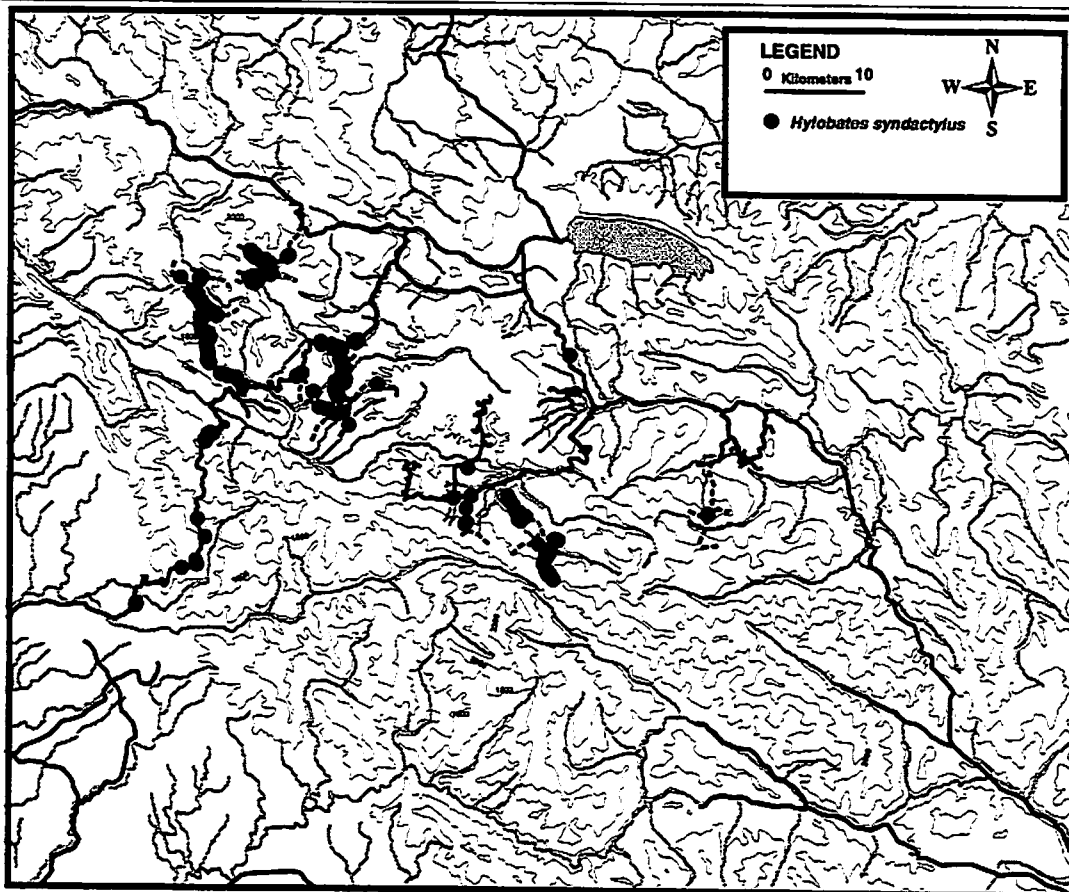
Siamang were heard ubiquitously over the study area and were sighted frequently, from an altitude of 70 m-2375 m (see Table 3.p).

One family group was recorded in a small area of mature ladang, isolated from the forest by a large expanse of new ladang. The presence of this primary forest species in such a sub-optimal habitat highlights the pressure being exerted on the forest.

Table 3.p: Summary of *Hylobates syndactylus* distribution

Study site	Number of records	Average record per day	Type of sign	Altitude range
A	23	1.3	Sighting, call	950-1600
B	11	1.4	Sighting	1070-1410
C	32	1.5	Sighting, call	1360-2375
D	2	0.2	Sighting	1710-1725
E	5	0.6	Sighting	1550-2195
F	54	4.2	Sighting, call	1080-1850
G	19	1.7	Sighting, call	1800-2220
Mengajah Road	17	1.8	Sighting, call	70-1750

Map 3.i: A map to show the distribution of *Hylobates syndactylus* data



Hylobates lar (Linnaeus 1771)

White-handed gibbon (Owa)

H. l. vestitus

IUCN: Lower risk: near threatened

CITES: Appendix I

Distribution: South Yunnan, East Burma, and West Thailand to Malaysia, North Sumatra

Map 3.j: A map to show the distribution of *Hylobates lar*

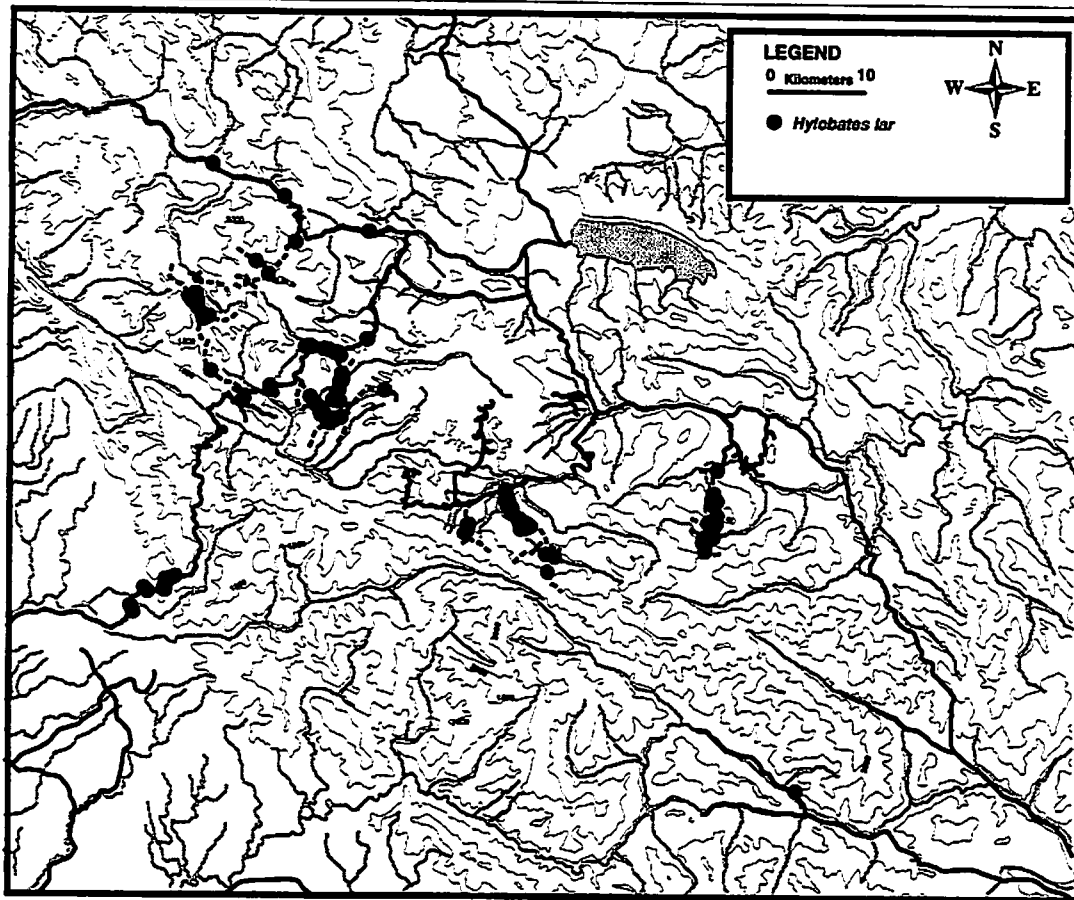


Table 3.q: Summary of *Hylobates lar* signs

Study site	Number of records	Average records per day	Spoor type	Altitude range
A	11	0.6	Sighting, Call	1000-1500
B	9	1.1	Call	1100-1400
C	25	1.2	Sighting, Call	850-2225
D	15	1.3	Call	985-1975
E	4	0.5	Sighting, Call	1050-2195
F	10	0.8	Sighting, Call	1435-1765
G	9	0.8	Sighting, Call	630-2045
Mengajah Road	18	3	Call	70-1840

White-handed gibbon was heard in all study sites, most frequently along the Mengajah road.

Two individuals were seen in a lone tree in an area of freshly cleared forest. Such encounters provide support for the observation that the presence of gibbons in ladang is an indication of the rapid destruction of the forest.

SUBFAMILY COLOBINAE

Presbytis thomasi (Collett 1893)

Thomas' Leaf monkey/Thomas' langur (Kedih)

IUCN: Lower risk: near threatened

Distribution: North Sumatra.

Map 3.k: A map to show the distribution of *Presbytis thomasi*

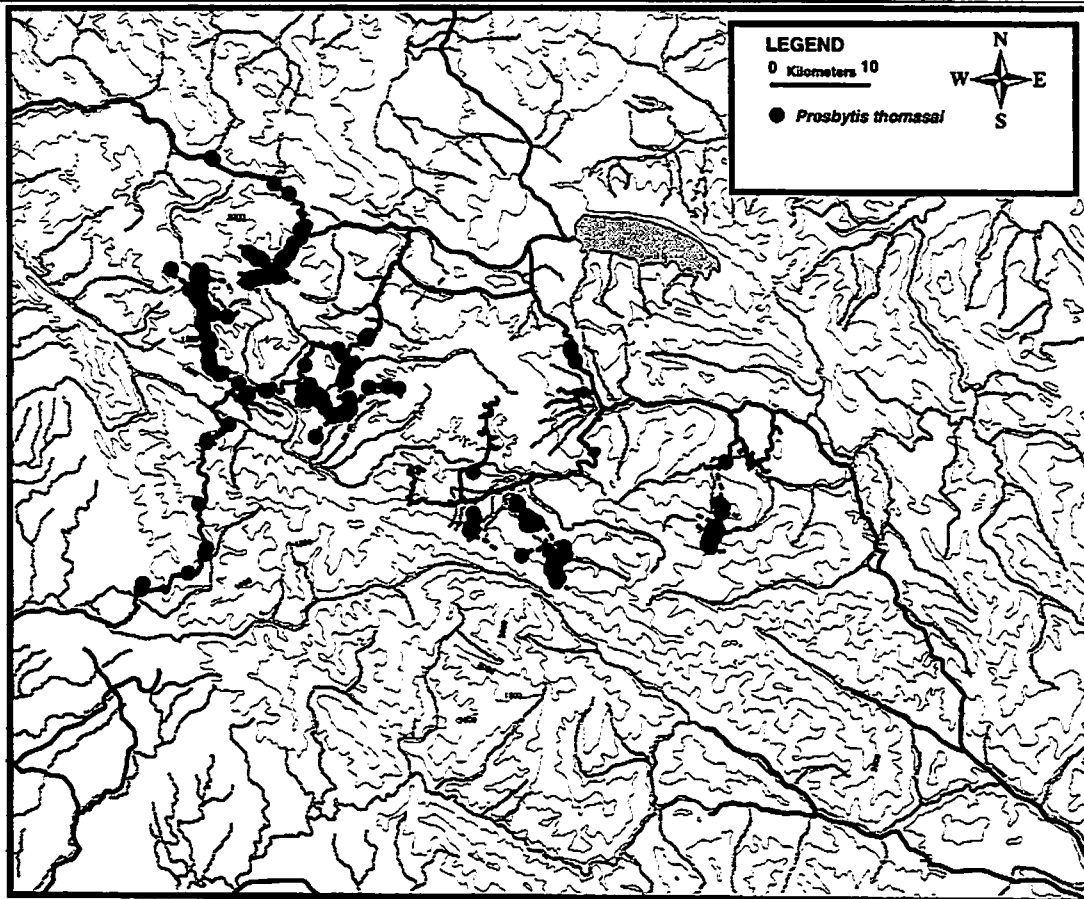


Table 3.r: Summary of *Presbytis thomasi* signs

Study site	Number of records	Average records per day	Spoor type	Altitude range (m)
A	11	0.6	Sighting, Call	1025-1700
B	23	2.9	Sighting, Call	900-1350
C	32	1.5	Sighting, Call	835-2270
D	15	1.3	Sighting, Call	1200-1830
E	5	0.6	Sighting, Call	1495-2240
F	46	3.5	Sighting, Call	600-1835
G	38	3.5	Sighting, Call	525-2115
Mengajah Road	11	1.8	Sighting, Call	810-1750

Frequent sightings and calls were recorded for all study sites. This species was seen and heard more readily than other primate species, because of its conspicuous reaction upon encountering humans.

SUBFAMILY CERCOPITHECINAE

Macaca nemestrina (Linnaeus 1766)

M. n. nemestrina

Pig-tailed macaque (Beruk)

IUCN: VU A1cd

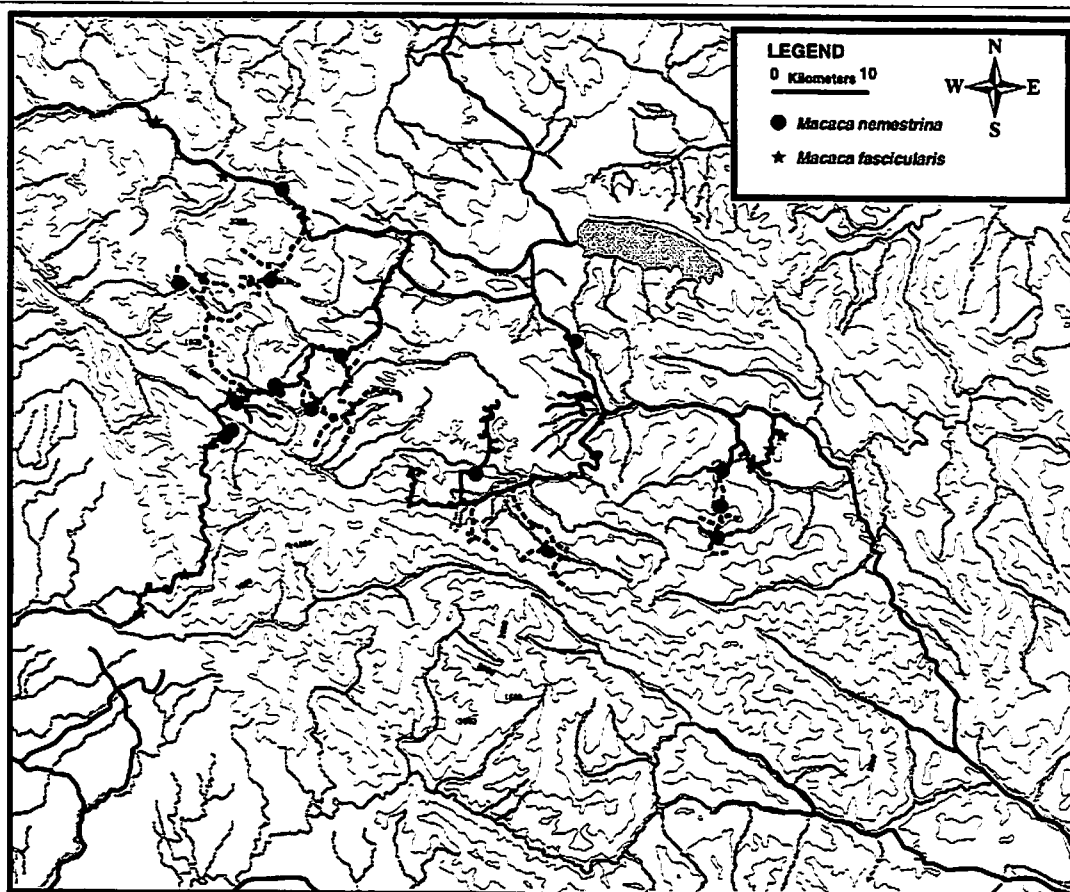
Distribution: Myanmar, Vietnam, Malaysia, Borneo and Sumatra.

Pig-tailed macaque was recorded in most sites, with an altitude range between 730 m and 1880 m. Sightings ranged from a lone individual to groups of 20 or more.

Table 3.s: Distribution of *Macaca nemestrina* signs

Study Site	Date	Altitude	Location	Observer	Sign
A	25.8.97	925	N04°27'53" E096°36'481"	BL,K	S20+
A	4.9.97	1665	N04°19'500" E096°50'400"	All	S4
C	4.9.97	1665	N04°19'480" E096°50'600"	BL,K	Print & Scat
D	2.10.97	1355	N04°20'400" E096°59'500"	JM,JB	S20
D	7.10.97	1535	N04°22'400" E096°59'650"	JM,JB	S1
F	15.10.97	1600	N04°34'600" E096°29'500"	JB	skull and Bones
G	19.10.97	730	N04°41'077" E096°31'863"	JM,JB,CB	S6
G	23.10.97	1880	N04°35'125" E096°34'171"	JM	H1
Mengajah Road	2.8.97	1250	N04°27'787" E096°32'300"	BL,JM,JB	S4
Mengajah Road	2.8.97	860	N04°28'783" E096°34'534"	BL,JM,JB	S8
Mengajah Road	4.8.97	1750	N04°31'818" E096°51'619"	All	S4
Mengajah Road	8.8.97	811	N04°26'424" E096°32'632"	All	S2
Mengajah Road	10.8.97	871	N04°28'783" E096°34'534"	All	S1
Jagong Road	3.8.97	1450	N04°23'918" E096°46'187"	All	S6

Fig. 3.1: A map to show the distribution of Cercopithecinae data



Macaca fascicularis (Raffles 1821)

M. f. fascicularis

Long-tailed macaque (Kera)

IUCN: Lower risk: near threatened

Distribution: South Burma to Vietnam and Malaya, Philippines, Sumatra, Java and Borneo.

The preference long-tailed macaques have for lowland and hill forest can most likely explain limited number of sightings, as the majority of this study area is montane zone.

Table 3.t: *Distribution Macaca fascicularis data*

Study Site	Date	Altitude	Location	Observer	Sign
D	26.9.97	835	N04°25'408" E096°01'864"	JM,JB	S6
D	27.9.97	775	N04°24'300" E096°59'850"	JM,JB	S10
G	18.10.97	1025	N04°28'500" E096°32'400"	JM	S2

G	19.10.97	570	N04°44'616" E096°25'238"	JM,JB,CB	S6
Mengajah Road	9.8.97	136	N04°15'966" E096°26'717"	All	S8
Perlak road	5.8.97	655	N04°26'108" E097°03'413"	All	S1

3.3.7 ORDER RODENTIA

FAMILY HYSTRICIDAE

Hystrix brachyura (Linnaeus 1758)

South East Asian Porcupine (Landak biasa)

Distribution: South East Asia, Borneo and Sumatra.

Table 3.u: *Distribution of Hystrix brachyura signs*

Study Site	Date	Altitude	Location	Observer	Sign	Notes
B	17.8.97	1700	N04°28'600" E096°41'100"	BL,JM,JB	Quill	
B	18.8.97	1400	N04°30'393" E096°39'356"	JB,CB,K	Quill	
C	10.9.97	2350	N04°19'600" E096°52'300"	JM	Quill	
D	1.10.97	1100	N04°20'626" E096°59'847"	JM,JB	Print	Photograph taken
D	1.10.97	1185	N04°20'649" E096°59'365"	JM,JB	Print	Cast taken
D	5.10.97	1075	N04°20'600" E096°97'150"	JM,JB	Print	

Quills were identified by their characteristic markings.

FAMILY SCIURIDAE

SUB FAMILY RATUFINAE

Ratufa bicolor (Sparman 1778)

R. b. palliata (Miller 1902)

Black giant squirrel (Jelarang kerawak hitam)

CITES: Appendix II

Distribution: Southern China south to Sumatra, Java and Bali.

Ratufa affinis (Raffles 1821)

Pale giant squirrel (Jelarang paha putih)

CITES: Appendix II

Distribution: The Malay Peninsular, Borneo and Sumatra.

Giant squirrels identified to the genus *Ratufa* were sighted in study sites A, G and on the Mengajah road.

SUB FAMILY CALLOSCIURINAE

Callosciurus notatus (Boddaert 1785)

Plantain squirrel (Bajing kepala)

Distribution: Thailand, Malay Penisular, Sumatra, Java and Bali.

Sundasciurus species

S. lowi, *S. tenius* or *S. hippurus*.

Sundasciurus distribution: Thailand, Malay peninsular, Borneo and Sumatra.

Lariscus insignis (Cuvier 1821)

Three striped ground squirrel (Bajing belang)

Distribution: Thailand, Malay Penisular, Borneo, Sumatra and Java.

Table 3.v: A table to show Sciuridae data

Species	Study Site	Date	Altitude	Location
<i>Ratufa bicolor</i>	Mengajah road	8.8.97	850	N04°25'619" E096°31'183"
<i>Ratufa bicolor</i>	A	24.8.97	925	N04°27'502" E096°36'401"
<i>Ratufa affinis</i>	G	26.10.97	1760	N04°35'000" E096°34'000"
<i>Callosciurus notatus</i>	Mengajah Road	9.8.97	136	N04°15'966" E096°26'717"
<i>Sundasciurus spp.</i>	Mengajah Road	9.8.97	136	N04°15'966" E096°26'717"
<i>Lariscus insignis</i>	B	16.8.97	1020	N04°28'813" E096°38'548"

3.4 CONCLUSIONS

From the data obtained it can be seen that the Beutong forests are able to support populations of the four conservation flagship species on which the project focused: *Dicerorhinus sumatrensis*, *Elephas maximus*, *Panthera tigris* and *Pongo pygmaeus*. Large areas of relatively undisturbed, continuous forest cover are present with important features such as mineral springs being found throughout the region. Such springs are important to a range of species, not least the Sumatran rhinoceros. They also seem able to help support a high ungulate density, which in turn may increase the number of carnivores surviving in an area.

Remote, high, flat valleys were located, which when paired with the available mineral springs indicates that suitable habitat for the Sumatran rhinoceros still exists in the region. Although only a proportion of the study area was surveyed, no recent signs of rhino activity were found,

although it is thought that rhino inhabited the region as recently as two years ago. The current absence may be due to poaching and not lack of a suitable habitat.

The elephants from the study area are part of the Western Aceh population (Blouch and Simbolon 1985). Being at the southern most tip of this population's range the elephants that inhabit the study area are linked to further groups to the north only. Our study, however, found elephant trails on the highest ridge paths and so the possibility that the mountainous region to the south acts as a barrier to dispersion may not be true and deserves further study. The development of the Megajah and Rumahbaru roads will act as a barrier to northward movements. This will lead to two problems; firstly human-elephant conflict in the ladang bordering these roads, and secondly the population will become bisected, effectively creating two isolated sub-populations. No conclusive evidence of an elephant migration route was found.

To our knowledge, tiger has not previously been recorded from the area, although it was presumed to be present. The presence of a plentiful prey base, for example ungulates, leads to the presumption that tiger populations in the region are restricted by habitat, altitude or disturbance. The study area is within a level 1 TCU and so is very important for the long-term survival of the species. Tigers do cross ladang, roads and plantations, so these land uses are not barriers to dispersal. In order to maintain the integrity of the TCU the area must be managed to facilitate such tiger movement.

Orang-utans were found in three localities, and although a population estimate cannot be calculated with the methods used in this study, the Uwis valley seems to hold a permanent population. Orang-utans are known not to live at high altitudes, but will disperse through such areas. The high altitude of much of the study area does not allow for a permanent population to be maintained, but this undisturbed forest serves as a valuable corridor for dispersal. Without such corridors, small isolated populations such as those in the Uwis valley would be lost to the metapopulations' gene pool.

The population of orang-utans in the Uwis valley is important to the survival of the species. All individuals of a species threatened with extinction are vital not just by numbers, but for their genetic individuality. If orang-utan numbers continue to fall, a system of translocations may have to be undertaken to maintain genetic diversity. A small, but distinct population such as that in the Uwis may be vitally important for such actions.

By using the seven study sites to sample the mammalian community of the Beutong forests, we conclude that many species are present throughout the study area. Six species (*E. maximus*, *C. unicolor*, *M. muntjak*, *H. syndactylus*, *H. lar*, *P. thomasi*) were identified in every study site with many other species found in multiple sites. The environment, terrain, and vegetation impede the detection of animal signs in rain forest by producing rapid decay rates, poor visibility and much leaf litter. Considering these factors the non-confirmation of a species in a study site was not necessarily taken as an indication of absence. Due to the nature of data collection (diurnal observations only), the majority of data were from large mammals because methods focused on the identification of calls, prints and sightings.

4.0

BIRD STUDY

The avian fauna of the study area was investigated for a total of 91 days. One hundred and five species were identified, 7 of which are included as Red Data Book species. Sixteen "Sundaland" endemics, including 10 Sumatran endemics were recorded. Of the species identified 3 have not been previously recorded from Leuser Ecosystem which borders the study area. The results presented here show the region has a very rich avian community, which needs both further research and urgent protection from its rapid and imminent destruction.

4.1 INTRODUCTION

Aceh has been subject to some important collecting expeditions, most notably those made by F.C. van Heurn in 1920 (described by Baron Snouckaert van Schauburg in 1922), Kloss in 1930 (Kloss 1931), A. Hoogerwerf in 1937 (Chasen and Hoogerwerf 1941) and G. Vanderbilt in 1936 and again in 1939 with S. D. Ripley (Schauensee 1939a, 1939b Schauensee and Ripley 1940). All but the first of these expeditions included collections from the Beutong region centred around the town of Takengon. Since the 1970's, research on the birds of Aceh has become concentrated around four areas; Ketambe research station, Bohrok Orang-utan rehabilitation and research centre, Gunung Leuser and the Mamas Valley. Brastagi has also attracted a lot of attention due to the development of eco-tourism in the area. Recent environmental impact assessment surveys have also taken place in Kluet, Kapi, Lesten, the Gayo Highlands and on Mt. Kemiri (Wind 1996). However, the Beutong region has not been studied with regard to its avian fauna for over fifty years, and large expanses of the area are still unsurveyed, especially those containing submontane and montane vegetation.

Gunung Leuser National Park has an impressive species list of more than 380, including 36 Sunda Island endemics and 9 Red Data Book species (Wind 1996). This list, however, cannot be assumed as definitive as presence of some species is based on single and/or very old recordings; for instance the Rueck's Blue-Flycatcher (*Cyornis ruckii*) and the Sumatran Cochoa (*Cochoa beccarii*). Some species that were recorded outside the park borders, for example the Sunda Warbler (*Seicercus grammiceps*) and the Black-crowned Pitta (*Pitta venusta*) are also included in the list.

The nomenclature followed here is that used by MacKinnon and Phillipps (1993) due to its familiarity with researchers and bird watchers alike. MacKinnon and Phillipps followed the ordering of King *et al.* (1975) with revisions from Sibley and Monroe's DNA hybridisation studies (Sibley and Monroe 1990). A consensus of the taxonomic status of some species has not been reached, however, including Salvadories/Hoogerwerf's pheasant (*Lophura inornata/hoogerwerfi*) and the Sunda Whistling thrush (*Myiophoneus glaucinus*).

4.1.1 OBJECTIVES

- To produce a species list for the Beutong forests,
- To investigate species richness of the Beutong region,
- To collect data on the relative abundance, altitude range and basic ecology of the species seen.

27 mammal species were identified, 14 of which have IUCN status including 8 threatened species, for example *Neofelis nebulosa*, *Cuon alpinus*, *Macaca nemestrina* and *Naemorhedus sumatrensis*. Many Sumatran sub-species were present including the endangered *Elephas maximus sumatranus*, *Panthera tigris sumatrae*, and *Naemorhedus sumatrensis sumatrensis*. Many threatened species are protected by international and national law, however, this seems irrelevant if the survival of their habitat cannot be secured. The study area encompasses large tracts of forest in which we found a highly diverse mammal community. Such diversity coupled with the presence of many primary forest species indicates that the region, if effectively managed, would continue to support these populations. The charismatic image of mammals could be used to provide a solid base for eco-tourism that has the potential to contribute to conservation efforts in the region.

4.2 METHODS

Birds were being located by sight or vocalisation cues and investigated further to attempt identification. Time was not devoted to searching for species in minority niches or at specific altitudes and times. This allowed field time to be concentrated on the mammalian species. No bird, however, was ignored, once encountered although many birds evaded identification due to the dense vegetation.

Observations were made with 8x40 binoculars (BL: 10x50, JM: 7-21x50). Whenever an individual bird or flock was sighted, detailed notes on its appearance, behaviour and locality were made:

- 1) Date and Weather conditions,
- 2) Time,
- 3) Altitude,
- 4) Location (GPS waypoint where possible),
- 5) Species and/or detailed description (including size, shape, coloration, sex and call),
- 6) Height in the canopy,
- 7) Flock composition,
- 8) Interesting behaviour.

Where possible a photographic record of each species was attempted so that species identifications could be verified. All feathers found, and one skull, were collected and identified to species level using the collections of the British Museum of Natural History, Tring.

Species identified with absolute certainty were included in the species list, with uncertain identifications being presented here as a description, and where appropriate, provisionally identified (see Appendix IV).

Species diversity was estimated using the method recommended by MacKinnon and Phillipps (1993), that takes into consideration the intensity of searching effort. A chronologically ordered inventory was produced of all birds recorded in the field. A series of lists was then compiled, the first containing the first 20 species from the inventory, and the subsequent lists containing the next 20 species that appear in the inventory. Each list contains only one record of each species, but the same species may be represented in subsequent lists. Each species was taken to represent either a positively identified species or a unique unidentified but well described bird. The cumulative number of species was then plotted against the number of lists made to produce a species discovery curve. The gradient of the species discovery curve indicates species richness in the area (the higher the gradient the greater the species richness). An extrapolation of the curve provides an indication of the total number of species likely to occur in an area. The number of lists that a species occurs in acts as a good indication of that species abundance in an area.

4.3 RESULTS

Table 4.a: Annotated bird list

Family/species	English name	Altitude range recorded	N	Observed height in canopy (m)	Number of list inclusions
Accipitridae					
<i>Aviceda jerdoni</i>	Jerdon's Baza	1320	1	40	1
<i>Accipiter gularis</i>	Japanese Sparrowhawk	1125	*	*	1
<i>Spilornis cheela</i>	Crested Serpent-eagle	790-1100	1-2	10-30	8
<i>Ictinaetus malayensis</i>	Black Eagle	570-1825	1	I/F	3
<i>Spizaetus cirrhatus</i>	Changeable Hawk-eagle	1290-1510	1-2	20	3
<i>Spizaetus alboniger</i>	Blyth's Hawk-eagle	885	2	20	1
Phasianidae					
<i>Argusianus argus</i>	Great Argus	730	1	C	1
<i>Lophura hoogerwerfti</i> SM	Hoogerwerf's Pheasant	1290-2360	1	0	2
<i>Polyplectron chalcurom</i> SM	Sumatran Peacock-pheasant	1120-1405	1	0	3
Columbidae					
<i>Treron sphenura</i> **	Wedge-tailed Green-pigeon	1040-1320	1-30-40	30	2
<i>Ducula badia</i>	Mountain Imperial Pigeon	1320	1	30	1
<i>Macropygia unchall</i>	Barred Cuckoo-dove	1320	6	30	1
<i>Macropygia ruficeps</i> ^B	Little Cuckoo-dove	725-1825	1-20+	15-35	9
<i>Chalcophaps indica</i>	Emerald Dove	1130	1	0	1
Strigidae					
<i>Otus spilocephalus</i> ^B	Mountain Scops Owl	1655	1	10	1
Cuculidae					
<i>Cacomantis sepulcralis</i>	Rusty-breasted Cuckoo	1715	1	10	1
<i>Phaenicophaeus diardi</i>	Black-bellied Malkoha	980	2	15	1
<i>Phaenicophaeus tristis</i>	Green-billed Malkoha	770-1155	1	5-40	2
Trogonidae					
<i>Harpactes reinwardtii</i> ^{SB}	Blue-tailed Trogon	975-2210	1-2	1-25	10

Family/species	English name	Altitude range recorded	Number of individuals observed together	Observed height in canopy (m)	Number of list inclusions
Apodidae					
<i>Collocalia fuciphaga</i>	Edible-nest Swiftlet	835-1510	5-7	I/F	2
<i>Collocalia esculenta</i>	Glossy Swiftlet	835-1760	1-10	I/F	3
<i>Apus affinis</i>	Little Swift	1950	15	I/F	1
Meropidae					
<i>Merops leschenaulti</i>	Chestnut-headed Bee-eater	934	1	30	1
Bucerotidae					
<i>Anorrhinus galeritus</i>	Bushy-crested Hornbill	1115	3	25	1
<i>Aceros undulatus</i>	Wreathed Hornbill	835-1975	1-4 (30+)	20-30	8
<i>Buceros rhinoceros</i>	Rhinoceros Hornbill	900-2510	1-2	10-15	6
<i>Buceros bicornis</i>	Great Hornbill	1580	2	I/F	1
<i>Buceros vigil</i>	Helmeted Hornbill	910-1460	1-4	30	13
Capitonidae					
<i>Psilopogon pyrolophus</i>	Fire-tufted Barbet	975-2400	1-3	6-45	17
<i>Megalaima oorti</i>	Black-browed Barbet	1080-1635	1-3	10-40	3
Eurylaimidae					
<i>Corydon sumatranus</i> ^B	Dusky Broadbill	890-1080	2-6	10-15	2
<i>Serilophus lunatus</i>	Silver-breasted Broadbill	925-1725	1-4	5-35	4
<i>Psarisomus dalhousiae</i>	Long-tailed Broadbill	860-1405	2-11	5-15	4
Picidae					
<i>Dendrocopos canicapillus</i> ^B	Grey-capped Woodpecker	1915	1	20	1
<i>Blythipicus rubiginosus</i>	Maroon Woodpecker	2055	1	10	1
<i>Picus canus</i> ^B	Grey-headed Woodpecker	1310-1940	1	5-15	4
<i>Picus flavinucha</i> ^B	Greater Yellownape	1155-2400	1-3	5-30	8
<i>Picus chlorolophus</i> ^B	Lesser Yellownape	1480-1915	1-2	10-30	3
<i>Reinwardtipicus validus</i>	Orange-backed Woodpecker	1655	1	10	1
Pittidae					
<i>Pitta schneideri</i> SM	Schneider's Pitta	1175	1	0	1

Family/species	English name	Altitude range recorded	Number of individuals observed together	Observed height in canopy (m)	Number of list inclusions
Campephagidae					
<i>Hemipus picatus</i>	Bar-winged Flycatcher Shrike	750-1920	1-10	2-15	4
<i>Pericrocotus solaris</i>	Grey-chinned Minivet	1140-2280	1-12	10-25	10
<i>Pericrocotus miniatus</i> ^S	Sunda Minivet	1705-1955	3-9	10-20	3
<i>Pericrocotus flammeus</i>	Scarlet Minivet	1510-1800	1-4	10-15	4
Chloropseidae					
<i>Chloropsis cochinchinensis</i>	Blue-winged Leafbird	770-1150	1	2-30	3
<i>Chloropsis venusta</i> SM	Blue-masked Leafbird	1535	1	20	1
Pycnonotidae					
<i>Pycnonotus leucogrammicus</i> SM	Cream-striped Bulbul	1185	2	5	1
<i>Pycnonotus cyaniventris</i>	Grey-bellied Bulbul	725	2	5	1
<i>Pycnonotus tympanistrigus</i> SM	Spot-necked Bulbul	750-1180	3-7	5-10	5
<i>Pycnonotus goiavier</i>	Yellow-vented Bulbul	970-1525	2-3	5-20	3
<i>Pycnonotus brunneus</i>	Red-eyed Bulbul	980	3-7	10-15	2
<i>Alophoixus ochraceus</i> ^B	Ochraceous Bulbul	835-1155	1-3	5-15	5
<i>Alophoixus bres</i>	Grey-cheeked Bulbul	1205	1	1	1
<i>Iole virescens</i> ^B	Sunda Bulbul	975-2260	1-6	2-25	9
Sittidae					
<i>Sitta azurea</i>	Blue Nuthatch	1115-2220	1-3	5-20	23
Dicruridae					
<i>Dicrurus leucophaeus</i> ^B	Ashy Drongo	925-1895	1-2	3-40	13
<i>Dicrurus aeneus</i>	Bronzed Drongo	1135-1820	1-4	5-15	6
<i>Dicrurus remifer</i>	Lesser Racket-tailed Drongo	1155-1955	1-2	4-20	15
<i>Dicrurus sumatranus</i> SM	Sumatran Drongo	860-1795	1-2	7-35	11
Paridae					
<i>Parus major</i>	Great Tit	1320-1510	1-2	5-25	8
Oriolidae					
<i>Oriolus cruentus</i> ^B	Black-and-Crimson Oriole	975-1850	1-2	7-35	9
<i>Irena puella</i>	Asian Fairy Bluebird	835	2	10	1

Family/species	English name	Altitude range recorded	Number of individuals observed together	Observed height in canopy (m)	Number of list inclusions
Corvidae					
<i>Cissa chinensis</i>	Green Magpie	1120	1	5	1
<i>Dendrocitta occipitalis</i> SM	Sumatran Treepie	925-2270	2-3	10-20	21
Timaliidae					
<i>Malacocincla malaccense</i>	Short-tailed Babbler	975	1	0	1
<i>Napothera epilepidota</i> ^B	Eye-browed Wren Babbler	1670	1	1	1
<i>Pnoepyga pusilla</i> ^B	Pygmy Wren Babbler	1905-1970	1-2	0-1	3
<i>Stachyris nigriceps</i>	Grey-throated Babbler	1110-1780	1-4	0.5-1	4
<i>Stachyris striolata</i> ^B	Spot-necked Babbler	1175-1680	1-6	1-5	3
<i>Heterophasia picaoides</i> ^B	Long-tailed Sibia	975-2410	1-6	15-45	16
<i>Garrulax palliatus</i> ^{SB}	Sunda Laughing Thrush	1040-2285	1-20	3-40	11
<i>Garrulax leucolophus</i> ^B	White-crested Laughing Thrush	910-1780	1-4	2-20	8
<i>Garrulax lugubris</i>	Black Laughing Thrush	900-1700	2-20	5-20	9
<i>Garrulax mitratus</i> ^B	Chestnut-capped Laughing Thrush	750-2055	2-15	2-35	21
<i>Leiothrix argentauris</i> ^B	Silver-eared Mesia	1110-2275	2-10	1-15	8
<i>Pteruthius flaviscapis</i>	White-browed Shrike Babbler	2070	1	5	1
Turdidae					
<i>Copsychus saularis</i>	Magpie Robin	905	1-2	1-2	2
<i>Enicurus velatus</i> ^S	Lesser Forktail	970-1795	1-2	0	5
<i>Enicurus leschenaulti</i>	White-crowned Forktail	1185-1615	1-2	0-3	3
<i>Myiophoneus melanurus</i> SM	Shiny Whistling Thrush	1075-1915	1-2	1-5	4
<i>Myiophoneus glaucinus</i> S(M)	Sunda Whistling Thrush	1040-1915 (1655-2220)	1 (1-2)	0-1 (2-10)	2 (4)
Sylviidae					
<i>Seicercus montis</i> ^B	Yellow-breasted Warbler	1475-2320	1-4	2-25	9
<i>Abroscopus superciliaris</i>	Yellow-bellied Warbler	975-2220	1-8	1-35	7
<i>Phylloscopus trivirgatus</i>	Mountain Leaf Warbler	1775-2270	1-2	7-25	3

Family/species	English name	Altitude range recorded	Number of individuals observed together	Observed height in canopy (m)	Number of list inclusions
<i>Cettia vulcania</i>	Sunda bush Warbler	2255-2740	1-2	0.5	2
<i>Orthotomus cucullatus</i>	Mountain Tailorbird	1175-2105	1-6	1-5	8
Muscicapidae					
<i>Eumyias indigo</i> ^{SB}	Indigo Flycatcher	1110-2220	1-2	2-20	11
<i>Ficedula solitaria</i>	Rufous-browed Flycatcher	1470-1820	1	0.5-1	2
<i>Ficedula hyperythra</i>	Snowy-browed Flycatcher	1540-2025	1-2	0.5-10	4
<i>Ficedula westermanni</i>	Little Pied Flycatcher	1485-1985	1-2	2-15	5
<i>Culicicapa ceylonensis</i>	Grey-headed Flycatcher	1110-2205	1-5	2-20	21
<i>Niltava grandis</i>	Large Niltava	1105-1175	1-2	2-20	6
<i>Niltava sumatrana</i>	Rufous-vented Niltava	2220-2225	1	10	1
<i>Cyornis concreta</i>	White-tailed Blue Flycatcher	1225	1	5	1
<i>Rhipidura albicollis</i>	White-throated Fantail	1115-2220	1-3	1-25	17
<i>Philentoma pyrhopterum</i>	Rufous-winged Philentoma	1140	1	10	1
Motacillidae					
<i>Motacilla cinerea</i>	Grey Wagtail	835-1775	1-4	0	13
Nectariniidae					
<i>Aethopyga temminckii</i> SM	Temminck's Sunbird	1110-2350	1-2	2-35	11
<i>Arachnothera longirostra</i>	Little Spiderhunter	975	1	5	1
Dicaeidae					
<i>Dicaeum concolor</i>	Plain Flowerpecker	2020	1	25	1
Zosteropidae					
<i>Zosterops palpebrosus</i>	Oriental White-eye	1205-1510	1-2	3	2
<i>Zosterops atricapilla</i> ^B	Black-capped White-eye	2285	3	10	1
<i>Zosterops montanus</i>	Mountain White-eye	1930	4	2	1
Ploceidae					
<i>Lonchura maja</i>	White-headed Munia		6	1	1

Family/species	English name	Altitude range recorded	Number of individuals observed together	Observed height in canopy (m)	Number of list inclusions
Fringillidae					
<i>Serinus estherae</i> ^B	Mountain Serin	2530	10-20	15	1

Key

- ^M Endemic to mainland Sumatra.
^S Endemic of the Sunda islands.
^B Endemic sub-species of mainland Sumatra.
* Skull and wing feathers collected from an old carcass - see birds of special interest.
** Species identified by feathers with help from poor quality sightings - see birds of special interest.
() Data in brackets relates to the sub-species *Myiophoneus glaucinus castaneus* - see birds of special interest.

In total 105 species were identified during the 91 days in the field (Table 4.a). A further 15 species remain unidentified (Appendix IV). An additional 15 species were identified outside of the forest, a list of which can be seen in Appendix III. Seven forest species and one non-forest species recorded are classified as Red Data Book species (Groombridge 1996) (Table 4.b). Sixteen species endemic to the Sunda region were recorded, 10 of which are endemic to the island of Sumatra itself (see Table 4.a). Twenty four sub-species endemic to Sumatra were also recorded (see Table 4.a) including one endemic to Aceh; *Leiothrix argentauris rookmakeri*. This number may be increased to 25 should *Myiophoneus glaucinus castaneus* be recognised as a sub-species (see birds of special interest).

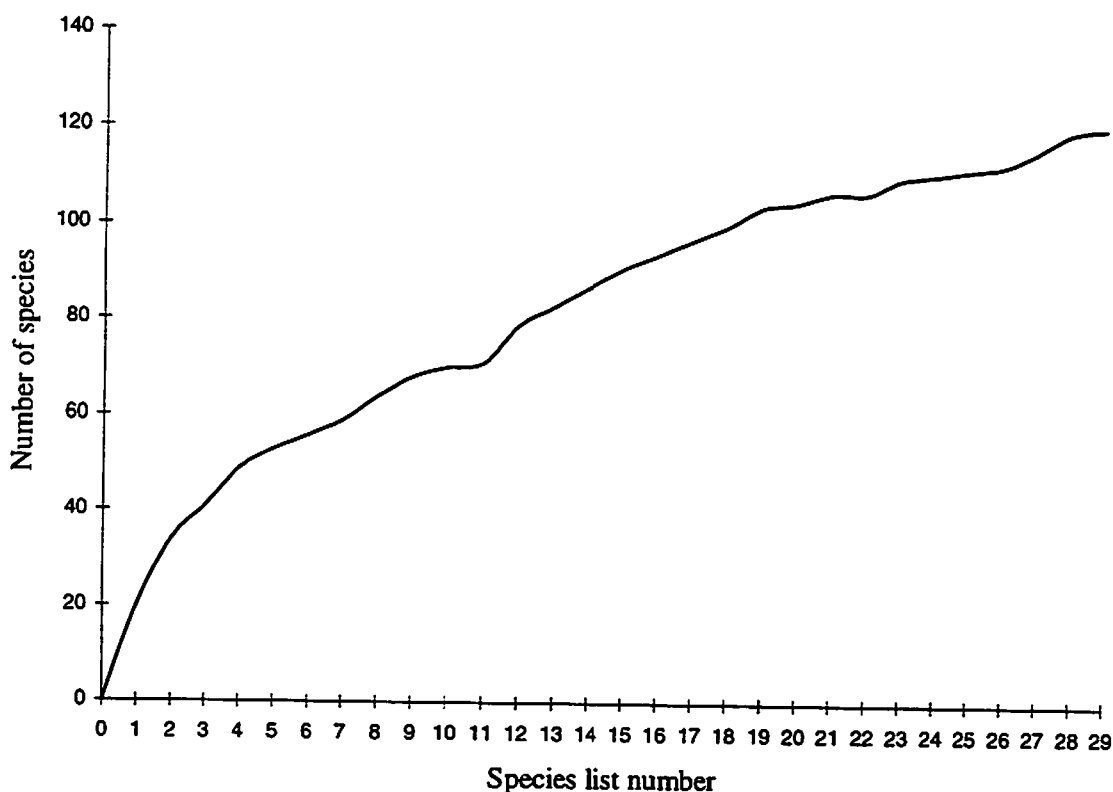
Table 4.b: Names and status of Red Data Book species found in the study area.

Forest species

<i>Aviceda jerdoni</i>	Jerdon's Baza	Lower risk: near threatened
<i>Lophura hoogerwerfi</i>	Hoogerwerf's Pheasant	VU B1+2c, C1+2a
<i>Polyplectron chalcurum</i>	Sumatran Peacock-pheasant	Lower risk: near threatened
<i>Buceros vigil</i>	Helmeted Hornbill	Lower risk: near threatened
<i>Pitta schneideri</i>	Schneider's Pitta	VU C1+2a
<i>Chloropsis venusta</i>	Blue-masked Leafbird	Lower risk: near threatened
<i>Pycnonotus tympanistrigus</i>	Spot-necked Bulbul	VU C1+2a
<i>Dicrurus sumatranus</i>	Sumatran Drongo	Lower risk: near threatened
Non-forest species		
<i>Leptoptilos javanicus</i>	Lesser Adjunt	VU C1

4.3.1 Species richness

Fig. 4.a: Species discovery curve



A total of twenty nine species lists were completed, and were plotted against the 120 species recorded to produce a species discovery curve for the Beutong region (Fig. 4.a). The number of list inclusions was also plotted for each species where more than five records were obtained (Fig. 4.b). From this graph it is possible to see that the most readily recorded species was the Blue Nuthatch (*Sitta azurea*) with 23 list inclusions. This was followed by the Sumatran Treepie (*Dendrocitta occipitalis*), Chestnut-capped Laughing Thrush (*Garrulax mitratus*) and Grey-headed Flycatcher (*Culicicapa ceylonensis*) with 21 list inclusions. The White-throated Fantail (*Rhipidura albicollis*) and Fire-tufted Barbet (*Psilopogon pyrolophus*) were the next most readily recorded species with 17 list inclusions.

4.3.2 Birds of special interest

Jerdon's Baza (*Aviceda jerdoni*)

Although recorded from Lhokseumawe in Aceh by Pam and Jack Stewart (van Marle & Voous 1988), this species was not included in the bird list of the Gunung Leuser National Park (Wind 1996) and is described in Holmes (1996) as "unaccountably rare". It was observed in study site A (JM, CB, JB) every morning and evening for four consecutive days (25th-28th August) on a perch 40 m above camp (N 04^o38'244"; E 096^o38'508"). Each sighting was lengthy, allowing a detailed description to be taken and a direct comparison with the field guide (MacKinnon and Phillipps 1993) to be made. The call of the bird was heard every morning and often in the

evening. The perch overlooked a large clearing made by a mineral spring, over which the bird was seen in flight. When over the forest, the bird flew very close to the canopy.

Description: Length 45-50 cm. Dark brown on back and upperwing; rufous barring on the belly and on the underwing coverts; prominent long, black crest with white tips usually held erect; when sitting upright the wing tips were almost on a parallel with the end of the tail; feet and legs yellow; call being a two noted whistle, the second note fading away.

Japanese Sparrowhawk (*Accipiter gularis*)

Recorded throughout the mainland of Sumatra (van Marle & Voous 1988), but not included in the bird list of the Gunung Leuser National Park (Wind 1996). A skull and wing feathers were collected from an old carcass of an adult female on 18th August (BL) above the river Barou in study site B (near N 04^o28'795"; E 096^o38'561"). These were identified using the collections of the British Museum of Natural History, Tring. The skull was identified to genus level, then all Sumatran species bar *A. gularis* and *A. trivirgatus* were eliminated (skulls of these species were not housed at the museum). Skins were then used to eliminate *A. trivirgatus*, which is significantly larger than *A. gularis* and possesses less barring on the wings.

Skull measurements: Zygomatic breadth 27.8 mm
Condylbasal length 37.3 mm
Postorbital constriction 12.0 mm

Grey-bellied Bulbul (*Pycnonotus cyaniventris*)

Recorded from Aceh (Kloss 1931), but few records of this species are available (van Marle & Voous 1988). This species was not included in the bird list of the Gunung Leuser National Park (Wind 1996). This species was seen once on 25th August by BL along Mengajah road at an elevation of 725 m in a flock of five individuals.

Description: Length 15 cm. Black or dark grey crown, nape, ear coverts, throat and breast with a lighter grey belly; mantle, back and upperwing green/yellow; vent bright yellow.

Schneider's Pitta (*Pitta schneideri*)

Holotype collected from Mt. Sibayak in Aceh by Hatert (1909), but only recorded once since then in Aceh by N. Bostock who heard it near Berastagi (see van Marle & Voous 1988). A male of this species was observed intermittently for 20 minutes by JM on 5th October at 1175 m in an open area of forest next to the river Uwis (study site D). It moved in a punctuated fashion, running for 5-10 m before stopping. The same bird was thought to have been seen with a female, by Pak Zulkarnain at a nearby location, previous to JM's sighting.

Description: Length 15-20 cm. Very deep orange forehead, crown and nape; white throat; black band below throat and nape; brown chest, belly and vent; metallic blue back, rump, uppertail coverts, tail, tertials and secondaries; black primaries.

Hoogerwerf's Pheasant (*Lophura hoogerwerfi*)

Females collected in Aceh by Hoogerwerf in 1937 and 1939 (Chasen and Hoogerwerf 1941) and by de Schauensee & Ripley (1940). Regularly seen and recorded using automatic camera-traps in the Mamas valley by Nico J. van Strien. Male seen by JB in study site F for about 10 seconds from the side then a brief view from the back on 16th October at 1290 m (N 04^o35'445"; E 096^o30'179"). Female seen by BL in study site C on 10th September on ridge above the river Jagong (N 04^o19'678"; E 096^o52'347") at 2360 m in dense montane forest with little

undergrowth. Whilst only one individual was seen, at least two others were known to retreat into the forest, from alarm calls heard and moving vegetation.

Description: Length 40-50 cm. Male: Black body with blue shine and a fanned tail; bill and legs of dark coloration; bare red skin surrounding eye with yellow streak behind the eye but within the red patch. Female: Uniform dark brown with fine patterning of black; bare red skin surrounding eye with yellow streak behind the eye; bill and legs of dark coloration.

Mountain Serin (*Serinus estherae*)

Collected by Hoogerwerf in 1937 (Chasen 1939) and by Ripley in 1939 (Schauensee, 1939a) on Mt. Leuser. Only one record since in 1978 near the upper Mamas Valley (see van Marle & Voous 1988). A flock of between 10 and 20 individuals were seen by JM in study site C on 8th September moving noisily in low trees on top of a ridge above the river Jagong at an elevation of 2530 m (N 04°17'542"; E 096°52'181").

Description: Length 10 cm. Forehead yellow; white lores; black nape, mantle, chin and throat; breast and vent flecked with black; white belly; wings black with three heavy transverse yellow wing bars; tail black and slightly forked; yellow rump and tail coverts.

Blyth's Hawk Eagle (*Spizaetus nipalensis*)

No breeding record from Sumatra (van Marle & Voous 1988). One pair seen from the Mengajah road mobbing a Crested Serpent Eagle by BL, JM and JB on 2nd August at 885 m (N 04°26'464"; E 096°32'288"). No nest site was observed, but the behaviour exhibited was indicative of a breeding pair.

Rhinoceros Hornbill (*Buceros rhinoceros*)

This species was regularly seen, being included in six species lists. All records were from above the previously published altitude range of up to 800 m (van Marle & Voous 1988). One sighting of a perched Rhinoceros Hornbill by JM and JB was at 2510 m above the river Jagong.

Spot-necked Bulbul (*Pycnonotus tympanistrigus*)

This poorly known Sumatran endemic has been rarely recorded, but has one previous record from Aceh (Schauensee & Ripley 1940). It was seen on five separate occasions with very good, clear and lengthy sightings by BL, JM and JB. Sightings were between 750 and 1180 m, extending the previously recorded altitude range by 180 m.

Sunda Whistling Thrush (*Myiophoneus glaucinus*)

This species was seen in study site C on two occasions; the first by BL on 18th August at 1040 m lasting between 3 to 5 minutes during which the bird was seen in excellent light, foraging on the ground 10 m away across the river Baru. The second sighting was by JM, JB and CB on 4th September by the river Jagong at 1915 m. Due to the nature of this species, this individual was also observed for a prolonged period of time allowing for a detailed identification to be made. The description of this species fits exactly with the description of *M. g. castaneus* in (MacKinnon and Phillipps 1993). A variation on this description was seen on six occasions with BL, CB, JM, K and JB all observing it for a total time in excess of 30 minutes. It was included in four lists as *M. glaucinus*. The description fits that of *M. castaneus* (Ramsay 1880), except that the blue on the upper body was spangled. Colour slides of poor quality were obtained by JM and BL. Delacour (1947) reviewed the Whistling Thrushes and concluded that only *M. glaucinus* should be recognised, van Marle & Voous (1988) regard *M. g. castaneus* as a distinct

form and suggest that it may be better treated as a separate species, whereas MacKinnon and Phillipps (1993) suggest treatment as allospecies. All birds seen in this study fitted the description of *M. g. castaneus*, but six of the eight sightings involved birds with spangles; the lack of which distinguish this species from other whistling thrushes according to MacKinnon and Phillipps (1993). It seems that this species is highly variable in plumage and care should be taken in evaluating its taxonomic status using plumage. Perhaps, as suggested by Holmes (1986), song comparisons would be more satisfactory.

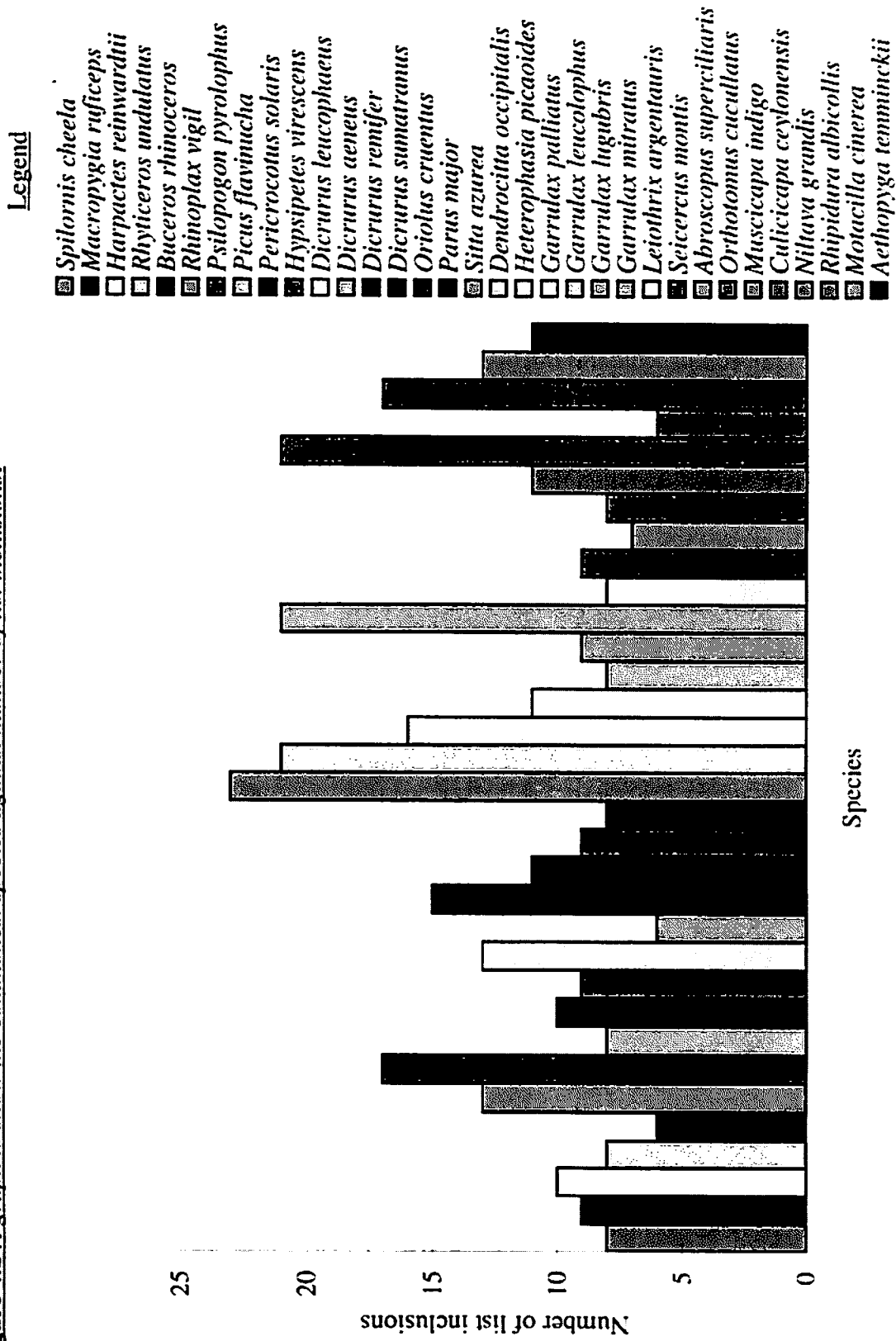
Description of spangled form: Length 25 cm. Forehead, crown, ear coverts, nape, mantle, chin, throat and breast deep, metallic blue with patches that shone lighter when caught by the light; upperwing, tail belly and vent dark brown; shoulders and supercilium bright metallic blue; eye, bill and legs black; tail with blue sheen down the centre.

Wedge-tailed Green-pigeon (*Treron sphenura*)

Green-pigeons were seen in flight by all members of the team as large flocks of up to 30-40 individuals inhabiting the canopy around the numerous mineral springs found throughout the study area. It is believed that this record may constitute many species as brief sightings often contradicted each other. It is recorded here as one species due to only one clear sighting and the identification of one feather. Seen (BL and JM) in study site B on 18th August at 1005 m in primary forest around a mineral spring, just before dusk when flocks started to roost.

Description: Length 30 cm. Yellow/green chest; yellow vent; barring on underside of tail; wings grey with green/yellow flashes (Seen from underneath, 30 m up in canopy and in failing light, so colours may not be accurate).

Figure 4.b A graph to show the commonest species against number of list inclusions:



4.4 DISCUSSION

The results presented here indicate that the forests of Beutong are extremely rich in avian fauna. This is shown by the total of 120 species seen during just 97 days of opportunistic observations. The angle of the species discovery curve shown in Figure 4.a shows the rate at which new species were found. This angle is slightly steeper than that produced for the Baluran reserve in Java (see MacKinnon and Phillipps 1993) which hosts over 200 species. These findings suggest that the Beutong region may support well over this total.

The methods employed in finding new species were very limited; no minor habitats or strata in which it was difficult to see birds were searched and only the Colline subzone, sub-montane and montane altitudinal vegetation zones (van Steenis 1972, 1984) were investigated. The bias to gregarious, conspicuous and noisy species, along with species that inhabit the middle strata of the forest (where visibility for the observer is at its greatest) is shown by the most common species recorded (see Figure 4.b). If these factors are taken into consideration, it can be suggested that the species discovery curve for this region should be much steeper, and so the total species numbers may therefore be even higher than our study suggests.

The area is very rich in endemic species with 16 out of the 50 Sunda endemics and 10 of 14 species endemic to the Island of Sumatra recorded. In addition to hosting many endemics, 7 Red Data Book species were recorded, testifying to the importance of the area and the need for its conservation.

The Rufous-tailed Shama (*Trichixos pyrrhopygus*) is the Aceh symbol for conservation, yet is a favourite cage bird amongst local people. Despite this accolade no sign of this conspicuous songbird was found by our study although much time was spent in primary forest of a suitable altitude. Numbers within the study area may be severely depleted because of the demand for this species as a cage bird. Being the region's conservation symbol, this does not bode well for the future of the region's avian fauna. Many birds were seen being shot at the edge of the forest to supply the local demand for meat. In addition, a large proportion of local houses are adorned with bird cages containing locally caught birds. Urgent action is required to halt the destruction of the wealth of bird life in the Beutong region before it is too late.

The recording of three species (*Aviceda jerdoni*, *Accipiter gularis* and *Pycnonotus cyaniventris*) not recorded in the Gunung Leuser National Park, the first sighting of *Pitta schneideri* in Aceh since 1909 and observations of poorly known species such as *Pycnonotus tympanistrigus*, *Lophura Hoogerwerfi* and *Serinus estherae* re-enforces both need for further ornithological work and conservation action to be conducted in the Beutong region of Aceh, Sumatra.

5.0

HERPETOLOGY STUDY

ABSTRACT

An attempt was made to identify all species of herpetofauna encountered. Five snakes, one tortoise and four lizards were identified, if not to species level, to family group. Three species are included in the IUCN Red Data or CITES list, and three have not previously been recorded near the study site.

5.1 INTRODUCTION

The herpetology of Sumatra is vastly understudied. There are therefore very few records of collections or studies that relate to Aceh province. The herpetology list for the Gunung Leuser National Park is, according to the authors, far from complete (Supriatna and Sidik 1996), highlighting the lack of research being done on this taxonomic group in the region and Sumatra as a whole. This study, although not primarily a herpetology study, tried to identify reptiles once encountered.

5.1.1 OBJECTIVE

- To produce a species list for the Beutong forests.

5.2 METHODS

Herpetofauna data was gathered opportunistically. Once encountered, detailed notes on appearance and locality were taken, and a photographic record obtained to aid in identification. Identification of snakes was made by Dr. Colin McCarthy of the British Museum of Natural History; and the lizards by Daniel Benett of the University of Aberdeen.

5.3 RESULTS

5.3.1 ORDER SERPENTES FAMILY PYTHONIDEA

Python reticulatus (Schneider, 1801)
Reticulated Python (Ular Sanca, Ular Sawah)
CITES: Appendix II
Distribution: India through SE Asia to Sumatra.

Identified from two localities: 17th August on the ground near a mineral spring (N 04°28'822"; E 096°38'456"), in study site B (CB and K), and 22nd August on the ground above A. Baru (N 04°29'300"; E 096°36'200") in study site A (JB, K, CB, BL, JM).
Photographic record obtained by CB and K.

FAMILY VIPERIDAE SUBFAMILY CROTALIDAE

Trimeresurus wagleri (Wagler 1830)
Wagler's Pit Viper (Ular cinto mani)
Distribution: Thailand, Malaysia, Philippines and Indonesia.

Recorded by BL and K in study site A on 27th August (N 04°28'133"; E 096°36'756"). Seen in dense scrub in the Baru valley at the elevation of 1005 m. Photographic record obtained by BL.

FAMILY COLUBRIDAE
SUBFAMILY PAREATINAE

Pareas carinatus carinatus (Wagler 1830)

Distribution: China south to Indonesia.

Recorded by BL, JB and K on 21st July at 910 m, near A. Baru (study site A). Photographic record obtained by BL. Previously recorded from Aceh including Bohorok (David and Vogel 1996), but not included in the list for Taman National Gunung Leuser (Supriatna and Sidik 1996).

Aplopeltura boa (Boie 1828)

Distribution: Myanmar, Thailand, Malaysia, Philippines and Indonesia.

Recorded by CB, JB, JM and K on 27th August at 1300 m (study site A) (N 04°26'700"; E 096°38'200"). Photographic record obtained by JM. Identified to genus level with confidence, species classification is tentative. Previously recorded from Brastagei, Pis-Pis and Peudawa (David and Vogel 1996), but not included in the list for Taman National Gunung Leuser (Supriatna and Sidik 1996).

SUBFAMILY COLUBRINAE

Lycodon species.

Three species of this genus occur on Sumatra, *L. capucinus*, *L. effraenis* and *L. subcinctus*. Identified by JM and BL on 13th September at 2000 m, on the ridge above A. Jagon (study site C). A photographic record was obtained by JM, but identification to species level could not be achieved with confidence. Previously recorded from Aceh (David and Vogel 1996), but not included in the list for Taman National Gunung Leuser (Supriatna and Sidik 1996).

5.3.2 ORDER LACERTILIA

FAMILY VARANIDAE

Varanus species.

Monitor species (Biawak)

CITES: Appendix II

Recorded by JB, JM, BL, CB and K on 15th August by the side of the road between Ankup and Brawanggeding. Photographed by JM.

FAMILY AGAMIDAE

Calotes emma

(not confirmed)

Bronchocela hayeki

(not confirmed)

Gonyocephalus spp.

(not confirmed)

5.3.3 ORDER TESTUDINATA FAMILY TESTUDINATA

Manuria emys (Schlegel and Muller 1840)

Asian Brown Tortoise, (Baning, Kura-Kura)

IUCN: VU A1cd

CITES: Appendix II

Distribution: India through SE Asia, to Indonesia.

Seen many times by all in study sites A, B and F. All localities were by water Photographed on 16th, 22nd and 25th August.

5.4 DISCUSSION

Five species of snake, one tortoise and four lizards were identified to at least family level. *M. emys* is classified as vulnerable by IUCN as well as being protected by CITES, the species of *Varanus* and *P. reticulatus* are also protected by CITES. *A. boa*, *P. carinatus*, the species of *Lycodon*, *C. emma* and *B. hayeki* are all not included in the species list for Taman Nasional Gunung Leuser, although the last two species are unconfirmed identifications.

Field studies were concentrated on mammals so no effort was made to try to catch or identify reptiles in the field. As a consequence one snake and two lizards could not be identified and doubtless many species went unnoticed as little effort was spent looking for them. Although work is currently being carried out, extensive and immediate research needs to be undertaken on the herpetology of Aceh and Sumatra to establish distributions and status so that effective conservation management plans can be compiled and put in place.

CONCLUSIONS

Populations of tiger, elephant and orang-utan were present in the study area. No fresh signs of rhino were encountered and it is speculated that this species has been poached out of the area within the last decade. In total 27 mammal species (14 threatened), 105 bird (7 threatened), 5 snakes, 1 tortoise (threatened) and 4 lizard species were identified in 91 days in the field. New localities for *Rafflesia arnoldii atjehensis* and *Amorphophallus gigas* were identified. These figures highlight the rich biodiversity of the Beutong region. When the large proportion of Sumatran sub-species and endemics is also taken into consideration, the full extent of the importance of this area as a refuge for endangered and limited range species becomes apparent.

Despite the presence of much agriculture and development within the study area, large expanses of forest cover still exist. Much of this forest was shown to be of primary classification, little impacted by human activities, which are localised around development hotspots. By cataloguing the activities of humans within the forest, it was shown that only the forest edge was greatly effected by mans presence, with fishing and hunting seeming to having the greatest impact on the wildlife communities. Much development has occurred in the study area since 1978, especially around the Jeget-Jagon Transmigration Project. This lowland region where the Transmigration Project was established, is believed to be where the traditional migration route of the resident elephant population passed. This study found no evidence of a migration route in use though the study area.

Three roads were found to cut though the forest, all of which were undergoing improvements. The presence of roads, in itself, does not necessarily damage forest integrity. However, as soon as agriculture starts to occur alongside these roads, the passage of many animals between the newly formed fragmented areas of forest is prevented. If agricultural development around the Mengajah, Rumahbaru and Perlak roads continues the forest will be divided into isolated pockets. This will result in large populations being reduced to small, non-viable populations. In order to protect the region's forests it is imperative that the development along these roads is halted. As these roads have only two access points, such enforcement should be possible with little effort.

Parts of the forest in the study area have been designated for conversion to agriculture and settlement. One such conversion surrounds the Jeget-Jagong Transmigration area. An area of forest sufficient to complement nearby protected areas in their conservation efforts can still exist in Beutong, providing this transmigration area only expands to its designated limits. An area of forest west of the Jeget-Jagong Transmigration area is designated for conversion to plantation. This area includes study sites A and B, which we found to contain a diverse wildlife community centred around the many mineral springs. Elephants were shown to be using this area to feed, and presence of both tiger and orang-utan was confirmed. If converted, the movement of populations between the Leuser Ecosystem and the forests in the north of the study area will be prevented. This has serious implications, particularly regarding the elephant and tiger populations, which require large continuous expanses of suitable habitat for their continued survival

The findings of this study have highlighted specific threats to the Beutong forests and its wildlife. If these threats are not addressed then total destruction of these forests is imminent. This study recommends that the following courses of action to prevent forest destruction be considered:

- 1) Upgrade the protective status of the forest beyond the designated limits of the transmigration conversion zones.
- 2) Prevent agricultural development along the Mengajah, Rumahbaru and Perlak roads.
- 3) Oppose the proposed conversion of forest between Angkup, Gunung Mengajah and Isaq to plantation.

Protection of the forest should not result in the total exclusion of humans. A mutually beneficial arrangement would allow sustainable use of the forest. For example harvesting quotas for fish, rattan and other forest products could be issued allowing economic gain from the forest. By allowing sustainable forest use, a buffer zone for deeper parts of the forest could be maintained, whilst enabling local people to benefit from the forest.

Protection of the Beutong forests would most effectively be achieved by their inclusion in either the Leuser Ecosystem or Linga Isaq reserve. With the wealth of charismatic mammals, birds and plants, the region could develop itself as centre for eco-tourism, helping to finance its conservation and management.

Vulnerable areas such as the Beutong region could prove to be the difference for many species between extinction and survival. Our results show the forests of Beutong to be highly diverse in terms of mammals, birds and plants, with the presence of many vulnerable species being confirmed. The region is the only forested link between the Leuser Ecosystem and the forests north of the Mengajah and Rumahbaru roads. If the area is protected, however, a continuous belt of protected forest will exist stretching over 200 km along the spine of the Barisan mountain range in the province of Aceh.

In conclusion, the region is a diverse biogeographical unit that will be lost if current trends continue; to prevent this, an upgrading of the protective status of the forest outside the Leuser Ecosystem, as well as strict enforcement of the whole area, are urgently required.

7.0

LOGISTICS

7.1 PRELIMINARY RESEARCH AND TRAINING

A reconnaissance trip was made to Indonesia in 1995 by CB and JB to visit organisations and find a logistically feasible study area. This was invaluable as an up to date understanding of the situation regarding research, visas, possible funding and collaboration with a Indonesian university was acquired. On return to the U.K. further research was carried out into the study species and appropriate survey techniques, using the University of Bristol, the British Museum and the Natural History Museum libraries. Maps were acquired from Bakosurtanal, Bogor, Indonesia and local information was supplied by LMU.

Courses were attended on expedition medical training and mammal survey techniques, run by the Royal Geographical Society.

7.2 PERMISSIONS

Research permits were applied for one year before the departure date. Acquisition of these permits was aided by the project's Liaison Officer, Mr. S. Oliver and Prof. H. Putro (IPB) prior to our arrival. It took us one and a half weeks to visit all appropriate offices in Jakarta and then a further 2 weeks in Banda Aceh (regional permits) and Medan (local permits). These permits lasted for 3 months, from which time they had to be renewed every month, which reduced fieldwork time.

7.3 FINANCES AND FUND-RAISING

Fund-raising was begun by applying to organisations, which proved successful after some effort, with organisations donating in total £6,914. Closer to home T-shirt sales and a raffle were organised. The public were informed and involved by carrying out fun runs and collections with the aid of a rhino costume, courtesy of Save the Rhino International. These efforts proved very successful, and organised all over the country in locations that attracted interested people (e.g. International Travellers World Fare, Woburn Wild Animal Park). These attempts in all raised £8,068 helped by publicity in a number of local newspapers (Banbury Guardian, Banbury Cake, Stratford Herald, Western Daily Press). Including the project member's donations of £500 each the total raised was £18,428. Full details on funding can be found below in the Budget and Acknowledgements sections.

Organisations that gave products in kind or at reduced prices included (inc. raffle prizes): Zeneca Pharmaceuticals (malaria medication), Psion, Heliair (Warwicks), Mr. P. Meecham (Balloon pilot), Howletts/ Port Lympne Wild Animal Park, P.P. Thornton (administration costs).

Some of these funds were taken to Indonesia as travellers cheques for the initial period until a bank account was set up with BNI Bank, Jakarta. The project expenses can be found in the Budget section.

7.4 BUDGET

7.4.1 Income

Organisations:

Netherlands Foundation for International Nature Protection (van Tienhoven Foundation),	£1564
Lindeth Charitable Trust,	£1000
University of Bristol and Alumni Foundation,	£1000
People's Trust for Endangered Species,	£500
Friends of Conservation,	£500
L. & D. Seccombe Charitable Trust,	£500
A. J. Burton 1956 Charitable Trust,	£500
Gilchrist Educational Trust,	£400
Mammal Society,	£250
Care For The Wild International,	£250
Wall Charitable Trust,	£200
Institute of Biology,	£150
Tysoe Utility Estate.	£100

Personal donations

Mr. M. Burton, Mr. G. Moore, Mrs. S. Harland, Mrs. L. Mitchell, Mrs. J. Moore, Mrs. R. Campbell, Mr. McKeon, Mr. M. Appleton, Mrs. Cochrone, Mr. Cubit, Mrs. M. Thornhill, Mr. and Mrs Burton, Mr. and Mrs Bloxam, Mr. and Mrs Long, Mr. and Mrs McPherson and everyone else (too many to mention by name) who helped us with their generosity	£1340
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Company donations

(Nash Fisher, Guard D'Oyly, Teak Tiger Trading Company)	£170
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Collections

£6073

Fun runs

(Banbury Water Softeners, Anker & Partners, Banbury, and individuals)

£995

Raffle

£760

T-shirt sales

£240

Expedition Member's contributions

(£500 each)

£2000

Total Funds Raised

£18,492

7.4.2 Expenditure

In UK

Administration:	
Postage, fax & telephone	£425
Proposal production	£200
Fundraising	£401
Insurance	£1000
Visas	£250
Liason officer	£150
Training	£250
Travel (Flights)	£2765
Equipment:	
Medical	£440
GPSs (3) & antennae	£689
Maps	£150
Portable computer	£510
Books	£170
Films & camera accessories	£475

Indonesia (Jakarta, Banda Aceh & Medan)

Internal travel:	
Public Transport	£265
Flights (5 returns to Medan)	£700
Living costs (accommodation, food)	£910
Visas(& renewals)	£300
Communication	£250
Equipment	£425
Bank's commission & loss with fall of Rupiah	£375

Fieldwork (inc. Takengon town)

Travel (fuel & repairs)	£625
Living costs (accommodation, food)	£3100
Communication	£210
Personnel:	
Counterpart	£595
Guides (4)	£1155
Driver	£815
Plant Identifiers (Sumatra & Java)	£350

Post-fieldwork

Administration	£300
Report publication	£250
Total Expenditure	£18,500

7.5 TRAVEL

Two of the U.K. members travelled to Jakarta with Kuwait Air, and then to Medan with our Indonesian counterpart on Merpati Airways. The two other UK members flew to Jakarta and then directly on to Medan. Travel to the nearest town to our study area (Takengon) and to the study sites was by 4x4 vehicle loaned to us by LMU. This vehicle was essential as logging roads were the only way of accessing many areas and buses only used a few of the roads. At all other times public transport was used.

7.6 SAFETY AND MEDICAL PRECAUTIONS

Expedition insurance was taken out with Alexander & Alexander(UK) Ltd., this covered our equipment and any costs incurred due to medical emergencies. However, no claims were made on our return. The state of the political situation was noted regularly, especially information from our Liaison Officer and contacts in northern Sumatra.

The main difficulty to be overcome was the isolation of the team when in the field. No radios suitable to our use could be found, so instead group numbers were made large enough to allow a group to divide in an emergency. Also pick-up times by the vehicle were carefully organised with our driver, who would have reported to LMU if the meeting had not occurred. Other possible dangers of the forest were minimised because of our experienced guides from LMU.

Medical precautions taken included training by CB (Wilderness Medical Training and First Aid) and BL (First Aid). Literature was taken into the field on all occasions (Medicine for Mountaineering & other wilderness activities. Edited by James A Wilkerson, MD). The following vaccinations were acquired by all members: Cholera, Diphtheria, Hepatitis A, Meningitis, Polio, Rabies, Tetanus and Typhoid. As some of the areas visited were reported to be malarial a course of antimalarial tablets were taken (Paludrine 100mg and Nivaquine 150mg). A comprehensive medical kit was taken into the field (see section 7.6.2) as well as individual first aid kits.

7.6.1 Medical Conditions Encountered

One expedition member contracted Paratyphoid, which was diagnosed in a hospital in Medan after a urine and blood test. On 18th July Flue-like symptoms became apparent including temperature reaching 103.5°, aching joints, fatigue and loss of appetite followed by difficulty swallowing, mild dehydration vomiting and loose stools. The patient slowly recovered over a period of about 3 weeks, when they were declared fit by the doctor. Medication prescribed Tarrid-4-quinolone ofloxacin 200mg. Precautions were taken to avoid infecting other members of the group (Not sharing food or water hand washing etc.)

On 1st September it was discovered that an injury on the right knee, sustained on 18th August had become infected. The wound was regularly irrigated, and extensive attempts to remove the roots of infection were made. The patient, after three days had a slightly elevated temperature, and was prescribed prophylactic antibiotics (to prevent septicaemia). A slight fever suggested minor septicaemia which was brought under control by antibiotics. An abscess developed to the right of the original injury, which was drained on 12th September. (Antibiotics: Flucloxacillin).

There were the usual mild diarrhoea which usually were not treated except with fluids. A couple of times it was treated with one tablet of Ciprofloxacin, and dehydration fluids were taken a couple of times.

7.6.2 Medical Kit List

Analgesics (Tablets):

Aspirin 300mg, Paracetamol 500mg, Ibuprofen 400mg, Paracetamol/Codeine 500/13.5mg, Tramadol 100mg.

Antibiotics (Tablets):

Augmentin 375mg, Ciprofloxacin 250mg, Metroconidazole 400mg, Flucloxacillin 250mg, Erythromycin 250mg.

Malaria Treatment (Tablets):

Quinine Sulphate 300mg, Oxytetracycline 250mg, Fansidar.

General:

Buccastem 3mg buccal tablets, Loperamide 2mg caps, Oral rehydration sachets, Senokot Tablets, Chlorpheniramine 4mg Tablets.

Eye, Ear and Nose:

Chloramphenicol 1% ointment, Normal Saline Sachets, Eye Dressing No. 16, Amethlocaine eye drops, Flurets Ophthalmic strips, Cotton Buds, Betnesol N Drops.

Sterile Surgical Equipment:

Sterile surgical gloves, Scalpel disposable, Mersilk suture 4/0, Stitch cutter, Syringes 2ml, 5ml, 10ml, Needles green, blue, Venflon Pink, Sterile field, Giving set.

Injections:

Dextrose saline 500ml, Lignocaine 1%, Nalbuline HCL 10mg/ml, Adrenaline 1:1000.

Skincare:

Hydrocortisone Cream, Lactocalamine cream, Daktarin cream, Diflucan 150mg Tablets, Blisteze cream, Flamazine cream, Cicatrin Powder.

First Aid:

Granuflex dressing 10x10cm, Gauze swabs (sterile), Melolin 5x5, 10x10cm, Micropore tape, 2.5cm, Zinc oxide tape 2.5cm, Plasters – assorted, Crepe bandage 7.5cm, 10cm, Tubigrip D, F Steristrips, Wound dressings 14,15, Triangular bandage, Safety pins, Steripods, Water Gel dressing, Jelonet, Tweezers, Disposable gloves, Lancets, Betadine Aqueous.

Miscellaneous:

Thermometer, Aneroid Sphygmomanometer, Stethoscope, Iodine Tincture, "Mountaineering Medicine" book, Whistles, Pen torch, DEET insect repellent, sun cream.

7.7 REPORT DISTRIBUTION

The report was distributed to all conservation organisations that were involved or aided with the project, and sponsoring organisations. Copies will also be held in the RGS and Bristol and Bogor Universities. For a copy of the report please James Burton at The Old Bakehouse, Upper Tysoe, Warwickshire, CV35 0TR.

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 Friends of Conservation
 Seccombe Charitable Trust
 A.J. Burton 1956 Charitable Settlement
 Gilchrist Education Trust
 Mammal Society
 Care for the Wild International
 Institute of Biology
 Wall Charitable Trust

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APPENDICES

10.1 Appendix I

ABBREVIATIONS AND TRANSLATIONS

Field observers:

BL	Barney Long
CB	Catherine Bloxam
JB	James Burton
JM	James McPherson
K	Kuswandono

Organisations:

AsRSG	Asian Rhino Specialist Group
CITES	Convention in International Trade of Endangered Species of wild flora and fauna
IPB	Bogor Agricultural University
IUCN	International Union for the Conservation of Nature and Natural Resources
LMU	Leuser Management Unit
LPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Sciences)
PHPA	Pusat Penelitian dan Pengembangan Biologi (Ministry of Forestry)
TNGL	Taman National Gunung Leuser (Gunung Leuser National Park)
UOB	University of Bristol

Indonesian terms

Alors (A.)	River
Gunung (G.)	Mountain
Hutan Lindung	Protection forest
Hutan	Forest
Ladang	Farm land produced by slash-and-burn agriculture
Parang	Machete
Pondok	Forest shelter
Uning	Mineral spring
Yayasan	Foundation

Abbreviations in Appendices:

(C)	Cast taken
(P)	Photograph taken
M	Mengajah Road
P	Perlak Road
B	Blankegerin Road
BL	Blangtero road
S(+number)	saw
H(+number)	heard

OTHER ABBREVIATIONS

FL Foot length

FW Foot width

PL Plantar length

PW Plantar width

S Stride length

TL Toe Length

TW Toe Width

MB Mastoidal Breadth

ZB Zygomatic Breadth

CL Condylolobasal Length

GPS Global Positioning System

GIS Geographical Information System

10.2 Appendix II

VEGETATION SPECIES LIST

Table 10.2.1: Vegetation Species List Found through Vegetation Study Site

No.	Sample Code	Local Name	Latin Name	Family
1	B 75	Balik Angin	<i>Acer niveum</i> (Blume)	Aceraceae
2	A 16	Keloang Tikus (Paku Tanah)	<i>Adiantum caudatum</i> L.	Adiantaceae
3	A 10	Akar Bayam	<i>Amaranthus</i> sp.	Amaranthaceae
4	A 11	Bayam Kurik	<i>Amaranthus</i> sp.	Amaranthaceae
5	A 33	Lelange #	<i>Curculigo</i> sp.	Amoryllidaceae
6	B 41	Berhul Mancang	<i>Mangifera laurina</i> Blume	Anacardiaceae
7	B 33	Bedarah Lebar Daun	<i>Semecarpus heterophylla</i> Blume	Anacardiaceae
8	A 31	Akar Entap	<i>Desmos chinensis</i> Lour.	Annonaceae
9	B 34	Gompol Kambing	<i>Polyalthia lateriflora</i> (Blume) King	Annonaceae
10	B 28	Banitan Kecil Daun	<i>Trivalvaria macrophylla</i> (Blume) Miq.	Annonaceae
11	B 54	Jerik Bunge Dua	<i>Xylophia caudata</i> Hook.f. & Thomson ?	Annonaceae
12	A 30	Akar Lengen	<i>Xylophia malayana</i> Hook. F. & Thomson	Annonaceae
13		Bunga Bangkai	<i>Amorphophallus</i> sp.	Araceae
14	A 53	Lange	<i>Aglaonema simplex</i> Blume	Araceae
15	A 12	Patat	<i>Phrynium</i> sp.	Araceae
16	B 53	Akar Manil	<i>Schefflera cephalotes</i> (C.B.) Harms.	Araliaceae
17	A 18	Uwi Pedih (Rotan)	<i>Calamus</i> sp.	Arecaceae
18	A 9	Uwi Rih (Rotan)	<i>Calamus</i> sp.	Arecaceae
19	A 27	Uwi Sabut (Rotan)	<i>Calamus</i> sp.	Arecaceae
20	A 19	Mberkeng (Bingbing)	<i>Pinanga</i> sp.	Arecaceae
21	A 26	Akar Pianang	<i>Aristolochia</i> sp.	Aristolochiaceae
22	A 22	Bebelo Rawan	<i>Thottea tomentosa</i> (Blume) Ding Hou	Aristolochiaceae
23	A 39	Keloang Gajah	<i>Athyrium kunstleri</i> Holtt.	Aspleniaceae
24	A 3	Keloang Item (Pk Tanah)	<i>Athyrium</i> sp.	Aspleniaceae
25	A 29	Kare Rawan (Paku Tanah)	<i>Diplazium cordifolium</i> Blume	Aspleniaceae
26	A 2	Keloang Rawan (Pk Tanah)	<i>Diplazium</i> sp.	Aspleniaceae
27	B 11	Terong Asam	<i>Canarium asperum</i> Bth.	Burseraceae
28	B 7	Risung (Kenari)	<i>Canarium littorale</i> Blume	Burseraceae
29	B 76	Manggis Hutan	<i>Garcinia dulcis</i> (Roxb.) Kurz	Clusiaceae
30	B 35	Pradah	<i>Garcinia forbesii</i> King	Clusiaceae
31	B 40	Asam Peder	<i>Gracinia parvifolia</i> (Miq.) Miq.	Clusiaceae
32	A 28	Bebuluh Bunge	<i>Forrestia</i> sp.	Commelinaceae
33	B 69	Medang Pisang	<i>Mastixia pentandra</i> (Blume)	Cornaceae
34		Pinus	<i>Pinus merkusii</i>	Coniferaceae
35	A 48	Lumut Gambut b	<i>Dawsonia</i> sp.	Dawsoniaceae
36	B 60	Tuhit	<i>Elaeocarpus</i> sp.	Elaeocarpaceae
37	C 2a	Sample 1	<i>Diplycosia brachyantha</i> Sleum.	Ericaceae

No.	Sample Code	Local Name	Latin Name	Family
38	C 4	Can (?)	<i>Vaccinium lucidum</i> (Blume) Miq.	Ericaceae
39	B 2	Tampang Rawan	<i>Blumeodendron tokbrai</i> (Blume) Kurz.	Euphorbiaceae
40	B 65	Cendana	<i>Cleistanthus glandulosus</i> Jabl.	Euphorbiaceae
41	B 56	Medang Lede	<i>Cleistanthus macropyllus</i> Hook. f.	Euphorbiaceae
42	B 55	Pepadi	<i>Cleistanthus sumatranus</i> (Miquel) Muell. Arg.	Euphorbiaceae
43	B 22	Jerik	<i>Drypetes neglecta</i> (Kds) Pax & K.Hoffm.	Euphorbiaceae
44	A 13	Akar Bayam Rusa	Euphorbiaceae	Euphorbiaceae
45	B 47	Tampu Licin (Mara)	<i>Macaranga tanarius</i> (L.) Muell. Arg.	Euphorbiaceae
46	B 13	Tampu Tapak Gajah (Mara)	<i>Macaranga triloba</i> (Reinw. ex Blume) Muell. Arg.	Euphorbiaceae
47	B 30	Pepoa Utan	<i>Mallotus penangensis</i> Muell. Arg.	Euphorbiaceae
48	A 5	Akar Rambut Galang	<i>Albizia</i> sp.	Fabaceae
49	A 24	Akar Tapak Kambing	<i>Phanera</i> sp.	Fabaceae
50	B 44	Kayu Kelumit	<i>Castanopsis acuminatissima</i> (Blume) A.DC.	Fagaceae
51	B 71	Munel	<i>Castanopsis acuminatissima</i> (Blume) A.DC.	Fagaceae
52	B 49	Kumpes	<i>Castanopsis</i> sp.	Fagaceae
53		Munel Kecil Daun	<i>Castanopsis</i> sp.	Fagaceae
54	B 29	Geseng Tanduk	<i>Quercus gemelliflora</i> (Blume)	Fagaceae
55	B 78	Bintangret	<i>Quercus lineata</i> Blume	Fagaceae
56	B 9	Geseng Batu	Fagaceae	Fagaceae
57	B 61	Bergang Piet	<i>Ryparosa javanica</i> (Blume) Kurz ex Koord. & Valetton	Flacourtiaceae
58	B 46	Dempok	<i>Ryparosa</i> sp.	Flacourtiaceae
59	A 25	Tutup Bumi	<i>Cyrtandra</i> sp.	Gesneriaceae
60	A 47	Paku Resam	<i>Dicranopteris linearis</i> (Burm. f.) Underw.	Gleicheniaceae
61	B 6	Tiga Urat	<i>Cinnamomum iners</i> Reinw. ex Blume	Lauraceae
62	B 48	Tiga Urat Lebar Daun	<i>Cinnamomum iners</i> Reinw. ex Blume	Lauraceae
63	B 70	Grupel	<i>Cryptocarya densiflora</i> (Blume)	Lauraceae
64	B 37	Geseng Bunge	<i>Cryptocarya ferrea</i> Blume	Lauraceae
65	B 73	Kayu Kelat	<i>Cryptocarya</i> sp.	Lauraceae
66	B 21	Medang Kunyit	<i>Cryptocarya</i> sp.	Lauraceae
67	B 20	Medang Gatal	<i>Dehaasia microcephala</i> Kost.	Lauraceae
68	B 58	Medang Gatal	<i>Dehaasia polyneura</i> Korth.	Lauraceae
69	B 66	Kayu Kuning	<i>Lindera bibracteata</i> (Blume) Boerl.	Lauraceae
70	B 59	Lengen	<i>Litsea mappacea</i> (Blume) Boerl.	Lauraceae
71	B 74	Banitan Kapas	<i>Litsea oppositifolia</i> (Blume) Vahl.	Lauraceae
72	B 45	Medang Kersik	<i>Litsea robusta</i> Blume	Lauraceae
73	B 19	Medang Licin	<i>Litsea robusta</i> Blume	Lauraceae
74	B 68	Medang Kambing	unidentified	Lauraceae
75	A 48	Lumut Gambut a	<i>Leucobryum</i> sp.	Leucobryaceae
76	A 50	Ske	<i>Dianella ensifolia</i> (L.) DC.	Liliaceae
77	B 54	Brahim Bapa	<i>Pleomele elliptica</i> (Thunb.) N. E. Br.	Liliaceae

No.	Sample Code	Local Name	Latin Name	Family
78	A 44	Akar Kawat	<i>Kadsura scandens</i> (Blume) Blume	Magnoliaceae
79	A 21	Akar Tombang	<i>Donax</i> sp.	Maranthaceae
80	B 72	Pepire	<i>Blastus sumatranus</i> Ohwi	Melastomataceae
81	A 43	Akar Kekeltep	<i>Medinilla cf. Laurifolia</i> (Blume) Blume	Melastomataceae
82	A 45	Akar Tiga Urat B	<i>Medinilla cf. Laurifolia</i> (Blume) Blume	Melastomataceae
83	A 34	Asam Susur	<i>Parasonerilia</i> sp.	Melastomataceae
84		Gelinggang Merak Sedang	<i>Disoxylum</i> sp.	Meliaceae
85	B 36	Stur Badak	<i>Dysoxylum exelsum</i> Blume	Meliaceae
86	A 37	Akar Cengkado	<i>Fibraurea</i> sp.	Menispermaceae
87	B 24	Medang Rungku	<i>Artocarpus elasticus</i> Reinw. ex Blume	Moraceae
88	B 26	Cempedak Rawan	<i>Artocarpus rigidus</i> Blume	Moraceae
89	B 42	Nanit	<i>Artocarpus</i> sp.	Moraceae
90	B 14	Kawa Hutan	<i>Ficus</i> sp.	Moraceae
91	B 52	Rambung Kraping (Ficus)	<i>Ficus</i> sp.	Moraceae
92	B 57	Bedarah	<i>Knema cinerea</i> (Poir.) Warb.	Myristicaceae
93	B 16	Kesebeh (Kayu Kesebeh)	<i>Ardisia fuliginosa</i> Blume	Myrsinaceae
94	B 23	Jambu Hutan	<i>Syzygium pycnathum</i> Merr. & Perry	Myrtaceae
95	B 25	Jerik Jambu	<i>Syzygium racemosum</i> (Blume) DC.	Myrtaceae
96	B 10	Bunge Kemaro	<i>Syzygium sexangulatum</i> (Miq.) Amsh.	Myrtaceae
97	A 41	Kantong Semar	<i>Nepenthes gracilis</i> Korth.	Nepenthaceae
98	C 7	Paku	<i>Neprolepis</i> sp.	Oleandraceae
99	A 6	Payarenah Rawan	Orchidaceae	Orchidaceae
100	A 40	Akar Pandan	<i>Freycinettia</i> sp.	Pandanaceae
101	A 38	Bengkuang Ske	<i>Pandanus</i> sp.	Pandanaceae
102	A 23	Uluh Ines (Bambu)	Poaceae	Poaceae
103	B 67	Kemuning Dewal	<i>Dacrycarpus imbricatus</i> (Blume) de Laub.	Podocarpaceae
104	B 80	Sango	<i>Dacrycarpus</i> sp.	Podocarpaceae
105	C 1	Sango Besar	<i>Dacrydium beccarii</i> Parlato	Podocarpaceae
106	B 27	Kayu Rotan	<i>Nagein wallichiana</i> (Presl.) O.K.	Podocarpaceae
107	C 6	Kuping Gajah Paku	<i>Dipteris conjugata</i> Reinw.	Polypodiaceae
108	A 49	Akar Pakis/Keloang	Polypodiaceae	Polypodiaceae
109	B 5	Kayu Gadung	<i>Helicia serrata</i> (R.Br.) Blume	Proteaceae
110		Rafflesia	<i>Rafflesia micropylorum</i>	Rafflesiaceae
111	B 32	Kayu Jaing	<i>Clematis</i> sp.	Ranunculaceae
112	B 4	Semaram	<i>Prunus arborea</i> Kalkm.	Rosaceae
113	C 5	Rumput Panjang	Rosaceae	Rosaceae
114	B 31	Kayu Kupa	<i>Ixora blumei</i> Z. & M.	Rubiaceae
115	B 18	Jejarum Merah (Ixora)	<i>Ixora coccinea</i> L.	Rubiaceae
116	[B 7	Bunge Kesemeu	<i>Lasianthus inaequalis</i> Blume	Rubiaceae
117	[B 8	Bunge Kesemeu Merah	<i>Lasianthus oculus-cati</i> Reinw. ex Miq.	Rubiaceae
118	A 42	Rumput Urip-urip	<i>Lasianthus stercorarius</i> Blume	Rubiaceae
119	B 3	Jejarum Putih	<i>Neonauclea calycina</i> (Bartl.) Merrill	Rubiaceae

No.	Sample Code	Local Name	Latin Name	Family
120	A 51	Akar Lengen	<i>Psychotria laxiflora</i> Blume	Rubiaceae
121	B 38	Semeje	<i>Psychotria</i> sp.	Rubiaceae
122	A 36	Gelenggung Hutan	Rubiaceae	Rubiaceae
123	B 43	Kayu Kanis	<i>Urophyllum corymbosum</i> Korth.	Rubiaceae
124	A 32	Akar Soyo	<i>Luvunga eleutherandra</i> Dalz.	Rutaceae
125	B 39	Beberong Cimun	<i>Meliosma simplicifolia</i> (Roxb.) Walp.	Sabiaceae
126	B 51	Medang Beberong	<i>Meliosma simplicifolia</i> (Roxb.) Walp.	Sabiaceae
127	B 77	Bintangur	<i>Guioa diplopetala</i> (Hassk.) Radlk.	Sapindaceae
128	B 50	Punti	<i>Palaquium rostratum</i> (Miquel.) Burck.	Sapotaceae
129	A 17	Karisnakang (Paku Rane)	<i>Selaginella plana</i> Hieron	Selaginellaceae
130		Bulu Ayam	<i>Sterculia</i> sp.	Sterculiaceae
131	B 62	Dongra	<i>Sterculia subpeltata</i> Blume	Sterculiaceae
132	B 15	Kemenyan	<i>Styrax benzoin</i> Dryander	Styraceae
133	B 79	Kayu Arang	<i>Symplocos fasciculata</i> Zoll.	Symplocaceae
134	A 4	Akar Pelas	<i>Symplocos</i> sp.	Symplocaceae
135	B 12	Kayu Sauh	<i>Symplocos</i> sp.	Symplocaceae
136	C 2b	Sample 2	<i>Ternstroemia</i> sp.	Theaceae
137	B 63	Seulon (Kayu Sulun)	<i>Tetramerista glabra</i> Miquel	Theaceae
138	B 17	Bergang Batu	<i>Pentace</i> sp.	Tiliaceae
139	B 1	Latong Rusa (Jelatang)	<i>Dendrocnide stimulans</i> (L.f.) Chew	Urticaceae
140	A 14	Sesirung	<i>Elastostemma</i> sp.	Urticaceae
141	A 15	Percos (Laosan) Sedang	<i>Alpinia</i> sp.	Zingiberaceae
142	A 1	Terkol (Laosan) kecil	Zingiberaceae	Zingiberaceae
143	A 20	Akar Tambun Tai	unidentified	
144	A 35	Akar Tiga Urat	unidentified	
145	A 52	Reriang	unidentified	
146	A 46	Sereh Hutan	unidentified	
147	B 64	Cendana (?)	unidentified	
148	B 8	Medang Sawa	unidentified	

10.3 Appendix III

BIRD LIST OF NON-FOREST SPECIES

Bird list: non-forest species (species not included in the forest list).

Family/species	English name
Ardeidae	
<i>Ardea cinerea</i>	Grey Heron
<i>Ardea purpurea</i>	Purple Heron
<i>Bubulcus ibis</i>	Cattle Egret
Ciconiidae	
<i>Leptoptilos javanicus</i>	Lesser Adjunt
Accipitridae	
<i>Machaeramphus alcinus</i>	Bat Hawk
Falconidae	
<i>Microhierax fringillarius</i>	Black-thighed Falconet
Alcedinidae	
<i>Pelargopsis capensis</i>	Stork-billed Kingfisher
Hirundinidae	
<i>Hirundo rustica</i>	Barn Swallow
<i>Hirundo tahitica</i>	Pacific Swallow
Laniidae	
<i>Lanius schach</i>	Long-tailed Shrike
Sturnidae	
<i>Acridotheres javanicus</i>	Javan Myna
Passeridae	
<i>Passer montanus</i>	Eurasion Tree Sparrow
Ploceidae	
<i>Ploceus philippinus</i>	Baya Weaver
Ploceidae	
<i>Lonchura striata</i>	White-rumped Munia
<i>Lonchura punctulata</i>	Scaly-breasted Munia

10.4 Appendix IV

DESCRIPTIONS OF UNIDENTIFIED AND PROVISIONALLY IDENTIFIED BIRD SPECIES.

Species 1

Babbler species. One individual seen on 7th August (CB) at 1535m in disturbed forest hopping between branches about 1m above the forest floor.

Description: 13-15cm. Dark brown all over but with paler breast; head with darker brown flecks; tail short; black eye and bill; long feather shafts looking like whiskers.

Species 2

Prinia species. One individual seen on 9th August (BL) at 980m at forest edge.

Description: 17cm. Nape, mantle and upperwing light brown; wing contour dark brown; throat and breast buff; belly creamy yellow; white supercilium; tail longer than body and often flicked to vertical position as if to aid balancing.

Species 3

Velvet-fronted Nuthatch (*Sitta frontalis*)?

One individual seen (BL) on 28th August at 1400m asl. in primary forest.

Description: 13cm. Upperparts blue; underparts salmon pink; forehead and crown black; white eyeline. Foraging on the trunks and branches of trees, often upside-down.

Species 4

Eagle owl species possibly Buffy Fish-owl (*Ketupa ketupu*)

A pair was seen at the same locality on two separate occasions (BL) at 1625m in disturbed forest. They were seen at close range for a brief moment then only through thick foliage.

Description: 40cm. Head and chest light beige; face, eyes and bill dark.

Species 5

Thrush species. One individual seen (BL) very clearly for about 30 seconds on 4th September in primary forest at 1680m.

Description: 25cm. The whole bird was light chestnut brown with a black eye and bill. The tail was held downwards and fanned regularly.

Species 6

Warbler species. Regularly seen by all members of the team with this species being included in ten species lists. Altitude range recorded was 1120-2330m, seen between 1 and 25m above the ground in associations of 2 to 6 individuals.

Description: 10cm. Crown, nape, mantle, upperwing and tail all brownish yellow; breast, belly and vent yellow; throat with an orange tinge; black bill, eye and eyestripe.

Species 7

Warbler species. One individual seen (BL) on 10th September in primary forest under good conditions at 2320m, 15m above the ground in the lower canopy.

Description: 15cm. Vent and chest orange; throat grey; upperwings dark brown with two white transverse wing bars; forehead, ear coverts, crown, nape and mantle brown.

Species 8

Shrike species. Seen three times (BL, JM) on 13th September around 1705m in primary forest foraging on airborne insects 15m above the ground.

Description: 20cm. Grey head with black eyestripe; Throat white grading into grey belly and buff vent; tail short with slight fork, black with a white trim; nape, mantle and upperwing chestnut brown; black (and possibly white) transverse wing bars; rump buff; large, black bill with hooked tip; legs orange/pink.

Species 9

Flycatcher species. One individual seen (CB) on 30th September in secondary forest at 1775m foraging in a flycatcher manner 1m above the ground.

Description: 13cm. Forehead white; crown, nape, mantle and back dark blue; chin and throat rufous (forming a triangular patch); chest rufous fading to a paler brown vent; upperwing brown (possibly with white under as seen when flew); rump and tail brown, tail with white edge; call "chip-chip".

Species 10

Two plus seen (JM, JB) at 835m in primary forest on 26th September.

Description: 20cm. Crown black; chin red; chest orange fading to a yellow vent; mantle and back green/orange; tail black; primaries black; white edge to wing.

Species 11

Flycatcher species? One individual seen (CB, JM, JB, K) high in the canopy at 1760m on 26th October.

Description: 13cm. Head, throat, chest, belly and vent white; black eyestripe; upperwing black with one white transverse wing bar; rump and tail black the latter having two transverse white bars.

Species 12

Frogmouth or nightjar species. Two individuals seen (CB, JM, JB, K) together from a distance of some 20m. Inconclusive colour slides taken (JM) at 1765m on 25th October. The birds were at eye level, but in the canopy of a tall tree which stood at the bottom of the cliff on which the observers were standing.

Description: One bird was a chestnut brown, the other a dark brown. Both had a series of white spots running down the wing, had a light stripe on the head and slight tufts on the back of the head.

Species 13

Fulvous-breasted Woodpecker (*Dendrocopus macei*)? Described as possibly an accidental visitor from Java (Marle and Voous 1988). Although its presence on Sumatra still requires verification, a trusted sighting at Lake Maninjau in 1993 by Marc Philippe (Holmes 1996) may show its existence on Sumatra. One individual was seen (JM) in a

mixed feeding flock at 1910m a.s.l. on 25th October. Was watched for a few minutes foraging on trunks and in the extremities of branches.

Description: 15-20cm. Red crown; black stripe up back of head; white ear coverts and throat; chest and belly buff with black streaks; vent red; black stripe running from the bill to the back of the head; nape, mantle, upperwing and tail all black with white barring.

Species 14

Cuckoo species Colour slide taken (JM).

Species 15

Babbler species Seen (JB) on 25th October at 1880m.

Description: 15-20cm. Black head with long, white supercilium; chest and belly white; back, upperwings and tail chestnut brown; thin, yellow decurved bill; dark coloured legs.

10.5 Appendix V

WILDLIFE TRADE IN MEDAN

Animal Trade in Medan, Northern Sumatra: A report for WWF by the University of Bristol and Bogor Large Mammal Expedition 1997			
Date:	Species:	No.	Location:
21.7.97	Pig Tailed Macaque	24	Animal Market
21.7.97	Long Tailed Macaque	2	Animal Market
21.7.97	Slender Tree Shrew	4	Animal Market
21.7.97	Thomas Leaf Monkey	1	Animal Market
21.7.97	Pangolin	4	Animal Market
21.7.97	Temmincks Flying Squirrel	1	Animal Market
21.7.97	Serpah	4	Animal Market
21.7.97	Brooks Squirrel	15	Animal Market
21.7.97	Slow Loris	14	Animal Market
21.7.97	Common Palm Civet	2	Animal Market
21.7.97	Flying Fox	28	64-24 bus route
21.7.97	Leopard Cat	1	Animal Market
23.7.97	Silver Leaf Monkey	1	64-24 bus route
23.7.97	Flying Fox	13	64-24 bus route
30.7.97	Prevosts Squirrel	7	Animal Market
30.7.97	Long Tailed Macaque	15	Animal Market
30.7.97	Silver Leaf Monkey	2	Animal Market
30.7.97	Young Silver Leaf Monkey	1	Animal Market
30.7.97	Three-Striped Ground Squirrel	3	Animal Market

10.6 Appendix VI

IUCN CATEGORY EXPLANATIONS

Key to IUCN Categories and Criteria for Threatened Fauna

CR Critically Endangered
 E Endangered
 VU Vulnerable
 DD Data Deficient

	Critically Endangered	Endangered	Vulnerable
A. Declining Population			
Population decline rate at least:	80% in 10 years or 3 generations	50% in 10 years or 3 generations	20% in 10 years or 3 generations
using either: 1. Population reduction observed, estimated, inferred, or suspected in the past or, 2. Population decline projected or suspected in the future based on: <ul style="list-style-type: none"> • direct observation • an index of abundance appropriate for the taxon • a decline in area of occupancy, extent of occurrence and/ or quality of habitat • actual or potential levels of exploitation • the effects of introduced taxa, hybridisation, pathogens, competitors, or parasites 			
B. Small Distribution and decline or fluctuation			
Either extent of occurrence,	<100 km ²	<5,000 km ²	<20,000 km ²
Or Occupancy	<10 km ²	<500 km ²	<2,000 km ²
And either 2 of the following 3			
1. Either severely fragmented * or known to exist at a number of locations	=1	<5	<10
2. continuing decline in any of the following	Any rate	Any rate	Any rate
<ul style="list-style-type: none"> • extent of occurrence • area of occupancy • area, extent and/or quality of habitat • number of locations or subpopulations • number of mature individuals 			
3. fluctuating in any of the following	> 1 order of magnitude	> 1 order of magnitude	> 1 order of magnitude

<ul style="list-style-type: none"> • extent of occurrence • area of occupancy • number of locations or subpopulations • number of mature individuals 			
C Small population size and decline			
Number of mature individuals and 1 of the following 2:	<250	<2,500	<10,000
1. Rapid decline rate	25% in 3 Years or 1 generation	20% in 5 Years or 2 generation	10% in 10 Years or 3 generation
2. continuing decline and either	Any rate	Any rate	Any rate
a. fragmented or	All sub-pops <50	All sub-pops <250	All sub-pops <1,000
b. all individuals in a single population			
D Very small or restricted			
Either number of mature individuals	<50	<250	<1,000
Or population is susceptible	N/A	N/A	Area of occupancy <100 km ² or number of locations <5
E Quantitative analysis			
Indicating the probability of extinction in the wild to be at least:	50% in 10 Years or 3 generations	20% in 20 Years or 5 generations	10% in 100 Years

*i.e. isolated subpopulations with a reduced probability of recolonisation, if once extinct