

**Malaysian Nature Society
1998 Expedition
to the proposed
Pulong Tau National Park
Sarawak, Malaysia**



Malaysian Nature Society, Miri Branch



Executive Summary

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- Pulong Tau National Park, in the Kelabit Highlands of Sarawak, was initially proposed in 1984 by the National Parks & Wildlife Office and supported with a petition from the local community (National Parks & Wildlife Office Sarawak 1984). The proposed park covered 164,500 ha and included Gunung Murud (Sarawak's highest peak), the spectacular twin peaks of Batu Lawi and the Tamu Abu mountain range.
- In 1986 a small breeding population of Sumatran Rhinoceros (*Dicerorhinus sumatrensis*), previously thought to be extinct in Sarawak, was found within the proposed park. Together with evidence of other endangered species, this led to a second proposal to constitute the park, now as 159,000 ha (National Parks & Wildlife Office Sarawak 1987)
- On 25th June 1998 the initial proclamation to constitute the proposed Pulong Tau National Park was passed (Notification No. 2174, 1998). The proclamation is a welcome step, however the proposed area has been reduced to 63,700 ha.
- Batu Lawi was not included and only a small area of Gunung Murud is protected (Map II). This will degrade the considerable tourism potential of the national park and failure to include the area in which Sumatran Rhinoceros was recorded also means that an opportunity to protect the habitat of this seriously endangered species will be lost.
- According to ITTO (Sarawak), Pulong Tau is registered as a Totally Protected Area of 164,500 ha extent. Hence, the proclamation of just 63,700 ha currently appears to be inconsistent with requirements under the 1994 International Timber Trade Agreement.
- Between 27th Aug. and 9th Sept. 1998, members of the Malaysian Nature Society (Miri Branch) and the local Kelabit community trekked through the forest between Batu Lawi and Gunung Murud, making observations on the flora and fauna, and ascending both peaks. In this report, we present an analysis of the great natural diversity of the area, an account of the journey, and make recommendations for the future.
- This report seeks to demonstrate that this area is an extraordinary piece of Sarawak's natural heritage, and submit that it should be preserved in perpetuity. It is recommended that the boundaries of the Pulong Tau National Park be extended to include Batu Lawi and the surrounding forests which form prime Rhinoceros habitat. This should guarantee the long-term viability of Pulong Tau, which as an area of outstanding natural beauty and a centre of biodiversity, has the potential to become a world-class tourist destination.

Malaysian Nature Society

1998 Expedition

to the proposed

Pulong Tau National Park

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1. Introduction to the Expedition

Pulong Tau: A Background

In Kelabit and Lun Bawang dialects "Pulong Tau" means "Our Forest" and expresses both the pride the local people have in their forest and the sense that it is the collective heritage of all Sarawakians and Malaysians. The concept of Pulong Tau National Park evolved from a community initiative in the late 1970s. In July 1984 the National Parks & Wildlife Office submitted a detailed proposal, together with a petition letter from the community, to the Government of Sarawak (National Parks & Wildlife Office Sarawak, 1984).

The area of park initially proposed was 164,500 ha. This included most of the Tamu Abu mountain range, the spectacular twin peaks of Batu Lawi (height 2043 m), and Gunung Murud, Sarawak's highest mountain (2650 m) (Map I, Map II). Lying close to the Indonesian border in northern Sarawak it encompassed the headwaters of the Limbang, Baram, Kelalan and Tutoh rivers, in fact the entire upper water catchment for northern Sarawak. Thus, as well as conserving biodiversity, the proposed park would have the benefits associated with watershed protection. Most of the area lies at over 1000 m above sea level and although no detailed survey had been undertaken at the time of the initial proposal, it was expected to harbour a flora and fauna representative of the montane areas of northern Borneo.

Between 1984 and 1987 the proposal was screened by the State Cabinet which led to approval in principle, pending on the redrawing of some of the boundaries to avoid conflicts with other land uses.

In 1986 the National Parks & Wildlife Office conducted a preliminary survey of the proposed park and a small breeding population of Sumatran Rhinoceros was discovered. The animal was considered extinct in Sarawak prior to this find. The survey also noted the role of the upland Oak-Laurel forests for maintaining the populations of Bearded Pig, which are of tremendous value to the local people (Caldecott 1986), and also make spectacular sporadic migrations down to the dipterocarp forest in search of fruit (Caldecott 1984). In the south of the proposed park, Orang Utans are

known to enter occasionally, and there are also some unusual upland grasslands of great value for their unique flora (National Parks & Wildlife Office Sarawak, 1984). The famed *Rafflesia* flower can be found around the base of Gunung Murud and the 1986 survey also noted the wild and undisturbed state of the forests, especially around Batu Lawi, and between there and Gunung Murud. A second proposal, submitted in 1987, therefore argued strongly for the inclusion of these areas within the boundaries of the park (reduced to 159,000 ha) and that the park be gazetted as soon as possible (National Parks & Wildlife Office Sarawak 1987) (Map II).

Further changes to the boundaries were recommended and on 25th June 1988 the initial proclamation to constitute the proposed Pulong Tau National Park was passed (Notification No. 2174, 1988). The area gazetted comprised 63,700 ha and does not include Batu Lawi and the surrounding forest (Map II). It does not include the forest in which Sumatran Rhinoceros was found in 1986. Furthermore, the summit of Gunung Murud, essentially the only piece of true montane habitat remaining in the gazetted area, is connected to the rest of the park to the south by only a thin strip of forest. This may have negative impacts on dispersal and population dynamics of plant and animal species present.

Failure to include Batu Lawi and the surrounding forest connecting it to Gunung Murud and the rest of the Tamu Abu range, has the potential to seriously compromise the value of the park, in terms of both conservation and attraction of revenue from tourism. The park may no longer be able to serve as a refuge for Sumatran Rhinoceros and other large mammals. The aesthetic beauty of Batu Lawi and Gunung Murud would likely be lost and with it the primary tourism attractions of the area.

As a wide area of remote, rugged and pristine forest, large enough to protect populations of rare animals such as Clouded Leopard, Bulwer's Pheasant, Bornean Gibbon and Sumatran Rhinoceros; with superb fishing, including Sarawak's state fish *Ikan Semah*; with the spectacular peaks of Batu Lawi and Gunung Murud and superb jungle trekking,

Pulong Tau has the potential to become one of South East Asia's elite national parks (National Parks & Wildlife Office Sarawak 1987). It could easily rival other already famous parks in Borneo such as Mulu or Mount Kinabalu National Parks, especially if it remains one of the few places in the world where Sumatran Rhinoceros still roam. This can only be achieved, however, if the park encompasses sufficient area and includes such special sites as the remote forests around Batu Lawi. A reconsideration of the boundaries of the park, more in line with the 1984 or 1987 proposals, is recommended. These could be constituted as an extension to the present proposal.

Justifications for gazetting the fully proposed area of Pulong Tau National Park (159,000 ha)

- 1) **Protection of a large area of valuable montane habitat.** The original area proposed was sufficient to secure the conservation of the species and genetic diversity of a large part of the mountain flora and fauna of northern Borneo.
- 2) **Protection of rare and seriously endangered wildlife.** These include: Bulwer's Pheasant, which is found in only a few localities in northern Borneo; Sumatran Rhinoceros, previously thought to be extinct in Sarawak; Clouded Leopard, rare over so much of Sarawak, but reputedly common towards the south of Tamu Abu. Large or rare species require large areas of protected habitat because smaller areas may not sustain sufficient numbers of individuals to maintain long term genetically viable populations.
- 3) **Protection of rare species of plants.** Although a detailed floral inventory of Pulong Tau is not yet available, it is already known that the area contains a pitcher plant, *Nepenthes murudensis*, which is not found anywhere else in the world. Many more plants are restricted to Pulong Tau and a few other montane regions in northern Borneo. The open swampy grassland of Ba'Sakun to the south of the area is unique and of great botanical interest.
- 4) **Protection of the mass migrations routes of Bearded Pigs.** The pigs feed in the oak and lithocarpus forests and move down to the dipterocarp forests during the occasional fruiting years.
- 5) **Protection of the cultural symbols of the Kelabit people.** These include stone carvings, and the mountains of Batu Lawi and Gunung Murud have a strong traditional and cultural significance.
- 6) **Protection and preservation of the mountain peaks.** The spectacular beauty of Batu Lawi and the fact that Gunung Murud is Sarawak's highest mountain warrant the protection of these peaks and the surrounding forests.
- 7) **Protection of the watershed of all the major rivers in northern Sarawak.** Locally this would protect the vitally important Bario rice paddies in Ba'Kelalan, Bario, Long Lellang and Pa Tik, which produce premium quality rice. Over the wider region it would safeguard drinking water and provide flood protection over a large part of Sarawak.
- 8) **The considerable potential for eco-tourism.** With the possibility of fishing, river trips, jungle trekking through a pristine forest with beautiful plants, hill climbing on spectacular peaks, viewing of rare wildlife and visits to culturally significant sites, Pulong Tau has much to offer the tourist. However, the main attractions of Pulong Tau are centred on Batu Lawi and Gunung Murud; unless the surrounding forests and the wildlife within them are protected, few people will be interested in visiting the park.
- 9) **Input to the local economy.** Eco-tourism requires infrastructure and there exists great potential for the local economy to gain from the existence of the national park. Revenue can be generated through the provision of lodgings, guiding and souvenirs.

The Malaysian Nature Society

Established in 1940, MNS is the oldest scientific and non-governmental organisation in Malaysia and is dedicated to promoting nature conservation and appreciation in the country. Its mission is to motivate the appreciation and care for the Malaysian natural heritage; to get people involved in nature and healthy outdoor pursuits through various activities; to promote realisation of the need to sustain and conserve the natural world for future generations. There are 13 member branches throughout Malaysia, served by a central HQ in Kuala Lumpur. Altogether there are about 4,000 members, both Malaysian and non-Malaysian, who share the Society's vision and passion (Malaysian Nature Society 1998).

The MNS Miri Branch was established in 1995 with the aim of sowing the seeds of

appreciation and care for Sarawak's natural heritage. We hope that this may grow into the realisation that there is a need for sustainable management and conservation of nature and natural resources in Sarawak for future generations. The Miri branch has about 70 members, of which approximately two thirds are Malaysian, the remainder being foreign workers living in Miri.

The branch organises regular lectures and slide talks, outings to local places of interest and, occasionally, longer trips to destinations including Pulau Tiga, Loagan Bunut and Similajau National Parks. The branch also runs several projects which, to date, have involved: recycling of rubbish; community beach clean-ups; awareness of ways to reduce open burning and a nature course for teachers. The Pulong Tau Expedition is the first conservation project of this type which the Branch has organised.

MNS expedition to Pulong Tau: background

The Malaysian Nature Society, Miri Branch together with members of the local community, conducted a nine day expedition to the northern part of the proposed park, with a view to raising awareness of the area as one of outstanding natural beauty and biological and economic value.

The origins of the expedition go back to a regional get-together of the MNS held at Lambir Hills National Park in October 1997. At this meeting, an invited speaker from the Kelabit community expressed concern over Pulong Tau. Given the importance of Pulong Tau to the conservation of Sarawak's biodiversity, MNS Miri branch decided to follow up on the issue. An expedition proved an ideal way of combining several objectives: to visit the area ourselves so we could have personal experience of the forest; to conduct some basic observations to contribute towards the scanty scientific knowledge of the area; and the primary objective of raising awareness of the issue of Pulong Tau through our photographs and experiences. Hence, preparations were made and permission was obtained from the National Parks & Wildlife Office, Forest Research Centre and the Resident of Miri (Permit no. RMD/45/98).

Starting on the 28 August 1998, the expedition followed the regular trekking route to Batu Lawi, climbing the lower peak on National Day. The team then set out through the remote forest around Batu Lawi to find a

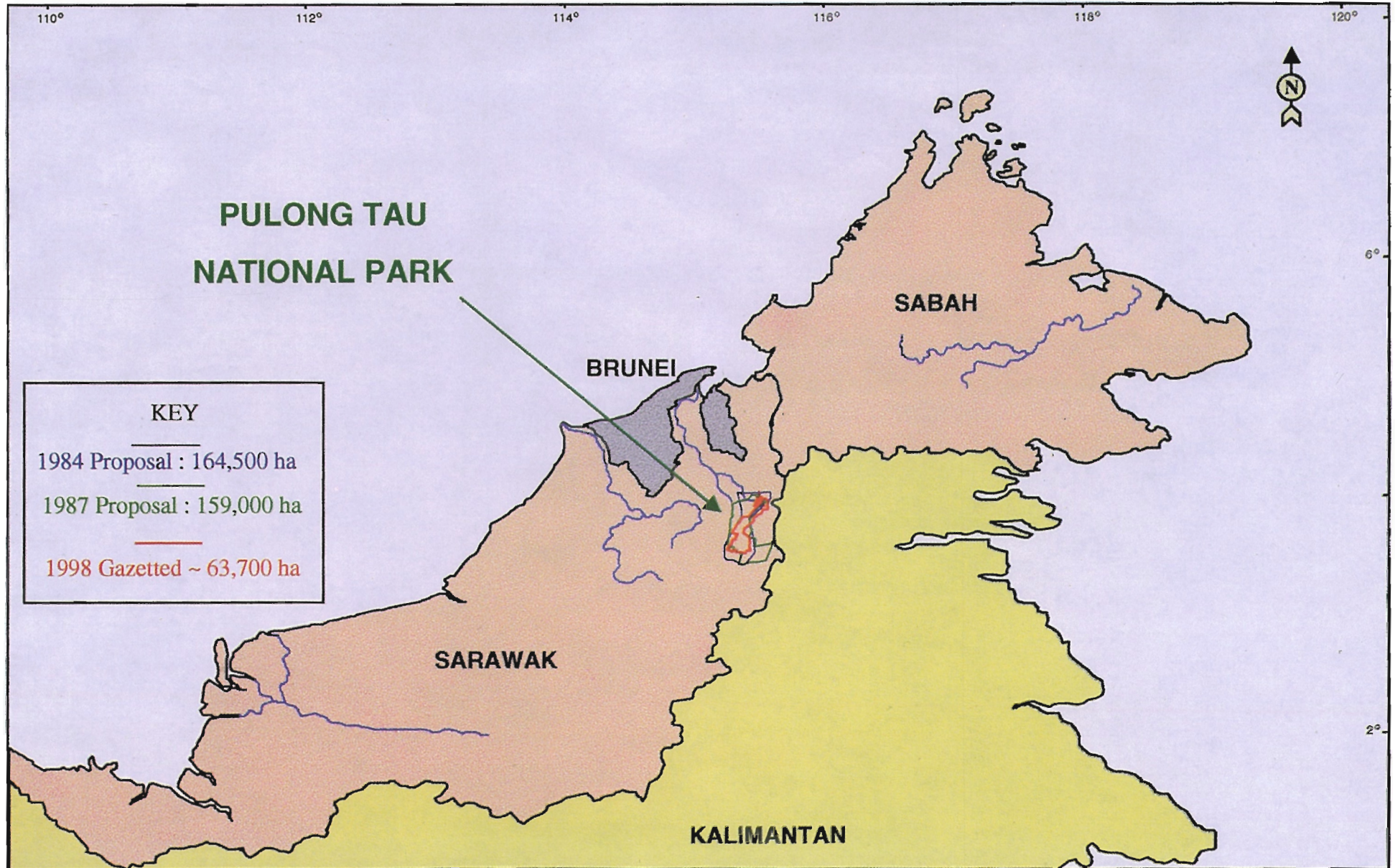
new approach to Gunung Murud and made the first ascent of the mountain from the south side. From there the group made its way across to the Church Camp and down to Ba'Kelalan which was reached on the evening of 5th September, nine days after setting off.

Along the way, surveys of the geology, vegetation, vertebrates and invertebrates were conducted. Despite the brief time in the area and the already demanding trekking schedule, an impressive array of interesting observations was amassed, revealing both the remarkable diversity of the forests and visibility of the wildlife, and further underlining the importance of this montane habitat. Of an impressive 67 bird and 28 mammal species recorded, one fifth of the birds and almost half the mammals were Bornean endemics, found nowhere else on the planet. Several, such as Helmeted Hornbill, Mountain Imperial Pigeon, Bornean Gibbon, Hose's Langur, Maroon Langur and Giant Squirrel are totally protected species in Sarawak.

However, it was, perhaps, the fantastic beauty of the forests that left the deepest impression on the expedition members. In walking through this area, one passes from upper mixed Dipterocarp forest through tall oak and lithocarpus forest, to enchanting Mossy forests on the lower ridges. Climbing higher, one encounters stunted Rhododendrons of the Elfin forest on the mountain slopes, literally smothered in soaking wet moss, and the interesting heath flora of the mountain summits. Every corner appears to hold a secret. Orchids abound. There is a profusion of pitcher plants, and the abundant tracks and sounds of wildlife add to the anticipation of what might be around the next corner. Then, when the summit of Gunung Murud is finally won there is the breathtaking view towards Batu Lawi. It is without doubt one of Malaysia's finest landscapes.

In the following pages of this report we detail our findings. The next section provides the background of the route and our trekking schedule. The subsequent sections detail our natural history observations, the result of each day's survey work. Here, geology, vegetation, vertebrates and invertebrates are given separate treatment. These are followed by our recommendations, a broader coverage of the importance of Pulong Tau for conservation, some suggestions for the park and comments on how it might be developed. Finally, we present a section of photographs taken on the expedition, essays written about various aspects of our trip and personal summaries of the members.

MAP I : LOCATION OF PROPOSED PULONG TAU NATIONAL PARK, NE SARAWAK



2. Expedition Route

Between the 28th August and 6th September 1998 nine members of the Malaysian Nature Society and six participants from the local community trekked through part of the proposed Pulong Tau National Park in the Kelabit Highlands. The route of the expedition

followed the regular trail from Bario and Pa'Ukat to Batu Lawi, then struck out through the forest from Camp One (this is its local name) to Gunung Murud, which was climbed for the first time from the south side, and finally descended via Church Camp to Ba'Kelalan (Table 2-1, Map III).

Table 2-1

Log of Malaysian Nature Society Expedition 1998 to the proposed Pulong Tau National Park, 28th August to 6th September

Friday, 28th August

- 10:30 Plane arrives at new Bario Airport, 3^o 43.608 N, 115^o 28.655 E
- 11:45 Depart, beautiful sunny day
- 12:00 Arrive Pa'Ukat (3^o 45.523 N, 115^o 29.438 E), lunch break at Longhouse.
- 13:00 Depart Pa'Ukat, path beside paddy fields
- 13:25 Enter secondary forest, amazing cauliflorous fig
- 13:35 Rest by sawn timber store, forest secondary mostly figs and jackfruit
- 14:30 Enter tall, primary forest, large dipterocarp trees. Following and re-crossing stream several times
- 15:00 Found Punan prayer sticks
- 15:30 Rain
- 16:30 Reached campsite
- 18:00 Set small mammal traps, found large hairy spider
- Night Clear if cold night, warmed by camp fire

Saturday, 29th August

- 08:00 First calls of Bornean Gibbon, small mammal traps had four captures, vegetation plot
- 08:30 Breakfast of Tom Yam porridge
- 09:00 Maria Fe found juvenile Pit Viper and large, bright orange weevil
- 09:20 Departed camp, continued up stream, weather started foggy but cleared up for walk
- 11:45 Reached ridge, several sightings en route - large group of Hose's Langurs, and heard Helmeted Hornbill
- 12:05 Continued along ridge
- 12:30 Lunch
- 13:00 Depart, steep ascent to gap in Tamu Abu
- 13:30 Reached gap and found it covered in litter. Collected litter. Otherwise beautiful mossy forest
- 14:00 First calls of Mountain Imperial Pigeon, boulders very slippery
- 14:30 Heavy rain continued for 90 mins. Plodded through soaking mossy forest.
- 16:00 River crossing, swollen after rain. Clear tea-coloured water
- 17:00 Arrived wet at Camp One (3^o 50.66 N, 115^o 25.94 E). Rain again for 1 hour.
(N.B. Camps One and Two are local names, given by the local people who built the huts & facilities.)
- 18:00 Set small mammal traps
- Night Very comfortable

Sunday, 30th August

- 06:00 Whitehead's Pygmy Squirrel observed from sleeping bag position
- 07:30 Traps had one capture, Summit Rat, vegetation plot, weather clear
- 08:00 Clear up rubbish from around camp and burn together with that collected from trail yesterday
- 09:20 Depart Camp One, trail follows up stream to ridge, along ridge top all mossy forest
- 13:00 Break for lunch, found beautiful Trilobite beetle; Whitehead's Pygmy Squirrel and Smooth tailed tree-shrew common

(Table 2-1 continued)

- 13:35 First view of Batu Lawi - spectacular
- 14:15 Red Bellied Sculptor squirrel and Giant Squirrel at view point
- 15:00 Arrive Camp Two (3° 51.91 N, 115° 23.48 E)
- 17:00 Set small mammal traps, vegetation plot
Caught up with washing

Monday, 31st August

- 07:00 Small mammal traps two captures including Mountain Giant Rat
- 08:30 Depart for ascent of Batu Lawi, weather overcast but not raining
- 08:40 Ran into party of Bornean Gibbons and watched for 45 mins.
- 09:15 Reach saddle
- 10:00 Reach summit of Female Peak (3° 52.122 N, 115° 22.6920), foggy but occasionally clearing for wide panorama
- 11:00 Depart summit
- 12:10 Reach Camp Two, stop for lunch
- 13:15 Depart Camp Two for Camp One
- 14:30 Find large pig wallow
- 15:00 Heavy rain continues for 3 hours
- 17:05 Reach haven of Camp One
- Night Too tired to notice

Tuesday, 1st September

- 08:00 Depart Camp One in direction of Gunung Murud, roughly following bearing of 040°
- 10:25 Boundary of timber concession (marker no. 1307), interesting things including Trilobite beetle and beautiful *Goniothalamus*
- 11:00 After wandering around decide to follow boundary, still roughly 040°
- 13:00 Lunch break
- 14:20 Set off again, markers every 20 m numbers dropped to 1050 m then started climbing again
- 15:20 Reach campsite previously used by those marking boundary (marker no. 1178)
- 16:30 Set small mammal traps, vegetation plot, Johnson caught one fish and three frogs
- Night Comfortable night on pole bed

Wednesday, 2nd September

- 06:30 Loud calls of Blue Breasted Quail, no mammals in traps
- 08:20 Depart camp, continue along border trail
- 10:20 Tough going just two kilometres travelled, steep and slippery, saw Maroon Langur and beautiful orchid
- 11:40 Reach Sungai Ulu Limbang, beautiful forest stream, stop for lunch
- 13:05 Depart from Sungai Ulu Limbang
- 14:35 Marker no. 1168, 3° 52.465 N, 115° 27.755 E
- 147:55 Distinctive change in vegetation crossing from Setap Shale to Meligan Formation, from mossy forest to tall forest
- 15:00 Reach end of boundary marks and make camp by stream, sign of Bearded Pig everywhere
- 16:00 Set small mammal traps, vegetation plot
- Night Enjoy huge meal so we don't have to carry food tomorrow

Thursday, 3rd September

- 06:00 Calls of Bornean Gibbons close to camp, traps caught nothing
- 08:15 Depart camp, walking from patches of stunted mossy forest to dry taller forest and back again
- 08:25 Beautiful Wagler's Viper, incredible assortment of Pitcher plants
- 09:50 Large pig wallow near river
- 10:20 Reach base of ascent, follow up convenient ridge

(Table 2-1 continued)

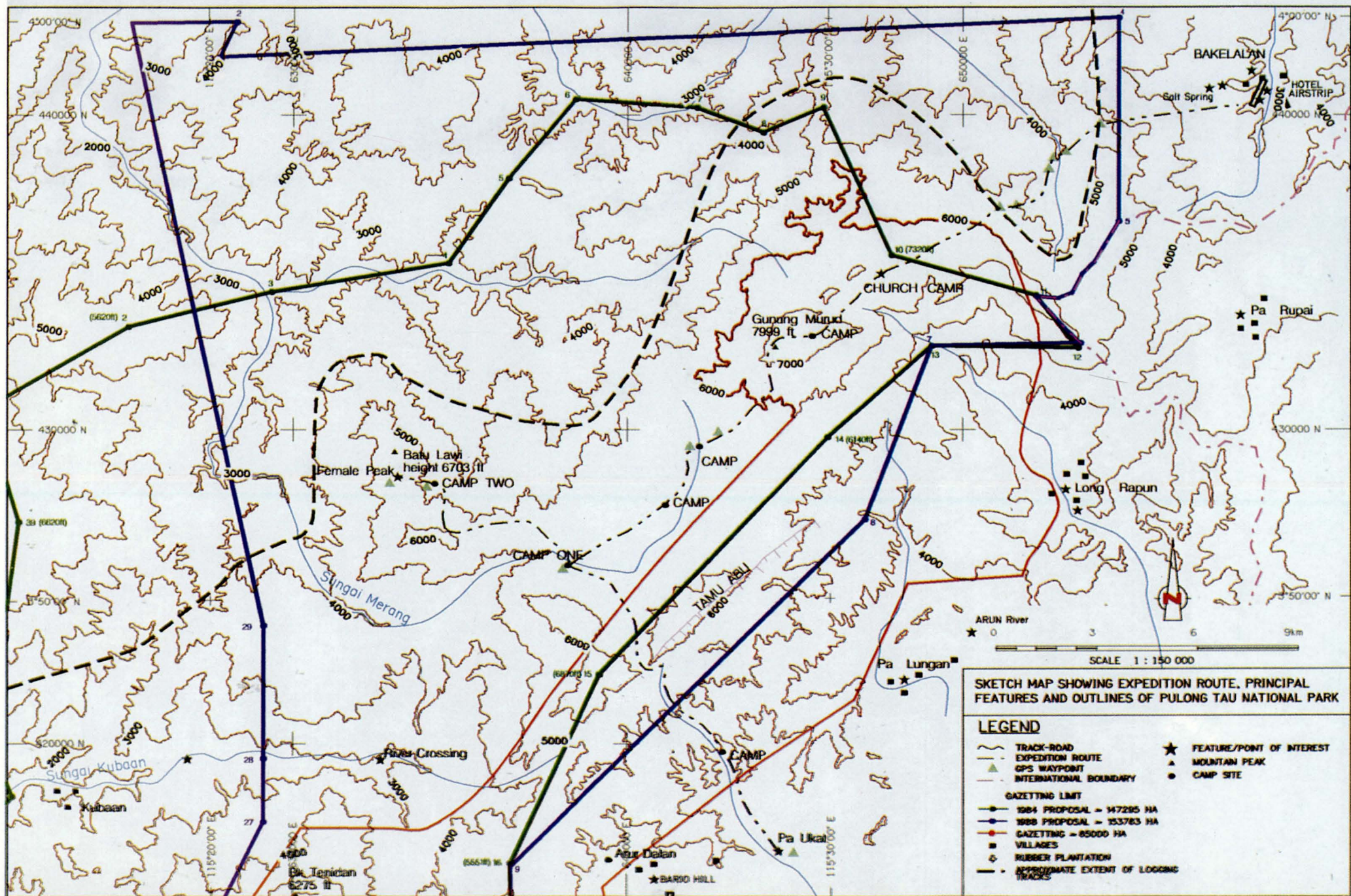
| | |
|-------|--|
| 10:50 | Find pig highway and follow it |
| 11:45 | Find open forest, easier walking, stop for lunch |
| 13:05 | Resume march, Pang Ayu estimates 1 1/2 hours to top! |
| 14:30 | First view of summit of Gunung Murud but still at least 2 hours off |
| 15:10 | Engage low gear, scrambling over mossy boulders and clambering up soaking roots |
| 18:30 | Reach summit just as dusk is settling, foggy, rain just starting, everybody tired but happy |
| 19:30 | Reach campsite by first stream since summit (Sg. Dappur), guides get fire going in record time |
| Night | Very cold |

Friday, 4th September

| | |
|-------|--|
| 05:45 | Beautiful sunrise, view across to Gunung Murud's second summit great |
| 07:15 | Depart with light loads for summit |
| 08:00 | Reach summit, spectacular view all around but especially of Batu Lawi, beautiful clear weather |
| 09:30 | Leave summit and return to camp |
| 10:50 | Leave camp for Church Camp |
| 11:00 | Most of trail through karangas forest, interesting sightings - Greater Mouse Deer, Civet track and Horse Tailed Squirrel |
| 12:30 | Reach Church Camp, it's huge, we are given shelter under roof of unfinished building, rain pours most of the afternoon |
| 17:00 | Set mammal traps but no more banana bait |
| 20:00 | One of the camp workers brings a dead Lesser Gymnure |
| Night | Very cold |

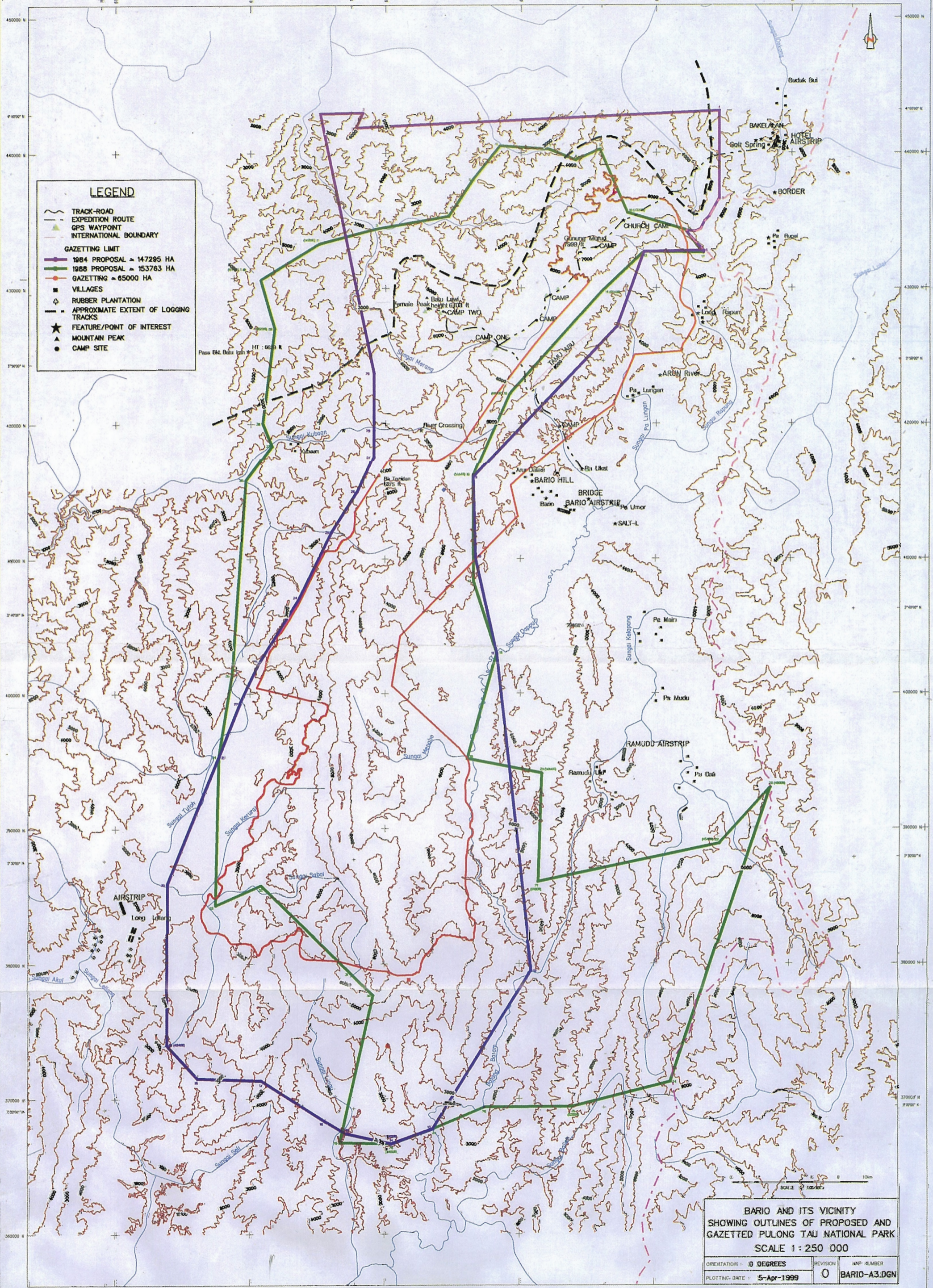
Saturday, 5th September

| | |
|-------|--|
| 06:00 | Misty sunrise, traps did not catch anything |
| 08:15 | Left Church Camp for Ba'Kelalan |
| 08:45 | On top of Gunung Murud's second summit, more clear views of Batu Lawi |
| 09:30 | Steep descent through tall mossy forest, but trail easy |
| 10:30 | Reach logging road - broad cleared cut through the forest, much erosion at the road sides |
| 11:00 | Start hiking back along road, hot and exposed |
| 12:30 | Stop for lunch by stream, Patrick knew this as a beautiful camp site before - now the stream is cloudy with increased sediment run off |
| 13:15 | Set off again, first 45 mins. very hot |
| 14:00 | Re-enter forest along village trails |
| 17:30 | Reach airport at Ba'Kelalan, tired today we did over 15 km |



LEGEND

- TRACK-ROAD
- - - EXPEDITION ROUTE
- ▲ GPS WAYPOINT
- - - INTERNATIONAL BOUNDARY
- GAZETTING LIMIT**
- 1984 PROPOSAL = 147295 HA
- 1988 PROPOSAL = 153763 HA
- GAZETTING = 65000 HA
- VILLAGES
- ◇ RUBBER PLANTATION
- - - APPROXIMATE EXTENT OF LOGGING TRACKS
- ★ FEATURE/POINT OF INTEREST
- ▲ MOUNTAIN PEAK
- CAMP SITE



**BARIO AND ITS VICINITY
SHOWING OUTLINES OF PROPOSED AND
GAZETTED PULONG TAU NATIONAL PARK
SCALE 1 : 250 000**

| | |
|---------------------------|--------------------------|
| OPERATION: 0 DEGREES | REVISION: 0 |
| PLOTTING DATE: 5-Apr-1999 | AMP NUMBER: BARIO-A3.DGN |

3. Natural History of the Proposed Pulong Tau National Park

Introduction

The primary objective of the 1998 MNS Miri Branch expedition to the forests of Pulong Tau was to highlight the diversity, distinctiveness and beauty of the plants, animals and physical features of the area. In order to acquire this information, notes were kept on the geology, flora and fauna of the portion of the proposed park covered by the expedition route. Our records were limited due to the physical demands of trekking, the lack of time for comprehensive surveys and the area's remoteness, which precluded the carriage of any heavy equipment. Nonetheless, the natural history of Pulong Tau is so exceptional that the short duration of the expedition was sufficient to allow us to gauge the natural wealth of these highland forests. This section of the report serves to detail the natural heritage of Pulong Tau as revealed during the course of the expedition.

We describe first the geology and geomorphology of the proposed park. The geology of an area is a fundamental determinant of all that lies above it, for the nature of the rocks governs the characteristics of the soil, thereby influencing the plant communities that can establish there. The plant life of Pulong Tau is therefore described next. Inextricably linked to the vegetation, the final component of Pulong Tau's natural history is the animal life, which we consider in two accounts, for vertebrates and invertebrates, respectively. Finally, some conclusions are made concerning the natural history of Pulong Tau and the initiatives required to further understand and conserve it.

3.1 Geology & Geomorphology

Introduction

Plate tectonic and structural framework

The Cenozoic to Recent (65 Million years to present) history of the Kelabit Highlands area can be understood, at a large scale, with reference to the theory of plate tectonics whereby the crust and upper mantle of the earth is composed of a series of rigid 'plates' which, over a geological time frame, are in motion relative to each other. The Kelabit highlands are viewed in the context of a complex interaction of three large lithospheric plates covering the SE Asian region:

1. the continental Eurasian (China) plate in the north-west,
2. the mainly oceanic Indian plate, and
3. the continental Australian plate.

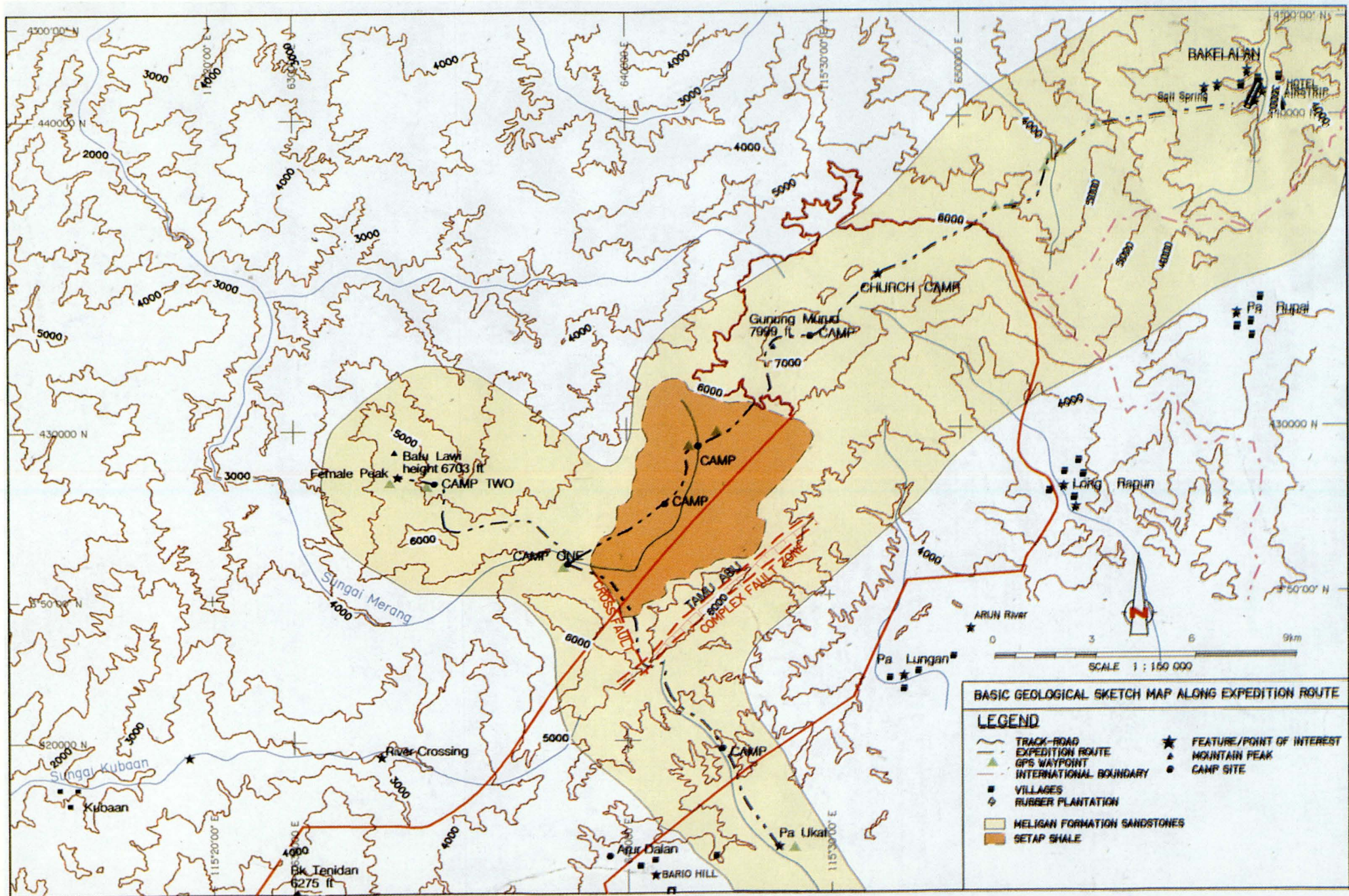
The interaction (extension, break-up and collision) of the plates has resulted in a complex mosaic of smaller microplates and plate collisional features, such as volcanic island arcs, accretionary prisms (sediments scraped off an underthrusting plate) and mountain belts, whose temporal and spatial relationships are still not fully understood.

The Kelabit Highlands are thought to be developed on an underlying basement of rifted (faulted) continental crust, upon which coastal and shallow water sediments were deposited before Borneo separated from the mainland Eurasian plate (Hutchison 1996). This hypothesis is based principally on evidence for subsurface evaporite sediments, and on the development of reef limestones around the margins of the area (e.g. in Mulu) suggesting the presence of a more stable (lower subsidence) block. To the east of this microplate, folded and thrust Rajang flysch (predominantly deep-water shales) deposits of Late Cretaceous to Eocene age are developed. These are interpreted as having developed over oceanic crust (mainly basalts) and continue northwards to form the Crocker Range of Sabah.

In the area covered by the expedition, the dominant structural features evident in the geomorphology are the folding and faulting along NE-SW to N-S trending axes. However, the area is structurally complex, with evidence of NNW-SSE cross-faults and peaks.

Sediments, depositional environments and stratigraphy

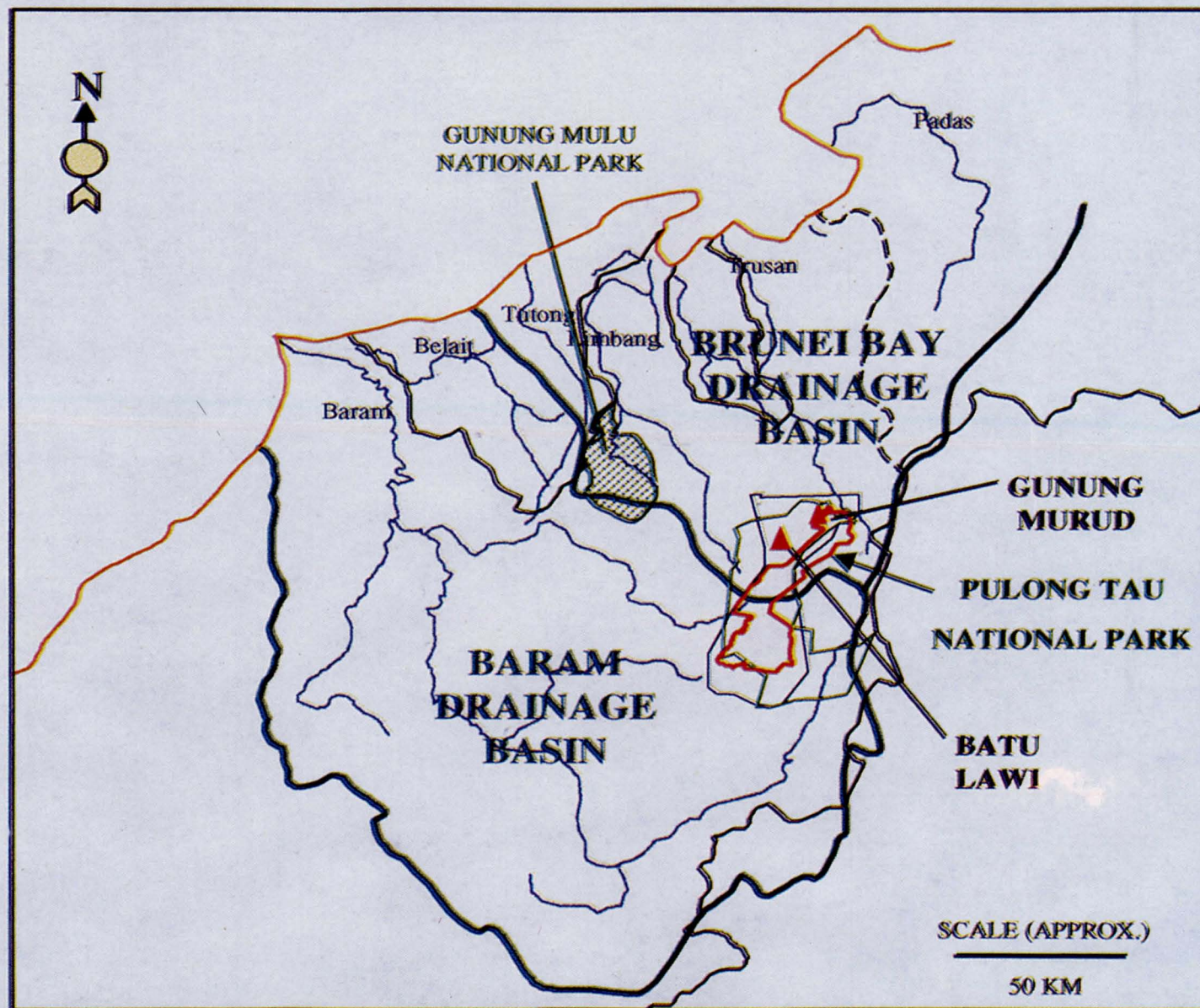
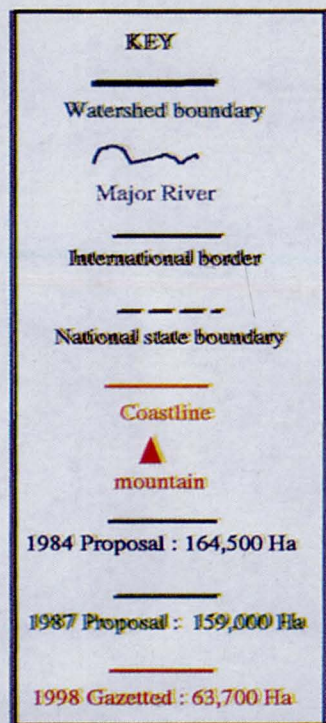
The geology of the Kelabit Highlands has yet to be mapped systematically and geological maps remain speculative over large parts of the area. The basic stratigraphic subdivisions have, however, been established.



BASIC GEOLOGICAL SKETCH MAP ALONG EXPEDITION ROUTE

- LEGEND**
- TRACK-ROAD
 - EXPEDITION ROUTE
 - GPS WAYPOINT
 - INTERNATIONAL BOUNDARY
 - VILLAGES
 - RUBBER PLANTATION
 - MELIGAN FORMATION SANDSTONES
 - SETAP SHALE
 - FEATURE/POINT OF INTEREST
 - MOUNTAIN PEAK
 - CAMP SITE

MAP V : SKETCH MAP ILLUSTRATING PULONG TAU'S POSITION RELATIVE TO MAIN DRAINAGE BASINS OF NORTHERN BORNEO



based on Sandral (1996) -
The Geology & Hydrocarbon Resources of
Brunei Darussalam

a) *Long Bawan and Kelabit Formations: Continental to Coastal & Lagoonal environments*

The sediments currently exposed at surface in the eastern part of the Kelabit Highlands comprise continental 'red' beds (the red colour is due to oxidation of iron and is typical of desert environments), and coal-bearing sandstones of the Late Cretaceous to Eocene Long Bawan Formation. These pass westwards into Kelabit Formation mudstones, commonly containing lignitic (coaly) layers, thin lenses of limestone and occasional pebbly conglomerates. These are interpreted as of coastal to lagoonal origin and have been dated as of Early Oligocene to Early Miocene (Tertiary) age. Salt springs at various localities in the area may indicate the presence of subsurface evaporite deposits (comprising salts such as halite and gypsum derived from evaporation of seawater). An alternative hypothesis is that the springs are sourced from salty waters expelled from underlying 'normal' open marine sediments which reach the surface along deep-seated faults.

Further west, but still within the area interpreted as part of the stable Kelabit Highlands microcontinent, are sediments assigned to the Meligan and Setap Shale Formations.

b) *Meligan Formation: Deltaic (river delta) environment*

The Meligan Formation is the name given to the massive sandstones forming the prominent mountain range of the Tamu Abu, including the peaks of Batu Lawi and Gunung Murud. The medium to coarse-grained, mainly grey sandstones are interpreted as the deposits of an Middle Oligocene to Early Miocene delta plain and braided river system which prograded (migrated) westwards in response to uplift of the Crocker-Rajang hinterland.

c) *Setap Shale Formation: Deep marine environment*

The Setap Shale is exposed mainly to the west of the Meligan sandstones. It is characterised by deeper water marine mudstones, with some thin turbidite sandstones (deposits of chaotic sediment-charged flows moving across the sea floor), and has been dated as of Early Oligocene to Early Miocene age.

d) *Recent alluvium: Fluvial (river) environment*

Quaternary to present day alluvium (river-deposited sands and clays) forms the sediments in the river valley bottoms within the Kelabit Highlands.

Geology and soil types of the expedition route

The expedition route traversed the Meligan and Setap Shale Formations (Map IV).

i) *Pa Ukat to Tamu Abu ridge*

Few outcrops were seen, but the underlying rock type is interpreted as structurally simple Meligan sandstones.

ii) *Tamu Abu range*

The high ridge with its steep scarp faces is interpreted as a complex fault zone and the 'notch' in the ridge which provides the access point for the trekking route is interpreted as a major cross-fault. This cross-fault is oriented roughly NNW-SSE and is thought to be the structural boundary between the Setap and the Meligan at the SW end of the Setap Shale inlier (see iii and v below). The Batu Buli peak is oriented roughly parallel to this structure.

iii) *Low ground west of the Tamu Abu*

This topographically flat area some 8km long by 3-6 km wide is interpreted as a Setap Shale inlier (isolated outcrop of older rocks surrounded by younger rocks). Geologists think that the Setap underlies the Meligan stratigraphically, but the contacts here are interpreted as primarily structural. The interpretation is new and based on observations of Setap between Batu Lawi and Gunung Murud (see v below).

iv) *Batu Lawi*

The Meligan sandstones are interpreted as forming the rugged high ground west of the flat area of Setap shales, and culminating in the peak of Batu Lawi. An alternative hypothesis is that the Batu Lawi sandstones represent a thick turbidite unit developed within the Setap. This contention could be tested by further field mapping.

v) *Batu Lawi to Gunung Murud*

The route traversed areas of both Meligan sandstones and Setap Shales. The expedition records of claystones and turbidite sandstones of the Setap Shale in stream sections between Batu Lawi and Gunung Murud appear to be a

new observations, as these have not been recorded on previous geological maps of the area (Singh 1998), which have assigned the area to the Meligan. It has led to a revised geological interpretation for the area of low ground west of the Tamu Abu.

vi) *Gunung Murud and route north to Ba'Kelalan*

The major peak of Gunung Murud and the high ground to the north is interpreted as being formed by Meligan sandstones, being more resistant to weathering than the softer shales/clays.

There is clearly a strong relationship between the geology and the topography in the area, with the higher elevations and steeper slopes formed by the sand-rich Meligan and the low-lying flatter ground developed over the soft clay-rich Setap. As expected, there are distinct differences in forest types between these two areas (see next section; Observations on the Vegetation of Pulong Tau).

Geomorphology and watershed protection

The Kelabit Highlands form a mountainous area bounded on the west and north-west by the series of ridges of the Tamu Abu range. These ridges are oriented with their axes in a NE-SW direction and reach heights of 2027 metres at the peak of Batu Lawi and 2423 metres at Gunung Murud, Sarawak's highest mountain. The ridges are thought to be primarily a result of uplift associated with faulting, combined with increased resistance to erosion (i.e. Meligan sandstones being harder than Setap clays).

The present-day saucer-shaped basins, separated by narrow faulted anticlines are later structural features rather than being of depositional origin. The steep scarp slopes at the edges of the Tamu Abu mountain range are interpreted as representing faulted contacts. A series of flat-bottomed inter-montane valleys are also developed between the ridges; some (outside the area of the proposed national park) are farmed for rice cultivation.

The Pulong Tau National Park, as originally proposed, covers the head of the water catchment area for two major drainage basins (Map V): the Baram (Baram & Belait rivers) and the Brunei Bay (Limbang, Tutong, Trusan & Padas rivers) basins (Sandal 1996). As such, it has a vital role in controlling the run-off of these major rivers, with the forest and soil cover acting as a 'sponge', absorbing

rainfall and releasing it slowly into the drainage basin. Recent catastrophic flooding events in the Indian subcontinent (notably Bangladesh) and in China have been linked to upper watershed deforestation in the Himalayas and upper Yangtze regions, respectively. This causal link has been sufficiently clearly established for the Chinese government to have banned logging in the areas of the upper river systems.

A likely consequence of logging the area around Pulong Tau will be increased run-off of sediments into the Baram and Limbang river systems, with greater flooding potential in the low-lying coastal areas of Sarawak and Brunei. A risk analysis of the benefits of the logging versus the flood damage potential is beyond the scope of this report, but it should be an important consideration in evaluating the economic benefits which the proposed Pulong Tau National Park could bring to Sarawak and Malaysia.

3.2 Observations on the Vegetation of Pulong Tau

Introduction

This section of the reports describes the changes in vegetation along the expedition route, the tree flora of several small plots surveyed at each campsite and some comments on noteworthy plants seen along the route.

To date, no published flora of the proposed Pulong Tau National Park is available. Several botanical collections of various detail have been made from Gunung Murud and the Batu Buli to Batu Lawi route (e.g. Beaman 1998; Ipor 1998). However, these studies tended to be of short duration and are likely to be quite incomplete. Furthermore, no attempt at summation of accumulated botanical records into a vegetation map, even of the restricted collection areas, has been made. Nonetheless, the flora of the proposed park is known to include a wide range of the vegetation types found in Borneo (especially the montane elements), and can be expected to be representative of the upland flora of northern Borneo (National Parks & Wildlife Office Sarawak 1987).

The typical zonation of vegetation with altitude seen so clearly in Peninsular Malaysia is less distinct in Borneo where soil type and topography blur the boundaries of vegetation types (Ashton 1995). This can be observed in Pulong Tau where very different vegetation types often abut whilst overlapping in altitude. Roughly speaking, the lower areas of the

proposed park can be expected to support Upper Mixed Dipterocarp forest, grading into Oak-Laurel forest at higher altitudes. Heath forest (*Kerangas*) is expected in lower areas overlying white sand soils, common towards the southern end of the proposed park and immediately outside around Bario, whilst at higher altitudes this will be replaced by Mossy Elfin forest rich in *Rhododendron*. On exposed mountain summits, a montane heath vegetation, with many short-stature Ericaceous plants, can be found. Sandy soil is typically extremely nutrient-poor and as a result generally supports a distinctive and interesting herb flora including orchids and pitcher plants. In montane environments, distributions of species are often restricted leading to high levels of endemism. At least one species of pitcher plant, *Nepenthes murudensis* is endemic to Gunung Murud and it is likely that several other plants will be endemic to Pulong Tau.

In the south of the proposed park unique upland swampy grasslands, such as Ba'Sakun, have been recorded and are clearly of great botanical interest (National Parks & Wildlife Office Sarawak 1984), however, our route did not cross any of these.

The high diversity and distinctive character of the vegetation types encompassed by the proposed park makes Pulong Tau potentially valuable in the conservation of the floral biodiversity of this area of Borneo.

Methods

While hiking, notes were made on the general features of forest, any changes of forest type, and any interesting flowers or trees encountered. For many of the more noteworthy plants, such as orchids or pitcher plants, photographs were taken to allow later identification. This was deliberately done to avoid unnecessary collecting of potentially rare species. Noting down the date and time, it was later possible to use the route map (Map III) to estimate the approximate position of each observation and thereby develop a vegetation map. Although our observations were brief and we did not have the benefit of a specialist plant taxonomist in the party, we deliberately aimed at mapping our observations to derive a more ecological interpretation of the environment we were hiking through, rather than restricting our survey to isolated observations.

At each campsite a small plot was surveyed. Initially the plots were to be 20 x 20 m but this proved too time consuming. Hence the first plot was 15 x 20 m and each subsequent plot 10 x 10 m. All trees whose girth

(girth at breast height; 1.3 m above ground level) was above 15 cm were measured, the canopy width and height estimated, and identified by local name. Where a scientific binomial is available for the local names we have recorded these; otherwise we have continued to use the local names.

These plots have enabled us to quantify some of the characteristics of the vegetation types we observed. From the basic data collected in the field we have calculated the total and mean basal area, total and mean canopy area, total volume and the relative dominance (contribution of basal area to the plot total basal area) for each species. For each plot we calculated the total basal area, total volume, mean maximum height (mean height of 5 tallest individuals) and species richness.

In addition, Simpson's diversity index,

$$D = 1 - \sum(p_i)^2$$

where p_i = the proportion of individuals contributed by the i th species; an index of similarity between the plots,

$$S = 2c/(a + b)$$

where a and b are the number of species in each plot and c = number of shared species; and a dominance index (similar to the diversity index but where p_i = proportion of basal area contributed by the i th species) were calculated. All data for Plot 1 was adjusted to account for its larger size. Each plot had one unidentified species and for the purposes of this report these were treated as a single species in the calculation of the above indices. This resulted in slightly inflated values for the similarity index (S), whilst providing more conservative estimates of diversity (D).

Results

Table 3-1 Vegetation types encountered during the expedition

- | |
|--|
| 1. Cultivated land (paddy field / buffalo pasture) |
| 2. Secondary forest |
| 3. Heath forest (<i>Kerangas</i>) |
| 4. Upper Mixed Dipterocarp forest |
| 5. Oak-Laurel forest |
| 6. Mossy Elfin forest |
| 7. Summit heath |

Description of vegetation types observed along the route

Our botanical observations over the nine days of the expedition together with surveys of five vegetation plots allowed us to identify seven distinct vegetation types between Bario and Ba'Kelalan (Table 3-1). These results are described below and illustrated on the vegetation map (Map VI). A great variety of interesting plants, particularly orchids and pitcher plants, were observed, notes on some of which also appear in Map VI. Table 3-2 summarises our observations of especially noteworthy plants, giving the species, location and method of observation / identification, field description and whether or not a photographic record was made. What follows below is a brief description of the changing vegetation encountered over each day of the expedition.

28 August 1998

The vegetation immediately around the airport in Bario is typical *Kerangas* forest, though obviously highly disturbed and interspersed with cleared fields. This *Kerangas* has the character of typical sclerophytic vegetation. It is of short stature (approx. 5 - 12 m), with only a few large diameter trees found in wetter patches. Common families include Ericaceae, Euphorbiaceae and Myrtaceae.

The *Kerangas* forest continued along the side of the track as far as Pa'Ukat where, around the longhouse, are found the wet paddy fields for which Bario is famous. The Kelabit Highlands is the only area of Borneo where wet paddy farming was traditionally conducted and there is still considerable debate as to how the Kelabit and Lun Bawang people, isolated as they are in the centre of Borneo, developed the technology. The paddy fields are generally small and bounded by low, about 30 cm, earthen banks that often have irrigation channels running between them. They are very picturesque, a locally important cultural landscape feature, and already today a tourism attraction.

From there the path entered an area of secondary forest where most of the larger trees have been extracted for local building and from which firewood is also collected. This forest is generally short in stature (< 10 m) and few trees are bigger than about 30 cm diameter. The forest appears scrubby and most trunks are of a similar size. Small, typical secondary forest plants such as members of the Melastomataceae and especially figs (*Ficus*, Moraceae) were common in this forest. Gradually, the path entered less disturbed

forest until we were walking in tall Upper Mixed Dipterocarp Forest. This forest was clearly species-rich and contained some very large trees, especially *Agathis borneensis* (Araucariaceae) and *Shorea* spp. (Dipterocarpaceae). Members of the Fragaceae, especially *Lithocarpus* species, were also a conspicuous component. Epiphytes, especially large Bird's Nest ferns (*Asplenium nitidus*), were common but ground vegetation was limited to occasional palms, such as *Licuala*.

29 August 1998

As the path ascended to the gap in the Tamu Abu range, the stature of the forest gradually decreased, though even at the gap the canopy still reached about 25 m in height. The forest here was Oak-Laurel forest with many trees of *Lithocarpus*, *Garcinia* (Clusiaceae) and *Callophyllum* (Clusiaceae) species. On the narrow ridge leading to the gap were several large *Tristaniopsis* (Myrtaceae) with their distinctive dusty red, peeling bark. Once at the gap, although still Oak-Laurel forest, there was a conspicuous change in character to much mossier forest with many large tree ferns gracing the under-storey. Immediately after the gap, as the path followed a route over the moss-covered boulders and thence over Batu Buli, the forest changed again to Mossy Elfin Forest. This forest is shorter in stature (< 10 m) and appears much less diverse, with mainly *Eugenia* (Euphorbiaceae) and *Rhododendron* (Ericaceae) species. *Tristaniopsis* was also common, especially along the banks of the stream. The ground, as well as many branches and trunks, were completely covered in a carpet of mosses, liverworts and lichens. The forest grows over a thin layer of sandy peat that was visible along the trail where the covering of moss had worn away. We found many pitcher plants (in particular *Nepenthes reinwardtiana* and *Nepenthes pillosa*) and orchids along this section of the trail. Nearing Camp One, the path dropped down to the Ulu Limbang, entering again the bigger-statured Oak-Laurel forest which appeared much more diverse.

30 August 1998

Between Camp One and Camp Two the vegetation changed from relatively tall Oak-Laurel forest at Camp One, to Mossy Elfin forest on the top of the ridge, before returning to Oak-Laurel as the path descended towards Camp Two. On the final descent to Camp Two there were occasionally some very large trees including some *Shorea* species, indicating a return to the boundary with the Upper Mixed Dipterocarp forest. This forest also had many *Agathis borneensis*.

31 August 1998

The ascent from Camp Two to the female summit of Batu Lawi was brief. After climbing out of the Oak-Laurel forest there was only a short section in Mossy Elfin forest before reaching the steep summit slope which is covered in mountain heath vegetation and large sandstone boulders. The shrubs here were mainly *Rhododendron*, though some others such as *Callophyllum* were present. Tall shrubs, over 3 m, were rare and on the female peak itself, the vegetation is much more open with many ground herbs and ferns. Here, several orchids and some flowering *Rhododendron* spp. were found.

1-2 September 1998

Our path from Camp One to Gunung Murud left the regular hiking route and cut through the forest. Following the Ulu Limbang upstream, we encountered predominantly Oak-Laurel forest whilst passing through patches of Mossy Elfin forest, either on ridges or simply on areas of slightly higher ground. The border between these forest types was usually distinct. On the morning of the first day out from Camp One we ascended a ridge to view Gunung Murud and found it to be covered with Screw Palms (*Pandanus*). During the afternoon our path took us through an area of Mossy Elfin forest which we did not leave until just before the evening campsite. Almost all of the next day's hike was through Oak-Laurel forest, although in the early afternoon we entered Mossy Elfin forest again for a little over an hour before returning to Oak-Laurel forest.

3 September 1998

The day spent climbing Gunung Murud was perhaps the most instructive in demonstrating the diversity of vegetation types in the area. Immediately upon leaving the camp site we re-entered the Mossy Elfin forest, gradually climbing up to a small knoll. Here we found a large variety of pitcher plants including

Nepenthes reinwardtiana, *N. pillosa*, and *N. veitchii*. Continuing, we entered an area of open Oak-Laurel forest. Here, evidence of Bearded Pig (*Sus barbatus*) was abundant. The Oak-Laurel forest continued until the steep escarpment of Gunung Murud. Soon, we were scrambling and slipping through a tangle of *Rhododendron* in short Mossy Elfin forest. This continued until the summit where montane heath vegetation similar to that on Batu Lawi was observed. In contrast to the summit of Batu Lawi, the area was much more extensive and in sheltered gullies taller ericaceous shrubs were found.

4 September 1998

Amongst the ericaceous heath we found several orchids and pitcher plants, including the mountain's endemic *Nepenthes murudensis*. As the path descended to the saddle between Gunung Murud's two summits it passed through an area of taller heath similar in appearance to *Kerangas*, being drier in character and lacking the moss cloaking characteristic of the Mossy Elfin forest. *Tristaniopsis* was common along the stream sides. Lower down this vegetation merged with Oak-Laurel forest, which continued until the Church Camp.

5 September 1998

Leaving Church Camp the path headed up steeply to Gunung Murud's second summit. The trail was cut through Mossy Elfin Forest and only at the highest point was there a small area of summit heath. The trail then descended steeply, passing quickly into Oak-Laurel forest. Initially this was rather mossy and had many tree ferns but further on the forest became taller and more open. The logging access roads reached roughly to the point where the Oak-Laurel forest graded into Upper Mixed Dipterocarp forest. Although cut through by access roads, the Upper Mixed Dipterocarp forest had not been logged yet when we visited. This forest continued until within two hours of Ba'Kelalan where it became increasingly disturbed due to the local extraction of building timber. Approximately 30 minutes from the village the path left the forest and entered an area of scrubby buffalo pastures interspersed with bamboo clumps.

Table 3-2 Noteworthy plants observed along the expedition route

| Date | Time | Notes |
|---------------|-------|---|
| 28th August | 13:30 | Cauliflorous fig, <i>Ficus schwarzii</i> , male tree with a huge crop of developing syconia |
| | 13:35 | More figs, <i>F. bunneo-aurata</i> and <i>F. parietalis</i> |
| 29th August | 11:45 | Found cones of Tumu, <i>Agrathis borneensis</i> , very common |
| | 14:00 | Several pitcher plants in mossy elfin forest. <i>Nepenthes reinwardtiana</i> and <i>N. pillosa</i> |
| | 17:00 | At Camp One found figs <i>F. sarawakensis</i> and <i>F. megaleia</i> |
| 30th August | 13:30 | Fruit of Aka (?fruit of tree eaten by gibbon) |
| | 14:30 | Very large <i>Shorea</i> on path |
| | 15:00 | Large strangling fig, <i>F. xylophylla</i> . Second strangler leaf similar to <i>F. xylophylla</i> but smaller, possibly <i>F. subsecta</i> |
| 31st August | 10:00 | Summit of Batu Lawi, found <i>Rhododendron</i> sp. in flower |
| 1st September | 10:00 | Following up river, many <i>Tristaniopsis</i> |
| | 10:20 | Beautiful <i>Goniothalamus</i> with small (2 cm long) flowers borne near ground |
| | 11:00 | Many <i>Pandanus</i> crowded on top of ridge |
| 2nd September | 13:00 | Orchid in flower, <i>Coelogyne</i> , sp. |
| 3rd September | 08:30 | Patch with many pitcher plants, <i>Nepenthes reinwardiata</i> , <i>N. pillosa</i> , <i>N. veitchii</i> . |
| | 16:00 | <i>Rhododendron</i> sp in flower |
| 4th September | 07:30 | Found many of Gunung Murud's endemic pitcher plant, <i>N. murudensis</i> |
| | 08:30 | Two Orchid species in flower |
| | 14:00 | Large orchid in flower at Church Camp, <i>Coelogyne radiofrens</i> |

Description of the small census plots

The information derived from the small plots should not be extrapolated too far, as single 10 x 10 m plots cannot possibly be completely representative of the forest surrounding them. Plot 1 and Plot 3 were both set in tall Oak-Laurel forest on the border with Upper Mixed Dipterocarp forest. The other three plots were all set in higher altitude Oak-Laurel forest. However, Plot 2 was located on the flat river terrace which supported a taller forest whilst Plots 4 and 5 were both located in mossy, slightly shorter-stature forest.

Table 3-3 lists the species recorded in each plot and compares them in terms of number of individuals, basal area, canopy area, volume and their relative dominance. None of the plots are particularly similar but given the small sampling area this is hardly surprising. Interestingly, *Agathis borneensis*, although reported as the most dominant species in this

area (Ipor 1998), only occurred as a single individual in two of the plots. *Eugenia* (Myrtaceae) was the most commonly recorded genus and was more prevalent, both in terms of species and individual contribution, in the higher altitude plots.

Table 3-3 Results from the small forest plots. Plot 1: 28/08/98, 1st campsite below Tamu Abu (20 x 15 m); Plot 2: 29/08/98, Camp One, Ulu Limbang (10 x 10 m); Plot 3: 30/08/98, Camp Two, Batu Lawi (10 x 10 m); Plot 4: 01/09/98, 1st forest camp, Ulu Limbang (10 x 10 m); Plot 5: 02/09/98, 2nd forest camp, Ulu Limbang (10 x 10 m).

| Plot | Family | Local name | Species | No | Basal area (cm ²) | | Canopy area (m ²) | | Volume (m ³) | Relative dominance |
|----------|------------------|--------------------------|-------------------------------|------|-------------------------------|--------|-------------------------------|------|--------------------------|--------------------|
| | | | | | total | mean | total | mean | | |
| Plot 1 | ? | Eukbelanai | ? | 10 | 317.8 | 31.8 | 144.4 | 14.4 | 1.43 | 17.5 |
| | Myrtaceae | Oubar labad | <i>Eugenia</i> sp.1 | 4 | 469.4 | 117.36 | 241.5 | 60.4 | 15.70 | 25.8 |
| | ? | Kelabono | ? | 3 | 244.6 | 81.5 | 49.6 | 16.5 | 3.47 | 13.4 |
| | Moraceae | Bua labo | <i>Artocarpus</i> sp.1 | 2 | 154.5 | 71.2 | 71.0 | 35.5 | 2.83 | 8.5 |
| | Rhizophoraceae | Lakae | <i>Carallia brachiata</i> | 2 | 185.9 | 92.9 | 80.1 | 40.1 | 5.84 | 10.2 |
| | Fagaceae | Salad buda | <i>Lithocarpus</i> sp.1 | 2 | 69.7 | 34.9 | 20.8 | 10.4 | 0.18 | 3.8 |
| | ? | ? | ? | 2 | 155.1 | 77.6 | 125.3 | 62.7 | 2.17 | 8.5 |
| | Araucariaceae | Bindang | <i>Agathis borneensis</i> | 1 | 59.0 | | 106.0 | | 0.80 | 3.2 |
| | Hypericaceae | Dad tamlian | <i>Cratoxylum</i> sp.1 | 1 | 16.6 | | 3.7 | | 0.01 | 0.9 |
| | ? | Darao | ? | 1 | 47.1 | | 17.0 | | 0.16 | 2.6 |
| | ? | Mararian | ? | 1 | 48.7 | | 12.5 | | 0.23 | 2.7 |
| Rutaceae | Para labo | <i>Pleiospermum</i> sp.1 | 1 | 52.1 | | 26.9 | | 0.37 | 2.9 | |
| Plot 2 | Euphorbiaceae | Tuba balud | <i>Euphorbia</i> sp.1 | 3 | 177.4 | 59.1 | 30.6 | 10.2 | 1.39 | 16.5 |
| | ? | Marabu | ? | 2 | 54.0 | 27.0 | 15.5 | 7.8 | 0.05 | 5.0 |
| | Myrtaceae | Oubar labad | <i>Eugenia</i> sp.1 | 2 | 149.5 | 74.7 | 42.1 | 21.1 | 1.32 | 13.9 |
| | ? | ? | ? | 2 | 48.4 | 24.2 | 6.2 | 3.1 | 0.04 | 4.5 |
| | Myrtaceae | Oubar buda | <i>Eugenia</i> sp.2 | 1 | 78.8 | | 20.4 | | 0.74 | 7.3 |
| | Myrtaceae | Oubar wag | <i>Eugenia</i> sp.3 | 1 | 49.6 | | 6.1 | | 0.26 | 4.6 |
| | Leguminosae | Segarangan | <i>Fordia</i> sp.1 | 1 | 49.0 | | 33.9 | | 0.17 | 4.5 |
| | Fagaceae | Salad paddi | <i>Lithocarpus papillifer</i> | 1 | 87.0 | | 64.7 | | 0.90 | 8.1 |
| | Fagaceae | Salad urung | <i>Lithocarpus burkili</i> | 1 | 119.3 | | 61.0 | | 1.59 | 11.1 |
| | Araucariaceae | Bindang | <i>Agathis borneensis</i> | 1 | 43.6 | | 30.0 | | 0.12 | 4.1 |
| | ? | Bitaur | ? | 1 | 29.8 | | 20.0 | | 0.05 | 2.8 |
| | ? | Marabada | ? | 1 | 53.4 | | 26.3 | | 0.18 | 5.0 |
| | ? | Lupau | ? | 1 | 46.2 | | 24.1 | | 0.08 | 4.3 |
| | Aquifoliaceae | Bubpuk | <i>Ilex cymosa</i> | 1 | 73.8 | | 15.2 | | 0.60 | 6.9 |
| Moraceae | Bua edti | <i>Artocarpus</i> sp.2 | 1 | 17.0 | | 0.7 | | 0.01 | 1.6 | |
| Plot 3 | Moraceae | Bua labo | <i>Artocarpus</i> sp.1 | 2 | 44.0 | 22.0 | 9.8 | 4.9 | 0.03 | 6.0 |
| | ? | Tarunpenan | ? | 1 | 84.5 | | 20.0 | | 1.42 | 11.4 |
| | ? | Bitaur | ? | 1 | 33.3 | | 3.9 | | 0.11 | 4.5 |
| | Fagaceae | Salad paddi | <i>Lithocarpus papillifer</i> | 1 | 96.4 | | 48.9 | | 1.11 | 13.1 |
| | ? | Eukbelanai | ? | 1 | 41.1 | | 21.3 | | 0.09 | 5.6 |
| | Myrtaceae | Oubar buda | <i>Eugenia</i> sp.2 | 1 | 45.2 | | 11.7 | | 0.14 | 6.1 |
| | Rutaceae | Para labo | <i>Pleiospermum</i> sp.1 | 1 | 77.9 | | 23.2 | | 0.58 | 10.5 |
| | Tiliaceae | Serdang | <i>Elaeocarpus</i> sp.1 | 1 | 42.7 | | 13.0 | | 0.13 | 5.8 |
| | ? | Urey | ? | 1 | 60.3 | | 24.2 | | 0.20 | 8.2 |
| | Lauraceae | Birar uwang | <i>Litsea</i> sp.1 | 1 | 61.9 | | 12.5 | | 0.27 | 8.4 |
| | ? | Lupau | ? | 1 | 18.2 | | 8.0 | | 0.01 | 2.5 |
| | ? | Belayo | ? | 1 | 54.6 | | 18.0 | | 0.26 | 7.4 |
| | Dipterocarpaceae | Serangan | <i>Shorea</i> sp.1 | 1 | 15.1 | | 3.5 | | 0.01 | 2.0 |
| | ? | ? | ? | 1 | 63.1 | | 14.1 | | 0.38 | 8.5 |
| Plot 4 | ? | Mararian | ? | 2 | 328.4 | 164.2 | 111.2 | 55.6 | 7.22 | 42.2 |
| | ? | Tabulin | ? | 2 | 69.7 | 34.9 | 8.6 | 4.3 | 0.16 | 9.0 |
| | Hypericaceae | Dad tamlian | <i>Cratoxylum</i> sp.1 | 2 | 72.8 | 36.4 | 34.7 | 17.4 | 0.16 | 9.4 |
| | Myrtaceae | Oubar tabu | <i>Eugenia</i> sp.4 | 2 | 259.4 | 129.7 | 175.6 | 87.8 | 5.08 | 33.3 |
| | Myrtaceae | Oubar buda | <i>Eugenia</i> sp.2 | 1 | 31.7 | | 8.9 | | 0.06 | 4.1 |
| | ? | ? | ? | 1 | 16.3 | | 1.6 | | 0.01 | 2.1 |
| Plot 5 | Myrtaceae | Oubar sp. | <i>Eugenia</i> sp.5 | 4 | 115.6 | 28.9 | 25.1 | 6.3 | 0.16 | 15.8 |
| | ? | Marabu | ? | 3 | 69.1 | 23.0 | 13.9 | 4.6 | 0.07 | 9.5 |
| | ? | ? | ? | 2 | 53.4 | 26.7 | 10.4 | 5.2 | 0.04 | 7.3 |
| | Myrtaceae | Oubar buda | <i>Eugenia</i> sp.2 | 1 | 24.5 | | 4.3 | | 0.03 | 3.4 |
| | Myrtaceae | Oubar tabu | <i>Eugenia</i> sp.4 | 1 | 52.8 | | 8.0 | | 0.24 | 7.2 |
| | ? | Kadfi | ? | 1 | 90.7 | | 34.4 | | 0.66 | 12.4 |
| | ? | Lapau | ? | 1 | 66.3 | | 9.1 | | 0.25 | 9.1 |
| | Tiliaceae | Kelannah | <i>Brownlowia</i> sp.1 | 1 | 20.1 | | 6.0 | | 0.01 | 2.8 |
| | ? | Ado | ? | 1 | 112.4 | | 19.6 | | 2.01 | 15.4 |
| | ? | Kati | ? | 1 | 47.4 | | 9.3 | | 0.20 | 6.5 |
| | Rubiaceae | Atap | <i>Nauclea</i> sp.1 | 1 | 77.2 | | 25.0 | | 0.38 | 10.6 |

Conversely, *Artocarpus* sp. 1 (Moraceae) and *Pleiospermum* sp. 1 (Rutaceae) were recorded only in the lower altitude plots. In other respects, however, the turnover of species and genera between plots does not follow a clear pattern.

Table 3-4 compares the plots on the basis of several ecological parameters. Again the small size of the plots is probably responsible for the slightly inconsistent results. The high value for the total basal area of trees in Plot 2 reflects the presence of several large trees on this flat river terrace site. Although Plot 4 had only a few individuals these included four large

trees producing the disproportionately high values for both total basal area and volume. Mean maximum height however appears to reflect the anticipated situation with Plots 1 & 3 in the lower altitude forest and Plot 2 on the river terrace being the tallest. If account is made for the clump of "Eukbelanai" in Plot 1 then the species richness also follows the expected pattern with the taller, lower altitude forests being more species-rich. The same applies to the diversity and dominance indices although, interestingly, all the plots are relatively diverse with many of species represented by a single individual.

Table 3-4 Characteristics of the five small forest plots

| Plot Location | Total basal area (cm ² per m ²) | Total volume | Mean max. height (m) | Species richness | Simpson's diversity index (D) |
|-------------------|--|--------------|----------------------|------------------|-------------------------------|
| 1 1st camp site | 6.07 | 11.06 | 23.4 | 8 | 0.84 |
| 2 Camp One | 10.77 | 7.46 | 14.6 | 15 | 0.92 |
| 3 Camp Two | 7.38 | 4.74 | 15.2 | 14 | 0.92 |
| 4 1st forest camp | 7.78 | 12.69 | 13.4 | 6 | 0.82 |
| 5 2nd forest camp | 7.29 | 4.05 | 10.2 | 11 | 0.87 |

Table 3-5 Comparisons of similarity of plots and dominance

| Plot | Similarity index | | | | | Dominance index |
|------|------------------|------|------|------|------|-----------------|
| | 1 | 2 | 3 | 4 | 5 | |
| 1 | * | 0.26 | 0.29 | 0.33 | 0.04 | 0.86 |
| 2 | | * | 0.17 | 0.10 | 0.15 | 0.91 |
| 3 | | | * | 0.20 | 0.08 | 0.92 |
| 4 | | | | * | 0.35 | 0.69 |
| 5 | | | | | * | 0.89 |

From the index of similarity (Table 3-5), which is based solely on presence or absence of species, none of the plots are very similar, the highest value being only 0.35. Again, some unusual results appear. Thus Plot 1 is most similar with Plot 4 and least with Plot 5 but Plot 4 is most similar to Plot 5. The latter is expected as these are the lower diversity, higher altitude sites. The lack of a consistent grouping amongst the other three plots, although they show a reasonable degree of similarity to each other, probably reflects the higher diversity coupled with the small plot size.

Discussion

The complex topography and juxtaposition of sandy and clay soils have led to a mosaic distribution of vegetation types across the area as a whole. This was especially evident with the continual crossing between rather tall Oak-

Laurel forest and more stunted Mossy Elfin forest during the Ulu Limbang section of the trek (Map VI).

To the uninitiated, the Oak-Laurel forest was surprisingly tall and open for a forest growing at this altitude (1000 - 2000 m). It also appears to be relatively diverse, as reflected by the high Simpson diversity index values. Three of the small plots had more than ten species (>5 cm dbh; diameter at breast height). With such small plots it is clear that only a small proportion of species at any one site are represented and this leads to the rather low similarity indexes between the plots. However, the complex topography also appears to have generated a high beta diversity, with riversides, well drained slopes, ridge tops and hollows, for example, all apparently supporting a slightly different forest. A more detailed survey using larger plots (0.5 or 1 ha) will be required to show this clearly.

The other vegetation type most frequently encountered was the Mossy Elfin forest. This was considerably less rich in terms of trees species diversity. However, it supports a fascinating array of herbaceous plants, especially the orchids and pitcher plants. The fact that this forest is nutrient-poor is also obvious from the dark, tea-coloured pools which are the result of tannins leached from decomposing leaves and indicate a slow and incomplete decomposition process. As explained above, the soil is composed of a thin sandy peat and the amount of surface water we observed reflects its poor drainage. This forest is found mainly in the elevated areas and ridge tops suggesting that the forest develops over rather hard, impervious sandstone that only allows the development of a thin soil, with a lot of surface run off and consequent nutrient leaching. Conversely, the Oak-Laurel forest appears to develop on deeper soils on the slopes and river valleys.

On our hike between Camp One and Gunung Murud, mostly over the Setap Shale, we tended to find Oak-Laurel forest associated with streams and turbidite sand outcrops, while Mossy Elfin forest occupied the flatter regions. Towards Gunung Murud, close to our second Forest Camp we found a distinct boundary between Mossy Elfin forest and tall Oak-Laurel forest with almost no associated change in elevation or inclination of the ground. Inspection of the soil however revealed that we had passed from a thin, slippery clay soil of the Setap Shale to a coarse-grained sandy soil, derived from the Meligan Sandstone. The latter had clearly allowed the development of a relatively deep, well-drained soil with which the Oak-Laurel forest was associated. Hence, within the Meligan Formation Oak-Laurel forest was associated with slopes allowing the development of a deep coarse grained sandy soil and Mossy Elfin forest with the resistant, poorly drained ridges.

On the other hand, within the Setap Shale, Oak-Laurel forest was found over outcrops of turbidite sands along the mountain streams and Mossy Elfin forest with the thin clay, and therefore poorly drained, soils of flatter areas.

In the case of the Mossy Elfin forest found on the steep slope of Gunung Murud, this had a thin covering of peaty soil over sandstone boulders and crags. In this case, although the source material was Meligan Sandstone, the steep inclination has led to very high run-off rate and, consequently, only a thin nutrient-poor soil could develop.

Clearly, complex topography and soil differences are responsible for complicated

distribution of forest types and a more precise survey would reveal differences within these general types. Thus, for example, we can reasonably expect that both the Oak-Laurel and Mossy Elfin forests overlying the sandy Meligan formation will be distinct from those over the clayey Setap Shales, and that the Mossy Elfin forest of the steep slopes is different from that on flatter areas.

The summit heath found on both the peaks of Batu Lawi and Gunung Murud is extraordinarily interesting for its diverse and highly endemic herbaceous flora. In general, mountain summits are better collected and studied than other areas because of their relatively small area and because botanists tend to find this environment interesting. Batu Lawi and Gunung Murud are no exception as the list of collections made there indicates (Beaman 1998). To this background our expedition can only add the short list of observations given in Table 3-2.

The route we followed through Pulong Tau revealed not only that the area has a montane flora representative of northern Borneo, but that these forests support a high diversity of species and complex and diverse association of forest types. This leads to a high turnover of species in a relatively small area. The high level of endemism and the presence of many fascinating plants, such as the pitcher plants and orchids, underlines the value of this area for conservation of the floral biodiversity of Sarawak.

3.3 Vertebrate Fauna of the Proposed Pulong Tau National Park

Introduction

As initially proposed, Pulong Tau National Park encompasses 164,500 ha of almost entirely undisturbed forest, from altitudes of approximately 900 m to 2650 m on Gunung Murud. As such, it can be expected to harbour a vertebrate fauna fully representative of the upland areas of northern Borneo. Evidence of rare and highly endangered species, such as the Sumatran Rhinoceros (*Dicerorhinus sumatrensis*) or Clouded Leopard (*Neofelis nebulosa*), and the abundance and visibility of many other species suggest that the remoteness of the area, especially that around Batu Lawi (Map II), has largely protected the fauna from the depredations of hunting (National Parks & Wildlife Office 1987).

Isolation following fragmentation of habitat into small pockets of intact upland forest

surrounded by expanses made unsuitable though human modification, is a major threat to such vertebrates. The often small size of these remaining forest patches (they can be individual mountain peaks) limits the size of populations they can support, placing the corresponding species at increased risk of extinction. Certain resources may be absent, forcing animals to migrate in a search which may be fruitless if the nearest suitable patch is simply too distant. Reproduction may also be affected - small population sizes can hinder mate-location or force animals to mate with close relatives, increasing the risk of genetic disorders manifesting in their offspring. Finally, small habitat patches are at greater intrinsic risk from the extremes of nature. Single, random environmental events such as fires, disease outbreaks or droughts have disproportionately large effects on small, isolated populations.

For these reasons, the existence in Pulong Tau, of a large area of quality montane habitat, capable of supporting populations of the largest mammals and birds (and, as a corollary, many smaller vertebrate species) is extremely exciting. The vertebrate fauna of the proposed park has yet to be inventoried in detail and that of the uplands of Bario is generally poorly known. For example, based on limited collections and early studies (e.g. Davies 1958), Payne *et al.* (1985) use "Kelabit Highlands" to describe distributions of mammals in the area, giving no indication of specific distributions within this large and habitat-diverse region. In 1986, Sarawak's National Parks & Wildlife Office conducted a survey of the proposed park and found evidence of a small breeding population of Sumatran Rhinoceros (*Dicerorhinus sumatrensis*) in the Ulu Sg. Limbang region (National Parks & Wildlife Office 1987). Prior to this discovery, the species was considered extinct in Sarawak. Other mammals were found in abundance, Clouded Leopard being apparently common in the southern part of the park, but no detailed list was published. The report also discussed the large populations of Bearded Pig (*Sus barbatus*) found throughout the Tamu Abu range, stressing the importance of Pulong Tau's forests for maintaining their populations. These pigs undertake periodic migrations from the Oak-Laurel forests down into the lowland Dipterocarp forests following the sporadic fruiting of the latter. The migrations are colossal in scale, lasting two to five years and involving hundreds of thousands of individuals, moving across the forest floor and crossing rivers - a natural phenomenon on

a par with the African Wildebeest migrations and, as such, a spectacular element of Sarawak's natural heritage (Caldecott 1984).

Birds

Compared to mammals, the birds of the Kelabit highlands have been studied somewhat more rigorously. However, bird surveys in recent years have not specifically concentrated on the area encompassed by Pulong Tau National Park. Two species lists published in the last four years (Gregory-Smith 1998, Sreedharan 1995) suggest that the avifauna of these highlands is diverse and representative of better described montane bird communities such as that of Gunung Kinabalu. There exists amongst the birds of Borneo an altitudinal partitioning of habitat and resources whereby community shifts can be recognised as one passes from the lowlands to the higher land. The range of altitude in Pulong Tau may therefore be reflected in the existence of several discrete avian communities within the park.

Mammals

The last major contribution to the knowledge of the mammal fauna of the proposed park was the survey conducted by the National Parks & Wildlife Office in 1986. In 1996 a study of small mammals was undertaken in the immediate vicinity of Bario. However, the capture rate was low and, apart from five bat species, only two common terrestrial species were recorded (Rahman *et al.* 1998). Simultaneously, larger mammals were recorded (mostly from casual observations by researchers working on other projects) but, again, most of the work was concentrated near Bario and relatively few species were recorded (Abdullah *et al.* 1998). These studies provide little information about the fauna of Pulong Tau, as they were largely conducted away from the primary forest.

Reptiles and Amphibians

Regarding reptiles and amphibians, a paucity of knowledge appears to be the norm for montane regions. In the most recent herpetological research in the area, Zainuddin (1998) recorded 18 frog species and four snake species (but no lizards) from the vicinity of Bario. Physiological constraints imposed by the cooler temperatures of the highlands are likely to limit the diversity of these cold-blooded vertebrates as altitude increases (Inger & Tan 1996). However, whilst this pattern is confirmed for snakes, some Bornean frogs appear to have adapted to montane habitats

(Inger & Tan 1996). Much remains to be discovered about reptiles and amphibians in Borneo and it is highly likely that new species remain to be discovered.

Aims of Vertebrate Survey

The aims of the vertebrate survey were:

1. to augment the scanty inventory of the proposed Pulong Tau National Park's vertebrate fauna;
2. to assess, in general terms, the degree of disturbance, diversity and endemism;
3. to pay particular attention for evidence of the Sumatran Rhinoceros (*Dicerorhinus sumatrensis*).

To achieve these aims, vertebrates were studied in three natural groups: birds, mammals, and reptiles & amphibians. For the third aim, the route of the expedition (Map III) was chosen largely to allow exploration of the general area in which Sumatran Rhinoceros was observed in 1986.

Methods

Birds

Avifaunal observations were made largely on an *ad hoc* basis during the each day's walk between camp sites. Additionally, when time permitted, birdwatching sessions were conducted in the early morning and late afternoon. Bird sightings were recorded in ten-species lists such that each observation was added to the current list only if it had not yet been recorded on that list. Once a list was complete a new one was started. This method allowed the construction of a species discovery curve and provided the basis for an index of commonness whereby the proportion of lists that a species appeared on reflected its relative abundance (or rather conspicuousness) in the area (MacKinnon 1993).

Mammals

Mammal records were made in three ways: direct observations of diurnal species; nocturnal live-trapping of small terrestrial mammals; and indirect observations based on calls, tracks, droppings and so forth. For practical reasons, no effort was made to survey bats. Direct observations, usually aided by binoculars, were made by all members of the expedition while trekking to Batu Lawi or between there and Gunung Murud and Ba'Kelalan (Map III). Small mammal live-trapping was conducted on most nights (except two occasions when time was lacking) and consisted of baiting collapsible, wire cage traps (30 x 15 x 15 cm) with sweet potato and

banana and placing them at approximately 20 metre intervals along transects perpendicular to the trail. Traps were set at dusk and collected shortly after dawn. Captured mammals were anaesthetised with chloroform, weighed, measured (length of head & body, tail, hind foot and ear length and width), identified and released. Although 50 traps were brought on the expedition, damage to some during the trip meant that only 35 were still working by the last night of trapping. The total number of trap nights was 255.

Species identifications were made following reference to the guide of Payne *et al.* (1985). This source was also used for field identification of mammal tracks. The local members of the expedition were able to identify mammal calls and other signs (e.g. diggings, droppings). In a similar manner to the bird census, species observations were arranged chronologically in lists of five species, each species occurring only once on a list. When a new list was started, species were recorded on it in the order they were observed until the list was complete. The number of lists on which a species occurs is therefore an index of its abundance and diversity can be assessed by the rate at which new species accrue on each subsequent list.

Reptiles and Amphibians

Snakes were recorded when encountered and photographed for subsequent identification. Frog sampling centred on the campsites and comprised locating individuals by their calls or by torchlight scans, followed by live capture in a butterfly net or by hand. To avoid damaging a frog's sensitive skin, rubber gloves were worn. Captured frogs were transferred to a clear plastic bag so that they could be handled easily and observed closely for identification purposes (using the key of Inger & Steubing 1997). Body length (snout to vent) was measured prior to release.

Results

Birds

During the course of the expedition 67 species of birds from 29 families were recorded, of which 13 species (19.4%) are endemic to Borneo (Table 3-6). These endemics represent 35% of Borneo's 37 endemic bird species. The species discovery curve for birds (Figure 3-1) created from the species lists has yet to plateau, suggesting that only a fraction of the total avifauna was recorded during the 9 days of sampling. Indeed, 64 additional species which have been recorded in the Kelabit highlands as a whole are likely to occur within the area of the proposed National Park (Appendix I). Thus, the total diversity of birds in the park is conservatively estimated to exceed 130 species. The majority of observed species (56 spp; 84%) were recorded relatively infrequently, being included on only one or two of the species lists made (Figure 3-2). Conversely, three species (Golden-naped Barbet, Mountain Imperial-Pigeon and Black-nest Swiftlet) were particularly common, appearing on 6, 7 and 8 of the 13 species lists, respectively.

Three broad bird communities could be discerned with respect to different habitat types included on the expedition route. In and around the human settlements of Bario, Pa Ukat and Ba'Kelalan, non-forest and forest-edge birds were common, many taking advantage of the padi fields as nesting and feeding sites. These species included Cinnamon Bittern, Eurasian Tree Sparrow, Yellow-vented Bulbul and Pacific Swallow. In the forest, bird sightings were not numerous enough to allow identification of distinct communities. In fact, a small number of bird species were recorded throughout the forest and appear to exemplify the avifauna of Pulong Tau. These species were Mountain Imperial-Pigeon, Chestnut-crested Yuhina, Black-nest Swiftlet and Golden-naped Barbet. The third obvious avian community could be found at the highest sections of the expedition route, notably the peaks of Batu Lawi and Gunung Murud. Ochraceous Bulbul and Mountain Blackeye were typically the only species recorded there (Map VII).

Particularly interesting observations include the sighting of Common Myna (likely to be an escape from Bario or Pa Ukat) and a number of lowland species (e.g. Blue-winged Leafbird and Little Green Pigeon) observed at higher altitudes than expected.

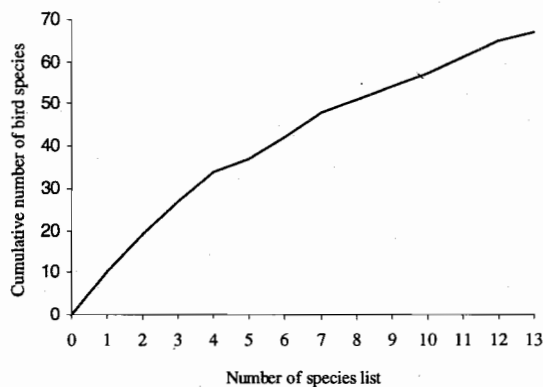


Figure 3-1 Species recruitment curve for birds observed along the expedition route

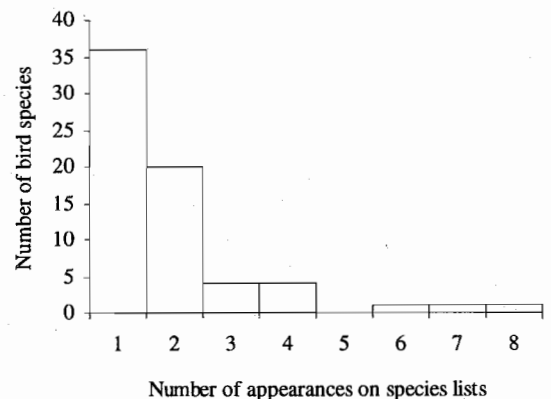
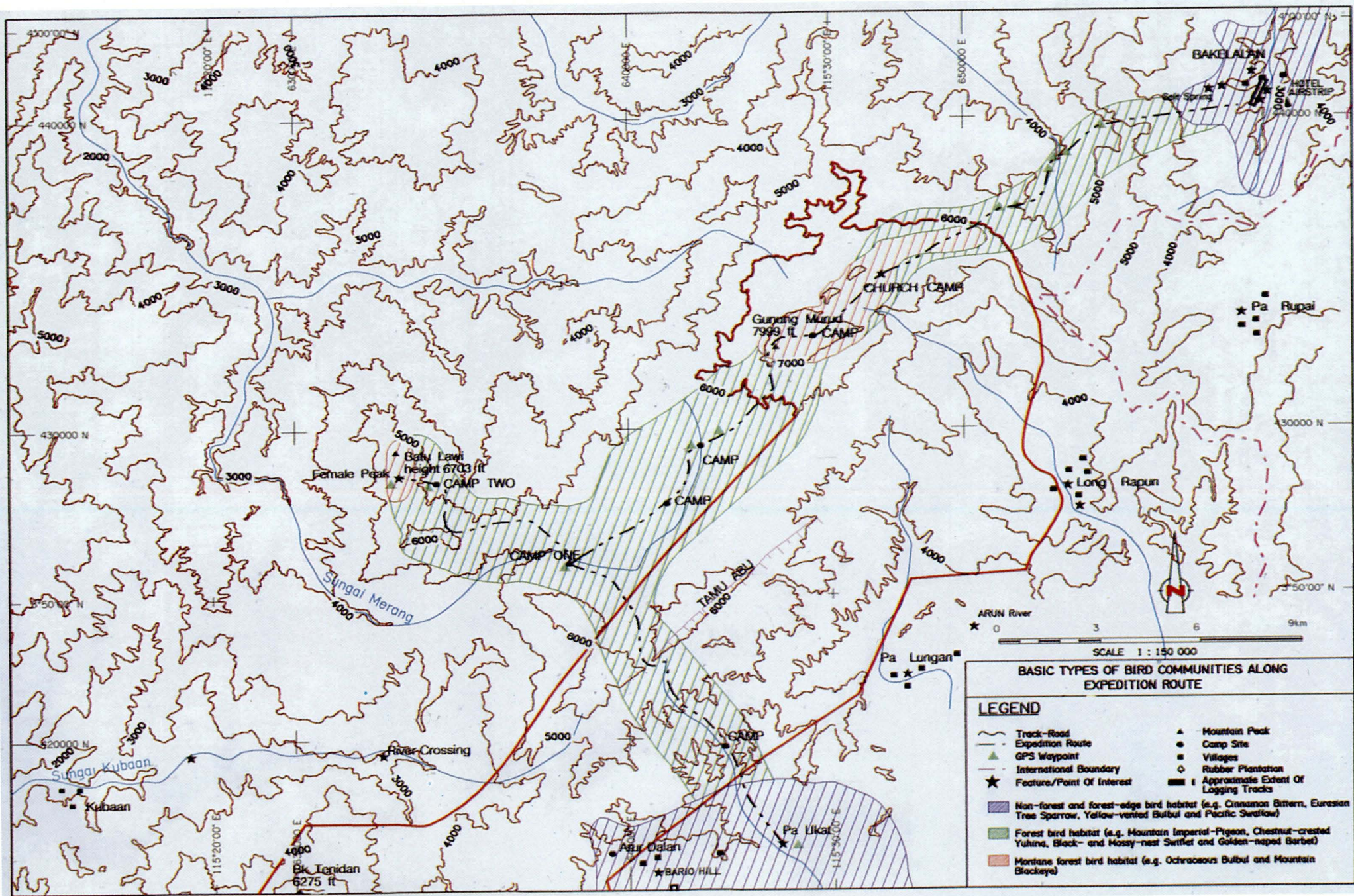


Figure 3-2 Frequency distribution of relative abundance of avian species

Table 3-6 Birds recorded between Bario and Ba'Kelalan. Species are listed by family with nomenclature following (MacKinnon & Phillipps 1993). Bold type indicates species endemic to Borneo.

| | | | |
|------------------------------|-----------------------------------|---------------------------------|---------------------------------|
| ARDEIDAE | | Yellow-vented Bulbul | <i>Pycnonotus goiavier</i> |
| Cinnamon Bittern | <i>Ixobrychus cinnamomeus</i> | Ochraceous Bulbul | <i>Allophoixus ochraceus</i> |
| ACCIPITRIDAE | | DICRURIDAE | |
| Black Eagle | <i>Ictinaetus malayensis</i> | Ashy Drongo | <i>Dicrurus leucophaeus</i> |
| PHASIANIDAE | | Bronzed Drongo | <i>Dicrurus aeneus</i> |
| Blue-breasted Quail | <i>Coturnix chinensis</i> | Hair-crested Drongo | <i>Dicrurus hottentottus</i> |
| Crimson-headed Partridge | <i>Haematoryx sanguiniceps</i> | ORIOOLIDAE | |
| SCOLOPACIDAE | | Black Oriole | <i>Oriolus hosii</i> |
| Common Sandpiper | <i>Tringa hypoleucos</i> | Black-and-crimson Oriole | <i>Oriolus cruentus</i> |
| COLUMBIDAE | | CORVIDAE | |
| Little Green Pigeon | <i>Treron olax</i> | Short-tailed Magpie | <i>Cissa thalassina</i> |
| Mountain Imperial-Pigeon | <i>Ducula badia</i> | Bornean Treepie | <i>Dendrocitta cinerascens</i> |
| Little Cuckoo-Dove | <i>Macropygia ruficeps</i> | Slender-billed Crow | <i>Corvus enca</i> |
| CUCULIDAE | | SITTIDAE | |
| Indian Cuckoo | <i>Cuculus micropterus</i> | Velvet-fronted Nuthatch | <i>Sitta frontalis</i> |
| Oriental Cuckoo | <i>Cuculus saturatus</i> | TIMALIIDAE | |
| Rusty-breasted Cuckoo | <i>Cacomantis sepulcralis</i> | Grey-throated Babbler | <i>Stachyris nigriceps</i> |
| Chestnut-bellied Malkoha | <i>Phaenicophaeus sumatranus</i> | Sunda Laughingthrush | <i>Garrulax palliatus</i> |
| APODIDAE | | Chestnut-capped Laughingthrush | <i>Garrulax mitratus</i> |
| Edible-nest Swiftlet | <i>Collocalia fuciphaga</i> | Chestnut-crested Yuhina | <i>Yuhina everetti</i> |
| Black-nest Swiftlet | <i>Collocalia maxima</i> | SYLVIIDAE | |
| Glossy Swiftlet | <i>Collocalia esculenta</i> | Yellow-breasted Warbler | <i>Seicercus montis</i> |
| TROGONIDAE | | Mountain Leaf-Warbler | <i>Phylloscopus trivirgatus</i> |
| Whitehead's Trogon | <i>Harpactes whiteheadi</i> | Mountain Tailorbird | <i>Orthotomus cuculatus</i> |
| Orange-breasted Trogon | <i>Harpactes oreskios</i> | Bornean Stubtail | <i>Urosphena whiteheadi</i> |
| BUCEROTIDAE | | MUSCICAPIDAE | |
| Helmeted Hornbill | <i>Buceros vigil</i> | Snowy-browed Flycatcher | <i>Ficedula hyperythra</i> |
| CAPITILIONIDAE | | Little Pied Flycatcher | <i>Ficedula westermanni</i> |
| Gold-whiskered Barbet | <i>Megalaima chrysopogon</i> | Grey-headed Flycatcher | <i>Culicicapa ceylonensis</i> |
| Red-crowned Barbet | <i>Megalaima rafflesii</i> | White-throated Fantail | <i>Rhipidura albicollis</i> |
| Mountain Barbet | <i>Megalaima monticola</i> | Asian Paradise Flycatcher | <i>Terpsiphone paradisi</i> |
| Golden-naped Barbet | <i>Megalaima pulcherrima</i> | PACHYCEPHALIDAE | |
| PICIDAE | | Bornean Whistler | <i>Pachycephala hypoxantha</i> |
| Checker-throated Woodpecker | <i>Picus mentalis</i> | STURNIDAE | |
| Orange-backed Woodpecker | <i>Reinwardtipicus validus</i> | Common Myna | <i>Acridotheres tristis</i> |
| EURYLAIMIDAE | | Hill Myna | <i>Gracula religiosa</i> |
| Whitehead's Broadbill | <i>Calyptomena whiteheadi</i> | NECTARINIIDAE | |
| HIRUNDINIDAE | | Ruby-cheeked Sunbird | <i>Anthreptes singalensis</i> |
| Pacific Swallow | <i>Hirundo tahitica</i> | Crimson Sunbird | <i>Aethopyga siparaja</i> |
| CAMPEPHAGIDAE | | Temminck's Sunbird | <i>Aethopyga temminckii</i> |
| Sunda Cuckoo-Shrike | <i>Coracina larvata</i> | Whitehead's Spiderhunter | <i>Arachnothera juliae</i> |
| Grey-chinned Minivet | <i>Pericrocotus solaris</i> | DICAEDAE | |
| Scarlet Minivet | <i>Pericrocotus flammeus</i> | Black-sided Flowerpecker | <i>Dicaeum monticulum</i> |
| CHLOROPSEIDAE | | ZOSTEROPIIDAE | |
| Blue-winged Leafbird | <i>Chloropsis cochinchinensis</i> | Everett's White-eye | <i>Zosterops everetti</i> |
| PYCNONOTIDAE | | Mountain Blackeye | <i>Chlorocharis emiliae</i> |
| Flavescent Bulbul | <i>Pycnonotus flavescens</i> | PLOCEIDAE | |
| | | Eurasian Tree Sparrow | <i>Passer montanus</i> |
| | | Black-headed Munia | <i>Lonchura malacca</i> |



SCALE 1 : 150 000

BASIC TYPES OF BIRD COMMUNITIES ALONG EXPEDITION ROUTE

LEGEND

| | |
|--|--|
| — Track-Road | ▲ Mountain Peak |
| - - Expedition Route | ● Camp Site |
| ▲ GPS Waypoint | ■ Villages |
| - - International Boundary | ▨ Rubber Plantation |
| ★ Feature/Point Of Interest | ▨ Approximate Extent Of Logging Tracks |
| ▨ Non-forest and forest-edge bird habitat (e.g. Cinnamon Bittern, Eurasian Tree Sparrow, Yellow-vented Bulbul and Pacific Swallow) | |
| ▨ Forest bird habitat (e.g. Mountain Imperial-Pigeon, Chestnut-crested Yuhina, Black- and Mossy-nest Swiftlet and Golden-naped Barber) | |
| ▨ Montane forest bird habitat (e.g. Ochraceous Bulbul and Mountain Blackeye) | |

Mammals

Over the nine days of the expedition 28 species of mammals were recorded (Table 3-9). Twelve of these are Bornean endemics and 11 species are montane specialists. Ten species are protected under Sarawak law.

The results of the small mammal trappings are presented in Table 3-7. Six species were caught in seven captures, an indication of the high diversity of small mammals in these forests. Only the first night's trapping was especially successful and after the third night no more captures were made, a possible consequence of bait and trap deterioration. Total trapping rate was relatively low (3.14 per 100 trap nights). Of particular interest were the captures of Mountain Giant Rat (*Sundamys infraluteus*), known from Gunung Mulu but not previously recorded in the Kelabit Highlands, and Summit Rat (*Rattus baluensis*), in Borneo previously only recorded from Mt Kinabalu, hence a first recording for Sarawak and the Kelabit highlands.

Table 3-8 presents, chronologically, the mammal observations made whilst hiking each day. Used in conjunction with Map III, the approximate position of each observation along the route was established. Referring to the vegetation map (Map VI), the vegetation type in which observations were made can then also be identified. It should not, of course, be assumed that each of these species only occurs at these points. Mammals are mobile and often elusive, hence the information on the observations only provides confirmation of where they were found.

Results of special interest include the observation of possible Oriental Small-clawed

Otter (*Aonyx cinerea*) spraints near the camp at about 2,500 m altitude on Gunung Murud. It appears to be much higher than any other record of the species and what it could be feeding on at that altitude is not at all obvious. The dropping was found on a prominent boulder by a stream 50 m from the camp and was approximately the correct size and shape for 'otter'. However, the field guide (Payne *et al.* 1985) does not provide a description of droppings and the local guides were unable to identify it, so it will have to remain unconfirmed. The second noteworthy sighting was the track of a civet (based on size, either Binturong or Masked Palm Civet), at about 2,400 m between the summit camp and Church camp. The former species has been recorded at altitudes of up to 1,500 m whilst the latter has been found at 2,100 m on Gunung Kinabalu (Payne *et al.* 1985; MacKinnon *et al.* 1996). Unfortunately, the details of the tracks were insufficient to separate which of these two species left them.

Figure 3-3 is a species discovery curve for the mammals based on the five-species lists constructed during the expedition. The curve is still climbing which suggests a significant proportion of the mammal fauna was not recorded. Judging by the broad distribution patterns described by Payne *et al.* (1985), we estimate the total mammal fauna of the proposed Pulong Tau National Park to include as many as 82 species. Most of the species recorded were montane species, for example Mountain Ground Squirrel, Slender-tailed Treeshrew or Mountain Giant Rat. However, a significant number appear to be more characteristic of lowland faunas (e.g. Plain Pygmy Squirrel, Yellow-throated Martin and Greater Mouse-Deer)

Table 3-7 Results of mammal trapping. Sex: M=male, F=female; Condition: Non Rep.=Non reproductive, Rep.=Reproductive; Measurements (all in mm): HB=Head & body; T=Tail; HF=Hind Foot; EL=Ear Length; EW=Ear Width; Wgt.=Weight in grammes. No captures were made after 30/8/98

| Date | Location | Species | Sex | Condition | HB | T | HF | EL | EW | Wgt. | |
|----------|-------------|----------------------------|-------------------------------|-----------|----------|-----|-----|------|------|------|-----|
| 28/08/98 | Forest camp | Chestnut Bellied Spiny Rat | <i>Maxomys ochraceiventer</i> | M | Non Rep. | 155 | 165 | 32.5 | 14.0 | 10.0 | 95 |
| | | Long-tailed Giant Rat | <i>Leopoldamys sabanus</i> | F | Non Rep. | 193 | 300 | 40.0 | 22.0 | 18.0 | 200 |
| | | Long-tailed Mountain Rat | <i>Niviventer rapit</i> | M | Rep. | 230 | 22 | 45.0 | 25.0 | 16.0 | 220 |
| | | Mountain Treeshrew | <i>Tupaia montana</i> | M | Rep. | 170 | 157 | 37.0 | 15.5 | 16.0 | 140 |
| 29/08/98 | Camp One | Summit Rat | <i>Rattus baluensis</i> | | 190 | 220 | 40? | 15.0 | 11.0 | 140 | |
| 30/08/98 | Camp Two | Chestnut Bellied Spiny Rat | <i>Maxomys ochraceiventer</i> | M | Non Rep. | 150 | 162 | 31.0 | 16.0 | 12.0 | 90 |
| | | Mountain Giant Rat | <i>Sundamys infraluteus</i> | M | Rep. | 290 | 300 | 55.0 | 23.0 | 15.0 | 485 |

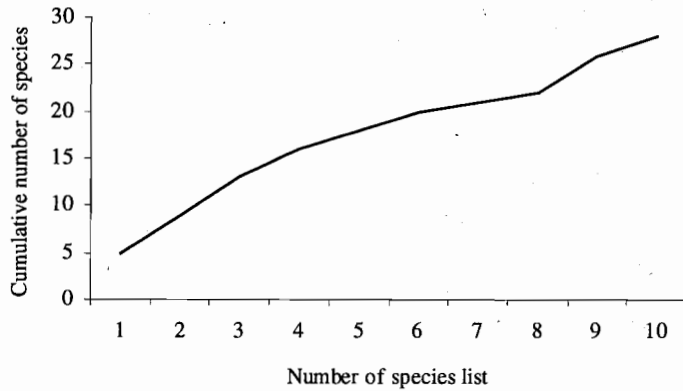


Figure 3-3 Species discovery curve for mammals recorded between Bario and Ba'Kelalan

Table 3-8 Mammal observations along the expedition route

| | <i>Morning</i> | <i>Afternoon</i> |
|-------|--|---|
| Day 1 | No observations | no observations |
| Day 2 | Bornean Gibbon Bornean Yellow Muntjac Sun Bear Hose's Langur Oriental Small-clawed Otter Common Porcupine Bornean Mountain Ground Squirrel | |
| Day 3 | Whitehead's Pygmy Squirrel Bornean Gibbon Smooth-tailed Treeshrew | Whitehead's Pygmy Squirrel Giant Squirrel Red-bellied Sculptor Squirrel |
| Day 4 | Bornean Gibbon Whitehead's Pygmy Squirrel | Bearded Pig |
| Day 5 | Bornean Yellow Muntjac Bornean Gibbon Pangolin Jentink's Squirrel | Bornean Yellow Muntjac |
| Day 6 | Bornean Gibbon Maroon Langur Jentink's Squirrel | Hose's Langur Bearded Pig Bornean Yellow Muntjac |
| Day 7 | Bornean Gibbon Pangolin Plain Pygmy Squirrel Bearded Pig Bornean Yellow Muntjac | Treeshrew (unidentified) |
| Day 8 | Bornean Gibbon Mountain Treeshrew Oriental Small-clawed Otter Civet (unidentified sp.) Greater Mouse-Deer Horse-tailed Squirrel | Lesser Gymnure |
| Day 9 | Bornean Gibbon Yellow-throated Marten Smooth-tailed Treeshrew Sun Bear | Red-bellied Sculptor Squirrel Red Muntjac |

Table 3-9 Mammals recorded between Bario and Ba'Kelalan. Nomenclature follows Payne *et al.*

| | Common name | Scientific name | Endemics | Montane | Protected | Observation |
|-----------------|----------------------------------|--------------------------------|----------|---------|-----------|-------------|
| Erinaceidae | Lesser Gymnure | <i>Hylomys suillus</i> | | * | | D |
| Tupaiaidae | Mountain Treeshrew | <i>Tupaia montana</i> | * | * | * | V, T |
| | Smooth-tailed Treeshrew | <i>Dendrogale melanura</i> | | * | | V |
| Cercopithecidae | Hose's Langur | <i>Presbytis hosei</i> | * | | * | V |
| | Maroon Langur | <i>Presbytis rubicunda</i> | * | | * | V |
| Hylobatidae | Bornean Gibbon | <i>Hylobates muelleri</i> | * | | * | V, C |
| Manidae | Pangolin | <i>Manis javanica</i> | | | * | S |
| Sciuridae | Giant Squirrel | <i>Ratufa affinis</i> | | | * | V |
| | Horse-tailed Squirrel | <i>Sundasciurus hippurus</i> | | | | V |
| | Jentink's Squirrel | <i>Sundasciurus jentinki</i> | * | * | | V |
| | Red-bellied Sculptor Squirrel | <i>Glyphotes simus</i> | * | * | | V |
| | Bornean Mountain Ground Squirrel | <i>Dremomys everetti</i> | * | * | | V |
| | Plain Pygmy Squirrel | <i>Exilisciurus exilis</i> | * | | | V |
| | Whitehead's Pygmy Squirrel | <i>Exilisciurus whiteheadi</i> | * | | | V |
| Muridae | Summit Rat | <i>Rattus baluensis</i> | | * | | T |
| | Mountain Giant Rat | <i>Sundamys infraluteus</i> | | * | | T |
| | Long-tailed Mountain Rat | <i>Niviventer rapit</i> | | * | | T |
| | Chestnut-bellied Spiny Rat | <i>Maxomys ochraceiventer</i> | * | * | | T |
| | Long-tailed Giant Rat | <i>Leopoldamys sabanus</i> | | | | T |
| Hystricidae | Common Porcupine | <i>Hystrix brachyura</i> | | | | Q |
| Ursidae | Sun Bear | <i>Helarctos malayanus</i> | | | * | S |
| Mustelidae | Yellow-throated Martin | <i>Martes flavigula</i> | | | | V |
| | Oriental Small-clawed Otter | <i>Aonyx cinerea</i> | | | * | F, S |
| Viverridae | Unidentified Civet | unidentified | | | * | F |
| Suidae | Bearded Pig | <i>Sus barbatus</i> | | | | F, S |
| Tragulidae | Greater Mouse-deer | <i>Tragulus napu</i> | | | | V |
| Cervidae | Red Muntjac | <i>Muntiacus muntjac</i> | | | | V |
| | Bornean Yellow Muntjac | <i>Muntiacus atherodes</i> | * | | | C |

(1985). Observations classed as visual (V), trapped (T), calls (C), dead (D), quills (Q), footprints (F) or other signs i.e. scratch marks, droppings (S)

Reptiles and Amphibians

Only four snakes were sighted during the expedition and, of these, only two remained motionless long enough for photographs to be taken. Both were Pit Vipers, an adult Wagler's Pit Viper (*Trimeresurus wagleri*), and a juvenile which may be *Trimeresurus popeorum*.

A total of ten frogs of six species were recorded (3-10). A Golden-legged Bush Frog (*Philautus aurantium*) was captured calling from a one metre high perch adjacent to the camp at the base of Batu Lawi (altitude

approximately 2000 m). Four frogs (*Leptobrachella baluensis*, *Rana kuhlii* (twice) and *Rana picturata*) were recorded in the space of one hour from within, or adjacent to, a small (two metre-wide), rocky stream at our first forest camp. Another *R. kuhlii* and one *R. palavanensis* were recorded from the Church Camp. Finally, two specimens of *Rana erythraea* were found on the final night of the expedition, near to rice fields in the settlement of Ba'Kelalan (altitude 1000 m).

No lizards were observed during the expedition.

Table 3-10 Frogs recorded from Pulong Tau

| Capture No. | Common name | Scientific name | Body length |
|-------------|----------------------------|---------------------------------|-------------|
| 1 | Golden-legged Bush Frog | <i>Philautus aurantium</i> | 26 mm |
| 2 | Kinabalu Dwarf Litter Frog | <i>Leptobrachella baluensis</i> | 20 mm |
| 3 | Kuhl's Creek Frog | <i>Rana kuhli</i> | 80 mm |
| 4 | Spotted Stream Frog | <i>Rana picturata</i> | 35 mm |
| 5 | Kuhl's Creek Frog | <i>Rana kuhli</i> | 45 mm |
| 6 | Smooth Guardian Frog | <i>Rana palavanensis</i> | 27 mm |
| 7 | Kuhl's Creek Frog | <i>Rana kuhli</i> | 25 mm |
| 8 | Smooth Guardian Frog | <i>Rana palavanensis</i> | 24 mm |
| 9 | Green Paddy Frog | <i>Rana erythraea</i> | 62 mm |
| 10 | Green Paddy Frog | <i>Rana erythraea</i> | 32 mm |

Discussion

In only nine days 106 vertebrate species were recorded, an impressive tally considering the physical challenge of hiking and camping in the highland forests. Given that many vertebrates exist at low densities, are elusive, nocturnal, or otherwise difficult to observe, this is a very respectable list and clearly reflects the diversity and visibility of wildlife in the proposed Pulong Tau National Park. Our captures of two species of small mammal previously unrecorded in the region and the possible otter spraints and civet tracks at high altitude on Gunung Murud demonstrate how limited the knowledge of even the mammal fauna is from this area.

The species recruitment curves for birds and mammals both show that the rate at which new species were recorded had yet to decline, indicating that many more species are likely to exist in the park. We estimate that Pulong Tau's bird and mammal fauna combined will number well in excess of 200 species. This is a conservative estimate given that Gunung Kinabalu (albeit with a greater altitudinal range) boasts over 100 mammal and over 300 bird species (MacKinnon *et al.* 1996). Clearly, a full inventory of vertebrates by dedicated fieldworkers is required. One reason for the observed high diversity is that, in addition to the typical montane element, the area supports many species more commonly associated with lowland forests.

Several of our records were of species, such as Sun Bear, Bornean Gibbon and Helmeted Hornbill, which are especially prone to hunting or other human disturbance. That they exist in Pulong Tau, together with the fact that mammals, in particular, were so visible is indicative of the quality of the habitat. However, one species of particular interest, the Sumatran Rhinoceros was not recorded. Our relatively intensive hiking schedule may have contributed to us missing evidence of this rare mammal. Alternatively, the Rhinoceros may already be absent from the area, a possible consequence of illegal poaching. Access roads for the logging concessions have been constructed right up to the foot of Batu Lawi and, given the high value of rhino horn, poachers are likely to take advantage of this route into rhinoceros habitat. Clearly, if the Sumatran Rhinoceros is going to be successfully preserved in Sarawak, quality habitat like this area urgently needs to be protected.

In contrast, evidence (in the form of tracks, nests, wallows and rootings) of Bearded Pig (*Sus barbatus*) was abundant, particularly on the ascent of Gunung Murud. It would appear that these montane Oak-Laurel forests are capable of sustaining large pig populations with their abundance of acorns. In addition to their amazing migrations mentioned earlier, Bearded Pigs are an important source of primary protein for local people. Conservation of undisturbed areas critical to the maintenance of their populations is therefore important.

Similarly, montane forests may also be the exclusive breeding grounds of pigeons in the genera *Treron*, *Macropygia* and *Ducula* (Wells 1985). These species feed in both the lowland and montane forests, where they may be important seed dispersers and, therefore, agents of rain forest regeneration (Crome 1975, Lambert 1989).

Small mammal captures were relatively low compared to those in other studies of Malaysian forests (Medway 1972, Langham 1983). The small mammal fauna of Pulong Tau remains enigmatic to the extent that we cannot make concrete statements about expected diversity or densities at such elevations. Other similar studies are equally ambiguous. In West Malaysia, Medway (1972) found a 3-fold increase in captures between altitudes of 150 m and 1000 m, whilst Langham (1983) found the reverse pattern.

The problems associated with attempting to study small vertebrates over a short time-scale were also evident with regard to the amphibians and reptiles. Because of the low encounter rate with these groups, we cannot draw any firm conclusion about their projected diversity in Pulong Tau. For example, no skink or lizard was recorded and only one *Philautus* frog was observed, despite members of this genus being specialist moss breeders common in montane areas (Inger & Tan 1996). We can, however, expect the herpetofauna of Pulong Tau to be similar in diversity and community composition to that of the well-studied Gunung Kinabalu in Sabah. There, 40 species of amphibians, 27 species of lizards and 36 species of snakes have been recorded (Smith 1931). In all likelihood, there exist species of frogs in the mountains of Borneo which are unknown to science (Inger & Tan 1996) and there is every reason to expect that discoveries await in the forests of Pulong Tau.

Many of the species of birds and mammals observed during the expedition are Bornean endemics, montane specialists, or both. These species in Pulong Tau are found nowhere else

on the planet save for the very highest land in Borneo. For example, 26 of the bird species recorded (eight of which are Bornean endemics) are considered to be "dependent extensively or exclusively on montane forest" (Wells 1985). As this montane habitat becomes increasingly disturbed and fragmented the long-term survival prospects of these species will be likely to deteriorate rapidly.

Our results show that Pulong Tau is an area in near-pristine condition, with a high vertebrate diversity and many unique species. The forest area is apparently extensive enough to support breeding populations of a number of large-bodied animal species. The visibility of many species suggests that this is one of a few, dwindling areas in which hunting has yet to take its toll. We believe that the findings of our brief observations will be borne out in more stringent surveys. Furthermore, it is highly likely that Pulong Tau is the last refuge of as yet undiscovered species. To conclude, Batu Lawi and the surrounding forests of Pulong Tau through which the expedition trekked supports a diverse and interesting vertebrate fauna - one that deserves immediate protection.

3.4 Invertebrates

Introduction

The great biodiversity of tropical forests is most obviously reflected in that of their invertebrate inhabitants. However, any attempt to thoroughly sample the invertebrate fauna of a given forest site requires considerable time, effort, variety of methods and expertise. An additional constraint is that most invertebrates encountered in the tropics have yet to be described and therefore lack scientific names. The nature of the expedition reported here was such that only limited records of invertebrates could be made. This section of the report briefly concentrates on insects, and beetles in particular, before making mention of other invertebrates observed.

Insects

Worldwide, insects comprise half of all known animal and plant species combined and nearly half of all insect species belong to the order Coleoptera, the beetles (Wilson 1988). Little research has been conducted on the insect fauna of the Kelabit highlands of Sarawak. Gunsalam (1998) recorded an impressive 71 morphospecies of ants during eight days of surveying and Zaidi & Ruslan (1998) and Fatimah & Hanapi (1998) have produced information on the region's cicadas and caddisflies, respectively. Whilst revealing some

of the area's insect diversity, the limited scope and time-scale of these studies emphasise how limited our knowledge of the total insect fauna of the Kelabit highlands is.

Predictably, most invertebrates observed during the expedition were insects, with the majority being beetles. Insect observations occurred either as random encounters during each day's hike or as the result of light-trapping. For the latter, a white sheet of cloth, one metre square was suspended near a bright kerosene pressure lamp most evenings between 7 and 9 p.m. Insects attracted to the light were identified to order or family level and limited collections of particularly interesting specimens were made. The collections have been lodged with the Forest Research Centre, Kuching.

The most commonly observed diurnal insects were ants and termites. However, no special attention was paid to these groups because of our lack of expertise in identifying them. Flies and mosquitoes were far less conspicuous than in lowland dipterocarp forests. On and around fungi, small clouds of tiny drosophilid fruit-flies were observed and a stalk-eyed fly was recorded in the camp on 2nd September. One large (6 cm long), brown, spiny stick insect was observed at the first campsite. Holloway (1984) reported a distinct upper montane butterfly fauna in nearby Gunung Mulu National Park. We observed few diurnal lepidopterans, however, and cannot provide supporting evidence from Pulong Tau.

During daylight hours, beetles were only encountered sporadically. The first and most spectacular beetle found was a large weevil (Curculionidae), possibly *Macrochirus praetor* (Tung 1983). Near Camp One, one carabid and one tenebrionid were found. Two noteworthy species of beetle were encountered along the trail in mossy forest (between Camp One and Camp Two, 30/8/98 and near Camp One, 1/9/98). These were Trilobite beetles (Lycidae); species in which the females never metamorphose into the adult stage but remain larval in appearance despite being sexually mature. The plating on the backs of the larvae is reminiscent of the Trilobites of the Cambrian period (now extinct), hence the common name. The winged males are able to locate the flightless females using olfactory cues. Both species observed were very large (5 - 7 cm long). The first was dark brown with orange-rimmed armour, and the other was a plain dark brown all over. During the walk along the first part of the logging road on the descent from Gunung Murud (05/09/98) the following beetles, found dead on the road, were observed

or collected: one coccinellid, four scarabaeid (of three species) and one bupresid. In addition, a cicindelid beetle was observed flying off. Finally, a few beetles were collected in Ba'Kelalan (06/09/98); one platypodid, three scarabaeid (of two species) and three chrysomelids of a single species.

Table 3-11 summarises the results of light trapping. Despite five and a half hours of operation, this method met with surprisingly

little success except on the night of 2nd September. Prevailing weather conditions may have limited the success of this method of insect sampling as most nights were relatively damp with clear skies and a large waxing moon. The pressure lamp attracted numerous moths, along with the occasional bug, wasp and earwig. Most of the insects attracted, however, were beetles.

Table 3-11 Results of light trapping for insects

| Date | Trap time | Weather and trap conditions | Insects observed on the light trap | Specimens collected |
|----------|---------------|--|--|---|
| 28/8/98 | 7 - 9.30 p.m. | Dry, fair, 20° C at 8 p.m. | Moths abundant (at least 15 medium-sized species), 5 tiny chrysomelid beetle species. 2 tiny weevil species. | NO COLLECTIONS MADE |
| 29/8/98. | 8 - 9.30 p.m. | Small clearing near river, wet conditions | Low insect activity, 1 black carabid, 3 wasps, few moths, few ants | Carabidae: 1 |
| 30/8/98 | 8 - 9 p.m. | After rain, wet conditions. 19.5°C at 9 p.m. | Low insect activity, few moths, 2 wasps, 2 tiny chrysomelid species | NO COLLECTIONS MADE |
| 31/8/98. | None | After heavy rain | TRAP NOT SET | NO COLLECTIONS MADE |
| 1/9/98 | 8 - 9.30 p.m. | Fair | Low insect activity, 2 black carabids (same species as 29/8/98), 2 wasps, few moths, 1 earwig. | NO COLLECTIONS MADE |
| 2/9/98 | 8 - 9.30 p.m. | After rain. Chilly. | Considerable activity. Mainly beetles (see next column). Moths also active - 5-10 different medium size species. | Elateridae: 1 Erotylidae: 1 Lampyridae: 1 Passalidae: 5 (3 species) Scarabaeidae: 6 (4 species) Tenebrionidae: 1 |
| 3/9/98 | None | Windy and cool after rain, 17°C at 9pm | TRAP NOT SET | NO COLLECTIONS MADE |
| 4/9/98 | | | | Cerambycidae: 1 Chrysomelidae: 3 (2 species) Staphylinidae: 3 (2 species) |

Other invertebrates

Crustaceans

An unidentified freshwater crab was found in the small stream at the first forest camp on route to Gunung Murud. This brown specimen with a whitish underside measured approximately 6 cm in width and 4 cm in length of the carapace. It was surprising to find a crab at approximately 1500 m above sea level.

Myriapods

Millipedes (Class Diplopoda) were encountered frequently on the trails and forest floor throughout the trip. At the divide and in the Gunung Murud areas their remains were occasionally seen as the only prey inside pitcher plants. Centipedes (Class Chilopoda) were seen under logs at Camp Two (30/08/98), near Forest Camp and Church Camp. These were brown coloured and of medium size, approximately 6 - 8 cm in length.

Arachnids

One scorpion, coloured metallic dark green-black, was seen, sitting motionless on the trail when we hiked back from Camp Two to Camp One (31/08/98). It measured approximately 10 cm in length. Spiders, mostly of the wolf, web and jumping varieties, were commonly seen. The largest and most striking specimen was a bird-eating spider found on a night walk near 1st Camp (28/8/98).

Worms

Platyhelminth worms were seen on several occasions. A particularly striking specimen of these primitive organisms was a terrestrial triclad (Class Turbellaria), possibly *Bipalium kewense*, with a broadened hammer-like head, found near the summit of Gunung Murud. Of the annelid worms, most abundant were leeches (Hirudinea) of at least two species, found on low vegetation and on the forest floor. They were ubiquitous throughout our

route, save for the highest ground near to the summit of Gunung Murud.

Discussion

Without a sustained sampling period, utilising a broad range of methodologies in order to record invertebrates with disparate ecologies, little can ever be said about an area's invertebrate fauna. Our results serve only to highlight the fact that the invertebrate fauna of Pulong Tau is interesting and diverse, and that considerable additional fieldwork is required to elucidate its ecology in any detail. Systematic studies by specialist entomologists, sampling a wide range of habitats are clearly required if Pulong Tau's invertebrate fauna is to be compared with that of other Malaysian forests.

3.5. Concluding remarks on Pulong Tau's natural history

Most of the information reported above was acquired in little over one week and, as such, serves to highlight a number of important facts concerning the natural history of Pulong Tau. Firstly, Pulong Tau is not simply one large forest, but a composite of a number of quite distinct habitat types including Upper Dipterocarp, oak & laurel, and Mossy Elfin Forests, and Summit Heath. This combination of discrete habitats results from the range of altitude and the underlying geology and topography encompassed by the park. Secondly, there is a high level of endemism among the plants, birds and mammals (and probably all other groups) inhabiting Pulong Tau. Many species in the proposed park are to be found only on Borneo. Others are yet more specific, the montane forests of north Borneo being the only parts of the planet on which they can be found. A third important feature of the wildlife of Pulong Tau revealed by the expedition is that large, vulnerable vertebrate species such as Sun Bear and Bornean Gibbon still roam these forests. The presence of such

mammals indicates the general health of Pulong Tau's forests, in terms of intact food webs, limited disturbance and hunting, and viable population sizes. All of these features of Pulong Tau suggest that it has the potential to become one of Malaysia's flagship national parks.

Whilst highlighting some facets of the great natural wealth of Pulong Tau, the gaps left in the findings of the expedition emphasise the need for intensive inventories of all components of the proposed park's biodiversity. The remoteness of the area and consequent lack of rigorous study, together with the fact that montane areas act as centres of speciation suggests that species new to science exist within the confines of Pulong Tau. Whilst this is hardly surprising with regard to plants and insects, undescribed vertebrates, particularly frogs and snakes, can also be expected to exist there.

With a sufficient area, similar to its originally proposed size, and adequate protection, Pulong Tau has the potential to conserve a considerable proportion of Sarawak's biodiversity. Pulong Tau's large size is crucial in that it encompasses a wide range of distinct forest types and can support the population dynamics and movements of large animal species.

The control of hunting, which appears to have had limited impact so far, is an important component of the future protection of Pulong Tau's larger birds and mammals. Necessarily, the traditional use by the local people of forest plants and animals would need to be controlled or curtailed within the boundaries of Pulong Tau. However, the potential for tourism-related revenue in the form of the need for guides, lodging and food, and local industries producing souvenirs is considerable. These alternatives suggest that the future of both the local communities and the wildlife of the Kelabit highlands are inextricably linked. For all these reasons, the gazetting of the full size of the proposed national park should be urgently considered.

4. Images of Pulong Tau

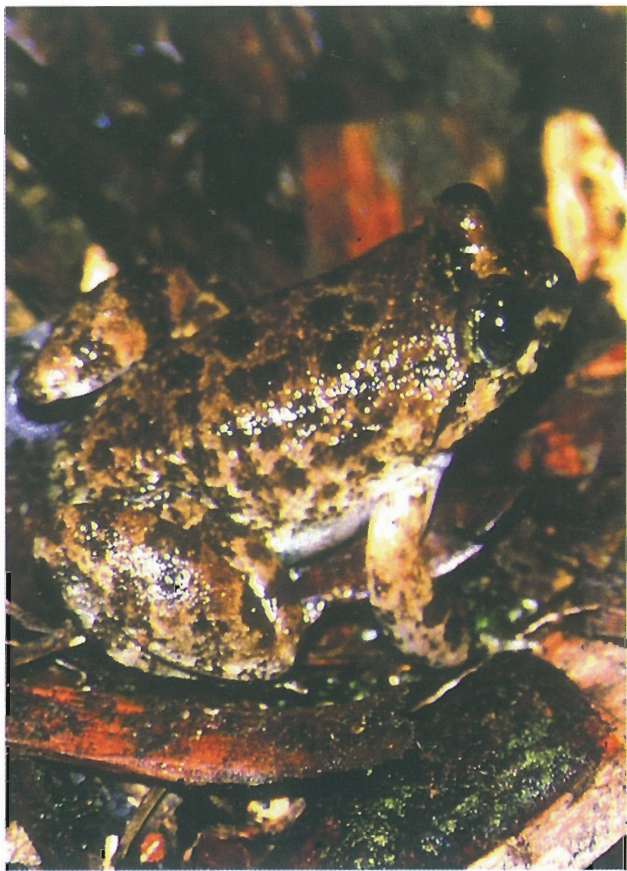
The economic and scientific justifications for gazettement the whole of Pulong Tau a national park are clearly those that hold sway with the local community and policy makers. However, Pulong Tau is much more than the simple sum of its components. Remoteness and unblemished nature create a flavour of 'wildness', of beauty of an uncompromising sort. This aesthetic quality, though difficult to convey to those who have not been lucky enough to see it for themselves, is as much a part of the heritage of Pulong Tau as are the mountains and streams or plants and animals that constitute its various parts. A national park that encompasses so much of beauty is a rare national asset.

Visiting Pulong Tau would definitely be the best idea but for those unable to drop everything and go immediately, we present here just a taste of what you may see. In this section we show the reader some of the many photographs we took while on the expedition. It should be stressed that these photographs were all taken on the expedition, in just nine short days while we tramped our way to Batu Lawi and then on to Gunung Murud.

1. The twin peaks of Batu Lawi viewed from the summit of Gunung Murud. The view of this extraordinary peak must be one of Malaysia's finest.
2. Kuhl's Creek Frog *Rana kuhlii*, a relatively common species of the mountain streams
3. A Trilobite beetle (Lycidae), this is the armour plated female larvae (roughly 7 cm long). The female becomes sexually mature without metamorphosing into an adult form. This species is unusually large and may prove to be a species particular to Pulong Tau.
4. Cliffs of the Tamu Abu range looking south just before the final ascent to the notch. These cliffs mark the boundary of Pulong Tau; once inside you enter a different world.
5. Crossing over Batu Buli there are many small streams and pools like this filled with deeply tea-stained water. The colouration is from leached tannins in this nutrient-poor environment.
6. Cauliflorous *Goniothalamus* flowers are usually produced singly but this species had bunches clustered at the base of the tree. The flowers are very fragrant.
7. A Lichen on the stem of a small tree. A common sight in the mossy elfin forests.
8. A weevil found by Walter. It was a veritable monster in shiny red armour.
9. Wagler's Pit Viper *Trimesurus wagleri*, as deadly as it is beautiful.
10. An agitated Scorpion, disconcerted after sixteen people trooped past.
11. A large bird-eating spider emerging from its hole.
12. Ginger flower pokes up through the moss.
13. Orchid *Coelogyne radiofrens*; this beautiful specimen was on a dead branch near Church Camp.
14. Orchid, *Coelogyne*
15. Orchid
16. Rhododendron at the summit of Batu Lawi
17. Profusion of growth on the forest floor
18. Batu Lawi, the taller 'male' peak is glimpsed through the foliage during the ascent
19. Batu Lawi's male peak in close up
20. The moss carpet
21. Atop Batu Lawi's 'female' peak we take a group photo with the male peak in the background.
22. The multicoloured and crenellated lip of a large pitcher plant *Nepenthes veitchii*
23. Composition of a single pitcher of *Nepenthes reinwardiata*
24. *Nepenthes lowii*, the Roman goblet shaped pitcher plant, amongst the undergrowth
25. Pitcher plant in miniature, *Nepenthes*
26. Two jugs of *Nepenthes veitchii*
27. A small hairy pitcher, *Nepenthes pillosa*
28. Gunung Murud's endemic pitcher, *Nepenthes murudensis*, amongst the summit vegetation.
29. A shady clear water stream in the Ulu Limbang.
30. A logging road encroaching on nature
31. Dawn over Mt. Temburong in Brunei viewed from near the summit of Gunung Murud
32. Airport buildings, with the runway in the foreground, at Ba' Kelalan



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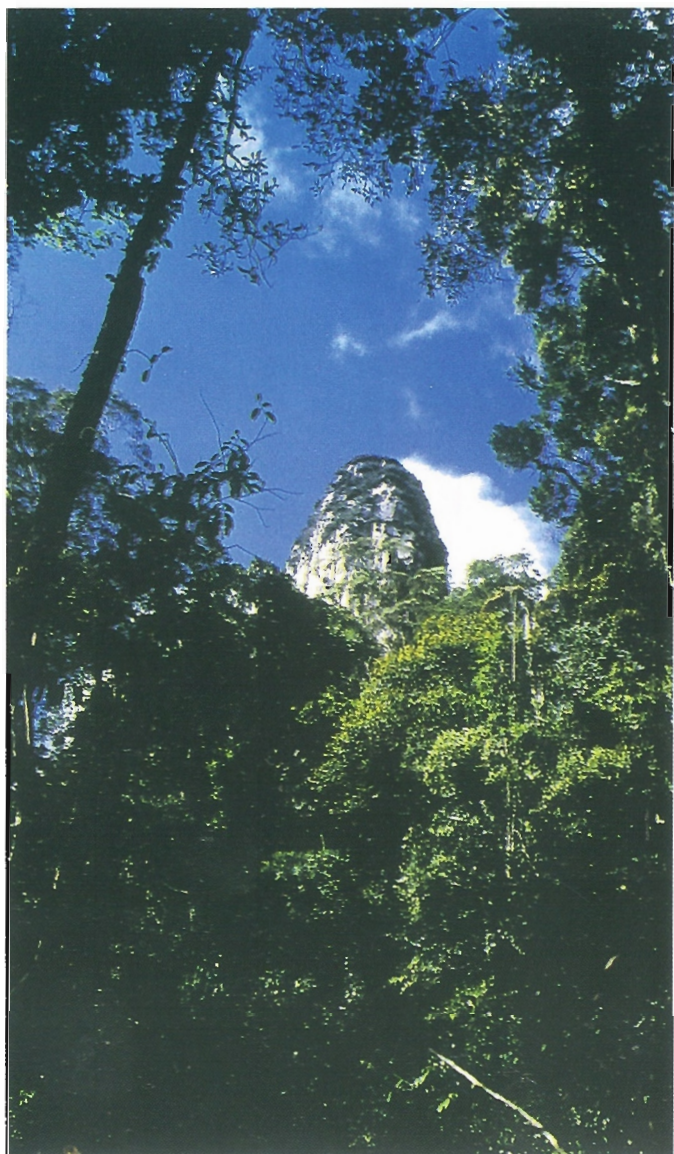
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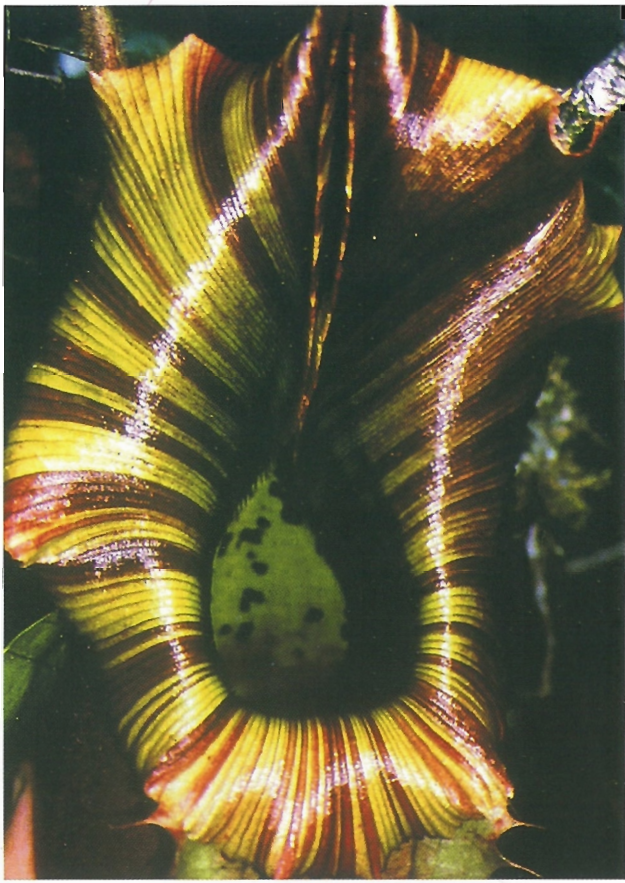
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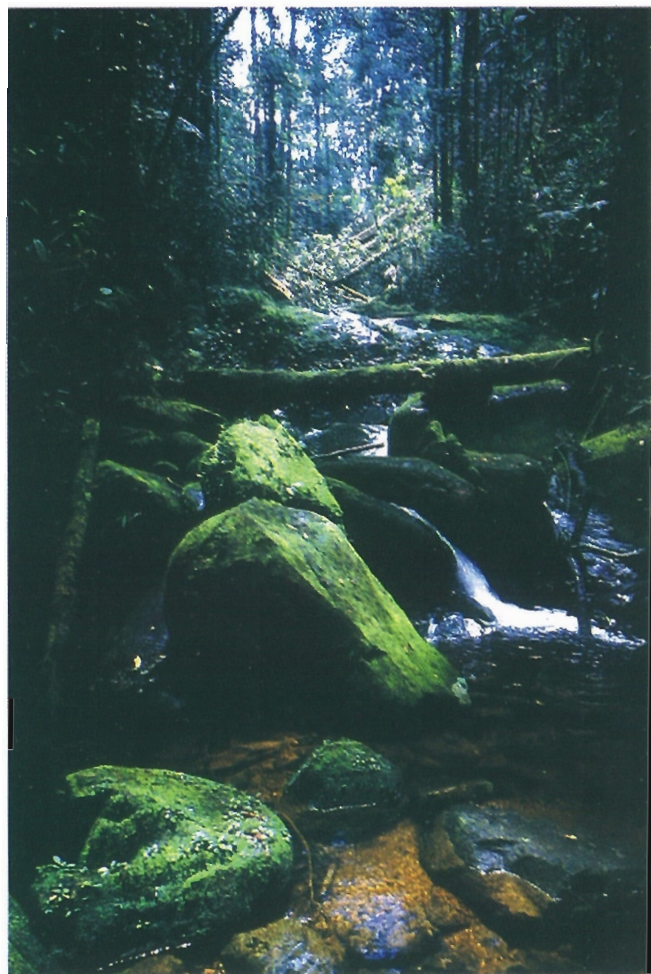
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5. Recommendations

As the reader should by now appreciate, Pulong Tau is an exceptionally valuable piece of the natural heritage of Sarawak. It is essential that this heritage be adequately protected. There is considerable urgency, given that the construction of logging access roads has already begun. It is also of the utmost importance that the park be sufficiently large to protect the full diversity of habitat types, particularly the altitude range from the Upper Dipterocarp Forests to the Summit Heaths, and that large areas of undisturbed forest are preserved to protect populations of rare species. If created without such design in mind the park might not be able to protect a significant proportion of the biodiversity of the area and hence would fail in its primary purpose.

The current proposal for 63,700 ha while a considerable achievement does not incorporate sufficient lower altitude forest, which is generally the more diverse forest and, as even our limited observations show, is an integral part of the higher altitude habitats because of the number of species in common. Especially important is consideration of ecological functional groups, such as seed dispersers and top predators. These are an essential component of the ecology of the higher altitude forests but cannot exist solely in them because they require a greater area to support their populations. The stability and future of the high altitude forest is thus linked to the protection of the lower altitude forests.

Our main recommendation is that the gazetted area of 63,700 ha should be increased to include Batu Lawi and a significantly larger area of lower altitude forest, more along the lines of the 1984 and 1987 proposals. This could be achieved by proposing an extension to the current protected area. In respect of logging concessions that may have been awarded within the area a compromise could be accepted by drawing the boundary along the line to which the access trails now reach (Map II). This is approximately the upper boundary of the Dipterocarp forest above which there are few large trees.

The boundaries must be designated before timber extraction commences and preferably as urgently as possible given the increased access that the trails have afforded poachers. Permitting timber extraction above this boundary and then including it the park later will not suffice. Firstly, forest at this altitude is slower growing and the environment

in general is more fragile to disturbance. Hence, ecology of the forest would be disturbed to such an extent that it would no longer function as a primary forest. Secondly, the short-term disturbance and increased access, if not controlled soon, will deplete the wildlife especially the rarer and more valuable species for which Pulong Tau is still a haven.

Finally, looking further to the future one of the principle revenues for Pulong Tau and the Bario vicinity will surely be that of tourism and Pulong Tau will make a valuable addition to the other parks given its spectacular scenery and the opportunity to see wildlife. However, much of the tourism potential lies in the attraction of Batu Lawi and the integrity of the surrounding forests, which support so much wildlife.

If the forests around Batu Lawi, extending to Gunung Murud, are logged rather than included in the park, it is likely that future tourism income from the national park will be seriously affected.

Suggestions for the development of Pulong Tau

The following suggestions are respectfully submitted respectfully to the relevant authorities for their consideration :

1. Increased flights to Bario, Ba'Kelalan and Long Lellang.

Currently one of the major constraints on the development of the economy of Bario and the vicinity is the small number of flights. This is particularly a problem for the tourism industry because obtaining tickets can be difficult and for larger groups impossible. It also limits the development of facilities and opportunity for small-scale industries.

2. Establishment of a park office and interpretation centre in Bario or Pa'Ukat.

A small office is required for the local administration of the park, enforcement of wildlife laws, education and to provide some limited employment opportunities for local labour. It is not recommended that a large facility with chalets and so forth is constructed given the considerable building costs and the fact that private enterprise, in the form of small local lodges and longhouse accommodation should be encouraged. The office could be

staffed by local people and take advantage of the existing informal network of local guides. One of the functions of the park office should be to formally train and licence guides for the national park trails, with an emphasis on safety and preservation of the environment.

3. Wildlife protection and hunting

Hunting is a popular and important activity for the local population of the Kelabit Highlands. Hence, a restriction of traditional hunting rights might be met with some opposition. However, the strong support of the local Kelabit people for the national park proposal indicates a deeper awareness of the ecological importance of Pulong Tau and the potential value of tourism. It is important that the Wildlife Department makes it clear that wildlife protection laws will be enforced, but also that some provisions are made so that traditional hunting, especially for Bearded Pig, could be allowed in certain areas.

- It must be made clear that all protected species cannot be hunted and that people will be prosecuted if caught.
- All regular tourist trails, especially to Batu Lawi and Gunung Murud and the surrounding areas must be non-hunting areas. The carrying of a firearm in these areas should be an offence.
- Hunting areas should be located conveniently in relation to the longhouses. If practical, a hunting quota system should be instated.
- The tourism industry and local community leaders should be educated in the importance of wildlife conservation for their own livelihood and enrolled as community wildlife officers. A particular emphasis should be placed on educating the children in the local schools.

4. Formation of a private Tourism Association for Bario and neighbouring villages.

This would provide a focus for development of tourism in Pulong Tau and the Bario vicinity in general. The association should be made responsible for registering accommodation and guides, standardising prices, producing small guide books and information pamphlets, maintaining trails including litter collection and the repair of camp huts and organising community participation. Most of the staff

could be recruited locally and some positions could be held on a part-time basis while the individuals continued with their traditional occupations.

Out of the association, a 'Friends of Pulong Tau' society could be administered. Visitors to the park could be invited / required to join and in return receive an informative newsletter for one year. Funds raised in this way could be channelled towards park development activities such as trail or hut construction, and conservation efforts.

5. Field study centre

Pulong Tau is still largely unexplored scientifically and it also could offer a valuable opportunity for the education of school and university groups if some limited facilities were provided. These should include a simple wooden laboratory building, a good quality, secure store for leaving equipment and samples and possibly an accommodation hostel. A limited amount of field equipment could be provided for visiting groups to avoid everybody having to carry equipment on the plane. Needless to say, the facility would always be small but it would be a valuable addition to the functions of the park. The centre could be run by the National Park office, with the teaching and guide staff recruited from the local population, where possible. The accommodation hostel could be administered by a local longhouse.

6. Small local Museum

Looking further ahead, a local museum for the Kelabit Highlands could be constructed in Bario or preferably one of the nearby villages. This could be funded in part by the local tourism association but would need government support, and possibly the support of the many educated Kelabits now living in Miri and elsewhere. The small local museum would be a valuable contribution to the local community by preserving artefacts and photographs, and allowing people to identify with their origins and understand the rapid changes their communities have undergone. A small facility administered locally would probably best meet these needs.

6. Essays

Scrambling up Gunung Murud

Clare Mandeville

Day 7. As soon as I woke up I felt a tension in the air. This would be the most demanding day of the expedition; we would make our ascent of Gunung Murud. Not along the forest trails used by others but from the south side through undisturbed forest, cutting our own path as we had for the previous two days. We'd left Batu Lawi behind us and struck off from Camp One in a north-easterly direction roughly following the main river in the valley lying on the far side of the Tamu Abu ridge. Although we all held the awe-inspiring image of Gunung Murud in our minds as we'd seen it on day four from the female peak of Batu Lawi, we hadn't seen it again for the last two days. We'd been navigating by compass bearings as the full canopy of mature trees above us isolated us from the mountains and ridges surrounding us. I felt very focused and packed quickly and carefully, making sure none of my equipment hindered me in the scramble, climb, slip, slide, tumble and sprawl which I had developed into my own personal style of jungle trekking.

Soon we were walking through a dense scrubby forest. Suddenly there was a shout from the front of "Snake!". I struggled to see over the shoulders of those in front but even when I looked in the direction of the waving arms I could see nothing. I peered closer and with a great deal of effort and repeated descriptions of where to look I eventually managed to distinguish a Wagler's pit viper from its background of leaves. Our guide, Pang Ayu had seen this snake clearly from a distance of about four metres. I couldn't help but wonder if I'd been in the lead how close to it would I have got before noticing it or would I have stumbled right into it?

All around us were superb examples of pitcher plants of an unbelievable variety of shapes, sizes and colours. When we found some examples of Veitch's pitcher plants which could easily hold a litre of fluid each, of course a photo was essential. I was brought in by Steve to act as scale with the resulting photograph being recorded as 'Clare with two big jugs'! Much to my combined horror and delight this photo made it into a local Chinese language paper.

At one point Pang Ayu, shinned over 10m up a tree to catch a glimpse of the elusive Gunung Murud, which he claimed was only 3-4 hours away. This was the first of his noted

underestimates of time. The forest floor opened up to yield ubiquitous evidence of bearded pigs. There were many tracks of both adults and young; indeed we took advantage and followed these natural pig trails whenever we could. There were frequent pig wallows, which sucked us in when we went too close looking for evidence of rhino horn marks, and pig 'nests', which unsurprisingly were not in trees but on the forest floor. I was sorely tempted to test the comfort of these nests of branches and leaves, which did look inviting, until someone mentioned ticks and fleas and I rapidly changed my mind.

Twelve o'clock and lunch was consumed quickly, as we were all keen to push on and meet the challenge ahead. This was when Pang Ayu made his much-remembered prediction, "Only one and a half more hours to the top". Little did we know then that we should have multiplied this estimate by a factor of four! Subsequently we've discussed whether this was a psychological ploy to keep up our morale but for me it became reverse psychology as I never believed any of his timings again and gloomily doubled, tripled or quadrupled his further estimates.

Accompanied by the cry of, "Engage low gear!", we began a gradual climb. The final part of our ascent is truly one of my most lasting memories of the expedition. Although it was physically long and arduous, there was never a moment when I felt I wouldn't be able to succeed. Whether this was due to the moral support of the other expedition members, my gritty determination not to fail myself in any way or a complete lack of imagination I'm not sure, but I suspect it was a varying mix of all three. We hauled ourselves through the almost vertical montane rhododendron forest for four hours. Our feet rarely touched solid ground as we scrambled over matted branches and roots, covered in moss. I was walking near the back with Walter and the porters and by the time I came to some of the trickiest sections, the best hand and footholds had been torn away and we proceeded with much pulling up with the arms and pushing of the person in front.

No time to be coy, just shove! Every so often a section would seem too difficult for me and one of the porters with a rueful smile would step forward and cut another hold or haul me up, backpack and all. Those at the front, however, had a different problem. The moss, which was growing prolifically over everything gave a false impression of the size of the branches and roots and caused them to crash through it unexpectedly, although the cushioning effect of the moss prevented

injuries to anything other than pride. Gradually it became darker and we were confronted with several sections of vertical rock, which we had to climb around. We all started to feel anxious and kept glancing at our watches and looking up trying to work out if we were nearing the top but the angle of the face and the cover of the trees kept making us see 'false summits' which dashed our hopes. We were all clear on one thing; this was not the best place to stop and make camp for the night! In fact it was imperative for our safety that we reached the summit before nightfall.

Slogging onwards, with hopes swinging wildly up and down, I strained to hear the joyous whoop I knew would come from those at the front when they made it onto the summit. Finally at just after six-thirty, when I was debating whether to get my torch out, I heard an excited buzz of voices from above and before I knew it, I burst out of a clump of bushes onto the welcome flat ground of the summit. All around me in the dark were smiles and laughter. An incredible feeling of accomplishment and comradeship welled up in me and made me feel an exhilaration that I have rarely experienced in my life. We all lined up for a team photo, the expedition members, guides and porters and the resulting print shows us peering out of the dark, exhausted, filthy up to our thighs and elbows with soil and moss, but obviously jubilant. We had succeeded in one of the physical objectives of the expedition, to be the first group to climb Gunung Murud from the south.

Two Gibbons in a Cage

Patrick Allman-Ward

Whilst climbing the female peak of Batu Lawi early on the last day of August we had been enchanted by the rare sight of a troupe of Bornean gibbons, apparently flying through the tree tops with the greatest of ease. Their calls pulsed in the clear morning air and accompanied us on our journey for a good hour or so. We were very fortunate, for sightings of the Bornean gibbon in its natural habitat are infrequent, and when made do not last long as they quickly make their elegant escape. It was one of the enchantments of our trip that we heard their swooping calls on most days, and indeed they made a relatively reliable alarm clock as they were most active at first light.

These beautiful primates are totally arboreal and travel rapidly in the rainforest canopy, swinging (or "brachiating") by their long arms. Their movement is fast and fluid,

poetry in motion indeed. They have been declared a Totally Protected species in Sarawak, meaning that they cannot be hunted or kept in confinement without a special licence. It was all the more shocking therefore to encounter two young gibbons held in relatively small cages at the end of our walking trip. The first was in a kampung in Ba'Kelalan, and the second was in the canteen of the logging company's main camp, three hours drive northwards on the way down to Lawas.

Whilst on a previous jungle trip my guides had shot and eaten a green leaf monkey (Hose's Langur). They had invited me to join them and I had done so out of a sense of camaraderie. But as I ate what I remember to be tasty (if chewy) meat, I saw, out of the corner of my eye, the lopped hands of the poor animal lying upon the ground. Its tiny fingernails and pads were intact and resembled for all the world those of a young child. The mouthful of stew turned to sawdust in my mouth, for there is something too recognisable, too resonatingly human about these creatures to make feeding upon them a comfortable experience.

A similar feeling enveloped me as I regarded the two young gibbons in their cages. Their melting dark eyes fixed upon mine with a clear sense of recognition and communication. A shoulder was turned against the wire netting, partly as a gesture of submission but mostly for the gratification of physical contact. As I tickled the fur through the wire a head would turn every now and again and would gaze at me quizzically and longingly, seemingly aching for the comfort of constant contact that would normally be theirs in their natural environment. These young animals have a bleak future. They were almost certainly taken at a young age from their mothers, who had been shot illegally by those working in the logging camps. These orphans would have no chance of survival if they were released back into the wild for it would be unlikely that any troop would accept them and they would quickly die, as social outcasts.

Humankind has created an unenviable paradox for these gentle creatures. To survive in captivity deprived of sibling affection and doomed to early death through inappropriate nutrition and disease, or to be released into almost precipitous death through starvation in their own natural habitat. The best that could be hoped for, is that the Sarawak Forest and Wildlife Department will collect them and send them to a rehabilitation centre where they can at least receive the necessary expert treatment and handling that they will need if they are ever to regain the freedom of the canopy.

These two tragic cases are but the visible tip of the iceberg of depredation that follows hard upon the heels of logging. For once access roads have been opened up into the forest with any degree of density all those who hunt, be they loggers, natives or "sportsmen" will take full advantage of them. There will no longer be a hardcore of undisturbed, inaccessible forest into which the animals can retreat and which can form a springboard for their resurgence. Other areas have been quite literally decimated and indiscriminately culled of anything that has culinary or monetary value, irrespective of statute or regulation. It is therefore all the more important that substantial areas, such as the proposed Pulong Tau National Park are preserved to allow the conservation and regeneration of all tropical rainforest species, including those like the Borneo gibbon which provide us with such unfailing pleasure.

Noises of the Forest Night

Michiko Nakagawa

At night in the forest, it was basically quiet. But when we meant to listen to something, it was filled with many kinds of noises. The noise of fire told us that it was getting dark and that we could drink something hot and have dinner about one hour later or so. During this expedition I fully realised that fire is really great. It plays many roles, lighting the camp site, cooking dinner, literally warming us and our heart, preventing leeches from getting to us, drying our wet socks, clothes and swollen feet and providing us with place for our chatter. We talked about interesting episodes which took place that day, experiences during other expeditions and the future of the forest every night, sitting down around the fire. Sometimes hearty laughter; sometimes serious discussion. Various kinds of our voice echoed through the forest.

There was surely a river by each camp-site because we need some water for cooking, drinking and washing our hands and faces. So when there was a momentary pause in our chat, we could hear a feeble sound of stream of water. Moreover a frog sometimes croaked, but to our regret as it is difficult for us (except for our frog-catcher, Johnson) to find frogs, we cannot tell what kind of frog that was nor how many species croaked. Though in the old days there had been much more frogs, one guide said. After logging in many places, rivers became dirty and turbid, the habitat of frogs was changed. Some frogs would be too sensitive to adapt themselves to new habitat.

In addition to frogs, chirps of insects (maybe cricket, grasshopper or something) were awfully wonderful. Their chorus soaked into us and was best music for listening at night in the forest. Sometimes we could hear a buzzing sound that was the noise of beetle wings. It was louder noise than I expected, so when a beetle suddenly flew by my ear, I was really surprised at it.

Every night we went to bed around 9 o'clock. Now the noise of fire and our talk faded out, but it was about to become quiet, when someone snored loudly. The more tired we were, the more terrible snoring and the more people snored. However, we were so exhausted that we fell into a deep sleep with lullaby of chirping sound of insects and even snores.

In the Forest

Rhett Harrison

Mist rose off the river, swollen with overnight rain, and wafted through the trees. Dew dripped heavily. The ground was sodden. It was chilly. The wet and cold fed our apprehensions.

But calling gibbons beckoned, their hoots inviting us to cross the river, to explore their forest.

The slight tension in the air, as we crawled reluctantly out of warm sleeping bags, splashed icy water over our faces in pretence of washing and organised our rucksacks, was because today we would leave the regular trail, the comfort of the huts and set off across the uncharted forest. Would it take us three days or five to reach Gunung Murud? Would we be swallowed by a swamp or reach all the way to the mountain only to be forced back by inaccessible crags? But this is what we had really come to do. What views would we encounter – which of the many denizens of this remote forest would show themselves? The previous evening we had held a meeting as to how we should proceed and overwhelmingly, in fact unanimously, it had been decided we would try to make our way through the forest. Even the guides, and they would be carrying most of the load, seemed eager. Yet only Pang Ayu knew anything of the forest. Ten years previously he had walked in roughly the opposite direction when assisting National Parks staff on a wildlife survey. Otherwise, it was new to all.

Sixteen packs on legs crossed the slippery logs that constituted the bridge and in Indian file headed up river. The first three hours were

slow and wearisome. The Limbang meandered around and our path, between avoiding the loops and trying to head in roughly the correct direction, meandered even more than the river. We hadn't gone far though when we had our first interesting observation of the day. A beautiful Trilobite beetle in dark brown armour with bright orange horns protruding from the corners of each segment. Soon after, the sweet fragrance of flowers, a cauliflorous tree (*Goniothalamus*). Simple flowers, hanging like bells but with thickened, triangle shaped petals, clustering around the base of the trunk. Iban ladies use the richly scented oil from these flowers as perfume in their hair, but here there were only the beetles and ourselves to appreciate their sweet aroma. We started to ascend a steep ridge. It was hot now. It became steeper. We hauled on trunks and roots, and sweated. A narrow crest crammed with thorny Pandans and ferns but the stunted trees allowed us a glimpse of Gunung Murud. It was a long, long way off.

"Just two days, maybe three," calls Pang Ayu cheerfully and then moves us on before we have time to object. It was the last time we would see Gunung Murud until we climbed it three days later.

We slide ungainly down from the ridge cursing and questioning why we had ever had to climb it in the first place. Then suddenly, in front of us, a red paint mark - the sign of an intruder, a statement of ownership trespassing in the common forest. It didn't take us long to work out that we'd stumbled on the markings of a concession boundary, right in the middle of a proposed national park. That put a 'right downer' on the proceedings. Was it really possible that all this beautiful forest was going to be ploughed up with bulldozer trails? It's not even as if there were any big trees. That someone could even consider marking a concession boundary through a forest like this spelt out a futility in our endeavour. Was it better to bear witness to this desecration of nature than to have never enjoyed it at all?

Pang Ayu opted to follow the boundary as it saved valuable time and effort from not having to cut our own trail and from here on we proceeded much more efficiently despite the slippery ground. Actually, it was a miracle that someone didn't impale themselves on one of the cut stems that mined the trail. These were about knee height and finished in a sharpened tip where the parang had sliced through. Perfect for transfixing the abdomen, especially with some help from a heavy rucksack pushing down from above. That afternoon we walked for several hours through

the mossy forest; being a little flatter the going was easier and, though tired, once or twice we managed enough enthusiasm to appreciate some orchids. Then for a while it drizzled and everybody was irritated from the continual slipping. It was time to camp - but Pang Ayu was out in front. We stumbled on. Not much longer? We pitched down a bank and suddenly there it was, El Dorado, a camp with a real wooden frame! A beautiful spot with a small stream and some lovely trees and with a ready-made frame left by boundary markers. With just a touch of irony, it dispelled the bad moods and tiredness, and we settled down to a great evening of fishing, one minnow sized specimen that was roasted and eaten before it was identified, frogging, wood-smoked socks and story telling.

Dawn pierced the canopy with a scattering of rays which danced with the leaves. A Blue-breasted quail called from just upstream. The gibbons were all the more eloquent for the effort we'd made in coming to visit them. We broke camp quickly and made our way along trail. It was in many ways similar to the previous day. Stumbling and slipping along between the stakes. The forest can be quite claustrophobic. Trunks reach up to the canopy, out of reach but closing out the sun, and on the ground both sound and sight penetrate only a short distance. Signs of progress are rare. One is lost is the scale of the forest. The interest is in the detail. Every bank and hollow, every tree and fern provide a different view. The small flowers, spiders, insects, the birds flitting across the path and the occasional signs or calls of more elusive residents, livening up the experience. Appreciating the forest requires more effort - not so much the physical exertion of having to hike through it but taking in the surroundings, observing the minute along the trail.

Nevertheless, we had lunch at a place even the most unimaginative could not have failed to enjoy. A tributary of the Ulu Limbang, it was a steep mountain stream with water cascading between giant, moss shrouded boulders. Cool refreshing water and a little break in the canopy which allowed us to bask in the sun while we rested tired limbs. There was also the magic of knowing that we were alone in this expanse of forest, further now from civilisation than we would be at any other time.

The afternoon's hike was brief. We passed through the mossy forest for about a further hour, bumping into a couple more orchids. Then emerged into a large gap created by a tree fall. We stayed to do some birdwatching for a bit, making use of the higher light levels

around the gap while the guides started to camp just over the river, actually a generous name for a sluggish peat brown stream. The tent was just a simple job with the canvas spread between two trees and everybody sleeping on the floor but we had a camp fire and that evening we settled down, after setting our traps and completing the other surveys, to a heartier meal than usual. There was a sense of anticipation floating round the camp. We hadn't know whether we'd make it this far when we set out two days ago, though in fact it hadn't proved so tough, and tomorrow we would climb Gunung Murud. It didn't seem daunting any more, at least not much. We were enjoying things too much.

That night a Yellow Muntjac was particularly noisy.

Toasted Socks and Porridge Oats: Camping in the Forest

Mariafe Nunez

During our nine days jungle trekking from Bario to Batu Lawi, Gunung Murud and Ba'Kelalan we had eight overnights. While the last night was spent in an open, newly constructed wooden house in the Church Camp on Gunung Murud, the other sites were in the real virgin forest. Three times we used wooden huts, constructed by Kelabit guides and people who regularly use the remote trails of the area. The little houses, for us four-stars of the forest, provided a perfect hideout on rainy nights. Besides a quite spacious area they even boasted a few kitchen utensils. But best of all, these huts had a central fireplace and a stock of dry wood - very valuable, given the fact that we arrived in these places totally wet and hungry.

Everybody found enough space for attempting to dry their dripping clothes and soaked shoes. These circumstances contributed to comfortable nights and rather good sleep and in addition we felt out of reach of the armies of leeches crawling around outside. These simple huts were at Camp One near the Limbang river and Camp Two near the foot of the Batu Lawi mountain, and both located along the trail from Bario to Batu Lawi. In the following, however, I will refer to the forest campsites, where nights were spent more or less in the open. Would this be comfortable at all?

When we arrived in our first camp site we felt very tired from a day's trek and wet from the rain. Our six Kelabit guides swiftly cleaned up the site by cutting grasses and removing the

fallen and rotten trees around. Then they started building a simple shelter. The roof of the shelter was a tarpaulin hung over a sturdy rope strung between two trees. The edges were tied near the ground with ten-foot guy ropes. The floor under this roof was furnished with soft, green twigs and leaves. The guides perfectly and smoothly shared the work. So, at the same time an open fire was made just next to the place where we were going to sleep. This routine was repeated from site to site. In the 'frog camp' we found an abandoned, wooden camp skeleton. The guides just needed to repair it and swiftly engineered an elevated wooden floor. One morning when we were ready to leave from the frog camp there was still a pair of lady's stockings hanging near the fireplace and nobody claimed them. My companions suggested that they were mine - but I denied - and the guides started giggling suspiciously. Apparently it belonged to one of them and was used as an anti leech device.

The daily routine developed such that while the guides were constructing our shelter we repaired and set the mammal traps. We baited the traps with banana and sweet potato and subsequently some of us placed the traps around the campsite in the forest. Others were busy with their respective surveys. After the main chores were completed we rid our bloody legs from leeches, cleaned ourselves in the river, and cured our bruises by applying ointments and plasters. Martin, our pseudo medic, was always at hand with medical gear and his advice. Our filthy, soaked clothes, socks and shoes were hung above and near the fireplace. As this procedure developed into quite a daily ritual, competition for the best 'toasting spots' got more and more intense. For some of us it became as important as getting the food in time. A futile struggle, as the next morning usually started with slipping into the cold, damp gear again!

After refreshing we rested and sat around the fire. The healing warmth felt too good, while we consumed coffee or tea. Some members of the group were writing their diary or looked into the mammal book identifying the animals we saw during the walk. Our porters were busy unpacking their heavy rucksacks, which contained our food. Then they selected - not such a hard choice at all - and prepared dinner. Sometimes we listened to each other's jokes like the funny stories of Martin and Rhett, which made us happy and helped to forget our tiredness.

Our food for nine days trekking was just canned foods which was sardines, biscuits, packs of instant Maggi mee, oatmeal which we

cooked like a porridge with tom yam or chicken cubes, cabbage as our vegetable, beans, bread, rice, basic spices and a can of custard powder. All of that was carried by our six porters together with the traps for mammals, the big and wide plastic roof we used for camping, utensils for cooking, kerosene, rope and Michiko's old newspapers. These were kept for storing samples of leaves of different trees species and they were getting heavier every day. They had to carry quite a bit, including their personal items.

After two days we ran out of bread, the third day we ran out of sugar and Milo. This was quite a blow since our energy had to come from somewhere. On the seventh day the cabbage, beans, canned biscuits and sardines were finished. Therefore the last 3 days we were left with nothing but oat porridge with tom yam and chicken cubes. Even the staples of rice and Maggi mee were rationed! Everybody dreamed of nice food but we had no choice because we had to eat what we had. At the end the oat porridge and Maggi mee became our favourites.

Our master cook was Johnson, the person with a remarkable humour. He proved to be a good frog catcher as well. One night, during our Johnson-style porridge dinner, Mike tried to serve from the hot pot, which suddenly slipped and got poured onto his foot. He screamed in horrible pain and Rhett rushed to remedy with cold water. Mike found some temporary relief in the nearby cold Limbang river, but faced the prospect of a walk with a swollen, blistering foot.

Late evening activities were the search for frogs or other interesting nocturnal animals or insects to study and identify. Walter went outside the shelter with our bright kerosene lamp to attract insects. The ladies were in the shelter writing notes or looking through book about wildlife. Our guides were usually still chatting but we did not know what they were talking about, as they spoke in their own language. They constructed their own basic shelter. We usually crawled into our bags not too late, feeling exhausted.

In the morning we got up around six O'clock either from the noise of our guides cooking our early breakfast and the calls of the birds and animals or sometimes Mike's alarm clock. After collecting the traps we set the previous evening, we studied the animals which were caught, removed the baits and collapsed the traps to make them portable again for the next journey. We were busy every morning after breakfast, packing again our luggage, got into our dirty and smoked clothes,

toasted socks and shoes from the fireplace and filled up water supplies for the next long walk. The porters were also busy packing our food and the other items. Before we left the place we made sure that we did not leave any rubbish to keep the area clean.

For me both the demanding trip and the forest camping were most challenging and rewarding. Upon our return home to Miri I felt happy and a little proud of having experienced the virgin forests of Pulong Tau.

My Pet Weevil

Walter Wuertz

It happened in the first forest camp where we got up in the morning on August 30th, after a good night's sleep. As we scuttled around the site in preparation for the day and everybody followed their routine to get going, my wife, Mariafe, shouted, "BEETLE! BEETLE!"

She stood just a few steps away from our campsite. I rushed there and realised that this was no false alarm, no, she really had discovered something! There was a large beetle on the low vegetation, about a foot above ground. With its long snout and typically shaped body I immediately recognised it as a weevil. It had brilliantly dark red coloured wing cases and black markings on the pronotum behind the snouted head. The first reaction was to call our other colleagues. Surely, this beetle would be one of the insect highlights of the trip and everybody would be keen to document it with their camera. For this photo session, certainly the first in the beetle's life, I relocated it onto a nearby log where the view was unobstructed by leaves. The beetle stayed put, as if it expected something pleasant, hardly irritated by this bunch of camera-flashing intruders. Although not equipped with the best apparatus for close-ups, I nevertheless gave it a try as well. Once everybody returned to their interrupted activities I had a closer look: a strikingly brilliant darkish red, spots on the neck, a long snout and relatively long legs. During handling its needle-sharp claws penetrated into my skin and it was almost impossible to shake or take it off. So I had to push it onto a leaf, just like you would push a stubborn mule. Even this was not entirely successful and, using a bit of force, one of its claws broke off. I had never seen this species before, although our local guides claimed that it was a not uncommon insect in the Kelabit Highlands.

After the photo session the beetle really didn't have a choice: it had to travel with us. We were not well equipped to carry specimens as large as this, in fact we had not even intended to carry any kind of live animals. As we had no special container for large live insects, it had to go into the wooden box meant for dead specimens and containing naphthalene cubes. This must have felt most unpleasant for our new pet, but certainly would keep flies and other potential visitors at bay. So we started walking, with the weevil-box attached to one of the guide's back-packs. Once we arrived at the rest place the next evening, I checked the beetle. It was in good condition, although somewhat dizzy from the naphthalene vapour. It must have felt good when exposed to a breeze of fresh air.

The chief guide, Pang Ayu, remarked that, in the Kelabit highlands, this beetle is commonly known as *buang kenangan*. He recalled that people occasionally used and continue to use both larvae and adults as delicacies, although he did not expand on the recipes. Another guide told me the adults are best eaten fried. And interestingly, live beetles are used by the Kelabit people in a number of other funny ways. Children play with them by tying a string to one of the legs, then swing the bulky insect, which then instinctively unfolds its two wing pairs with a loud, deep buzz. A second, more bizarre application of the living beetles is to tie them with their elytra to the wooden pillars in rural houses. In this position they would forcefully cling on to anything coming in touch with their struggling legs, thereby effectively becoming a mouse trap. The weevil's 'grip' is incredibly strong for an insect weighing only a few grammes. Aided by its sharp, anchor-like claws, it will render an unsuspecting small rodent trapped and unable to escape.

Having arrived at home, the beetle must have felt relief as well, since it was allowed to escape its wooden box. Fruit and water were offered. Adult weevils don't eat too much, however, fruit and water will keep them happy and will prevent desiccation. While the larval stage feeds and grows for a few years, weevils have a relatively short life expectancy as adults. I was not surprised when it finally died one week after returning from the expedition. The colouration, however, is expected to significantly fade after death. This is just one reason why living beetles are so much more awesome and enjoyable than dead collection specimens. Luckily, the photo taken in the wild proved to be of respectable quality, even with my camera.

Since the journey I searched for the species in several beetle books. However, documentation on beetles of the tropics and in particular this part of the world is scarce. I found a candidate in the book 'Common Malaysian Beetles'. It could well be *Macrochirus praetor*, a species that superficially matches the observed individual. However, a more scientific approach using identification keys for tropical weevils and possibly comparative work in a museum collection would be needed. Incidentally, of the approximately 150 families that make up the order of beetles (Coleoptera), the weevils' family is presently thought to be the most species rich with 60,000, or one in five of all beetles. However, the majority are tiny in size compared to this real giant of a beetle.

A Pilgrimage to Batu Lawi

Martin Storey

North of the green Kelabit valleys of Bario, beyond the Tamu Abu range, is a mysterious mountain called Batu Lawi. Its two white sandstone peaks emerge from the seemingly continuous canopy of primary rainforest like ancient raised stones or the two humps of a petrified monster. The sharpest sandstone peak, known as the male peak, rises vertically to some 300 metres above the surrounding forest, culminating at an altitude of about 2040 metres. Its partner, the female peak, stands close by along the same ridge, to the south. It is just a little rounder, almost as in deference to the main pinnacle. People have been awed and intimidated by Batu Lawi for time immemorial. In the Kelabit cosmology, the mountain of fire, Batu Apoi, once came to burn all living things, but the husband-and-wife peaks fought back and defeated Batu Apoi, which went extinct out of spite.

Thus the Batu Lawi peaks are revered as the original parents of all highland people, and to this day, as their protectors. A strange and episodic phenomenon adds to the mountain's haunting legend: although all but inaccessible, the top of the male peak is covered with shrubby vegetation, which sometimes spontaneously bursts into flame. The naturalist Charles Hose, who witnessed this himself, speculated that the bleached surface of the rock can reflect and focus the sun rays like a magnifying glass, causing dry grass to catch fire. In any case, the Kelabits still revere and fear the sacred mountain. In its neighbourhood, they refrain from speaking its name, so as not to awaken its spirits. Until a couple of

centuries ago, the Tabun, a branch of the Kelabit people, were living at the base of Batu Lawi; they have since migrated down river to the Limbang valley. Around Batu Lawi, the forests are traditional hunting grounds, and the Kelabits know them well. Yet in spite of all this human activity, there is no record of anyone climbing either peak before 1946, when British biologist and former soldier Tom Harrison reached the top of the female peak.

The late Tom Harrison first came to North Borneo in the early nineteen thirties, to study the avifauna of the Tinjar valley. The Tinjar river, a tributary of the Baram, is relatively near the Kelabit Highlands, to the west. In those days, the people of the Tinjar did not know anyone who had visited the Kelabits, whom they could describe nonetheless as a "lost tribe" living in a place of abundance and wealth. The Kelabits were living then as they had for centuries, a relatively peaceful life in near-total isolation from the rest of the world. They had developed advanced techniques of irrigation and wet rice cultivation, and the cycle of their life was driven by the cycle of rice. Both men and women wore sophisticated ear ornaments which elongated their ear lobes – a practice fast disappearing today. Several natural mineral seeps provided salt, which was the only currency they used. They lived in open, semi-communal longhouses, and their most cherished possessions were old jars, beads, and buffaloes.

Tom Harrison and his peers parachuted in this isolated area during the Second World War to organise a resistance hotbed against the Japanese occupants, a story he narrated in detail in his book "World Within". From the air, the white peaks of Batu Lawi had been the only reliable landmark for the dropping planes looking for the Bario valleys. When he later learned of the loss of one of the two aircraft which had dropped his men over Bario, Harrison pledged to climb the female peak of Batu Lawi. Thus, he achieved, in 1946, the first recorded ascent of Batu Lawi. Below the summit, he placed a Kelabit carved plaque in memory of the lost crew. It was another forty years, 1986, before anyone else climbed the Kelabits' sacred mountain. A few months after that, for the first time ever, the male peak was conquered by a group of British army mountaineers. Since then, in the past decade or so, it has become a favourite destination for adventurous hikers fascinated by the twin white peaks. In spite of having been climbed regularly, Batu Lawi remains a physical and spiritual challenge.

Walking on a mountain trail is normally like stepping into a different world, a sort of secret society. Just being there makes you an initiate. In the mountains, people are courteous to each other, and perfect strangers will have long conversations around a campfire, usually about food, the comparative anatomy of blistered feet, and the weather. The walk from Bario to Batu Lawi is a different experience, however, since one is unlikely to meet anybody along the trail. That is, until reaching the base of the mountain and "Camp Two", the second refuge built by the Kelabit people in memory of the victims of a 1992 aeroplane crash. On a makeshift shelf, in a rusty metal box to keep rodents at bay, is a visitors' book. Browsing through it, like previous visitors did in their time, one can get briefly acquainted with the other hikers, many locals and many foreigners, who braved leech bites and wait-a-while rattan stings to conquer Batu Lawi. Some of the entries are humorous, some are elaborate, with illustrative art, some are even a little bitter – like my own entry of two years ago, when the weather forced us to turn back at this point. Yet most contributors try to convey, in their own words and language, the privilege and joy they feel at being in a pristine rainforest, and let go a moving cry-from-the-heart to preserve it for the future.

The Camp Two wooden hut is wedged in a clearing between two little creeks, which keep the area humid and the grass lush. It takes about two days to reach it from Bario. After leaving the sheltered rice padi valleys of Bario, the path goes through tall dipterocarp forest into the Tamu Abu range, up and down a succession of steep ridges, sometimes along them. At the top of one, we came across a bunch of ruffled bamboo rods planted in the ground; our guides told us that they were prayer sticks, placed there by Kelabit people. Before reaching Camp One, the first chalet built by the Kelabit at the intersection of two rivers, one walks through a stretch of appropriately named elfin forest, at altitudes hovering around the 1500 metre mark. The trail is strewn with sandstone boulders covered by waterlogged moss, and it often takes hands and knees to prevent slipping. One of the boulders, early on, is covered by a large petroglyph of a human-like character, possibly a woman; our guides tell us that it was carved by "an old man", now deceased. Just before Camp One, a wide river required team work to cross. At the camp, a larger river was crossed by walking on a fallen log. From that crossing onwards, the deep cooing of the large mountain imperial pigeons kept us company all day as

the path took us up and down some more, through stretches of oak and of mossy forest. We heard many other birds, and the eagle-eyed naturalists among us also spotted a few small mammals. About one hour before reaching Camp Two, a fallen tree on the side of a ridge had created an opening that permitted the first sighting of the twin peaks of Batu Lawi. Since we could see the peaks, the peaks could see us too, and thus we now had to avoid irritating them by saying their name.

It was early the next morning that we left Camp Two to ascend the mighty mountain. Almost immediately, the sound of crashing branches right next to our ridge trail alerted us of some fast-moving presence in the trees. We all caught glimpses of the Bornean gibbons, who swung to the background while vocalising loudly. Rhett promptly set up the recording equipment, and we were able to monitor the quality of the sound he was hearing on the headphones by the width of the smile on his face. As we carried on walking, the group of gibbons kept us company for a while. The oak forest became increasingly mossy with altitude, and although hardly noticeable at first, the path itself was becoming narrower and steeper. The walk became a climb, and we started use our hands to maintain our balance as we ascended the eastern flank of the mountain. After less than an hour, we reached the saddle between the two peaks. The vegetation was low, with a profusion of pitcher plants, orchids, and rhododendrons – characteristic of poor soil and harsh weather conditions. We branched to the south, and started our final climb, up large boulders piled up miraculously along a steep and narrow ridge. At times, the ridge is only a few metres wide, and beyond the edge is a sheer drop of several hundred metres. The ground is soft under the foot, and at times the walk is on aerial roots precariously fixed to the rock substrate. In one instance, we had to use a rope to pass an overhanging boulder. Under the shelter of one of the larger boulders is a 1987 bronze replica of the wooden plaque left by Tom Harrison in 1946 – a moving tribute to the missing aeroplane crew, as well as a thinly-veiled tribute to the Kelabit people themselves, since Harrison signed the plaque using the name they gave him. I was particularly moved by the fact that the original wooden plaque had been left there too, where it was found. The wood is slowly decaying, and the words are barely discernible anymore. A few more metres along the trail, and we reached the top of the female peak, which afforded us with a circular view of the endless forest canopy, sprinkled with patches of rising mist. Gusts of wind were

bringing clouds from the valley which veiled partially the majestic male pinnacle. At that moment, we heard the sound of the spectacular helmeted hornbill, the largest in Borneo of the birds so symbolic of Sarawak. A different group of gibbons was vocalising in the distance. After a snack and numerous pictures of the group with the Kelabit guides, as we were getting ready to start our descent, the mist cleared, revealing to our horrified eyes a network of logging access roads to the West and the North of the mountain, some coming within just a few kilometres of its base. We walked down silently, while the gibbons, oblivious to the threat to their habitat, kept on calling. Within an hour, we were back to Camp Two where we had a lunch. We then pushed on back to Camp One, which we reached after a four-hour walk.

While walking on these rough trails, through the different forest types, one is compelled to reflect on the uncertainty of the area's future. The forest teems with life: all these insects, birds, mammals, plants and trees high and low, are a splendid demonstration of the amazing diversity of life, to use Edward Wilson's expression. The forest seems to have been there forever, but this air of timelessness is misleading: it is in fact precariously balanced, and should we throw it out of balance, it may all disappear forever. Like a beautiful dandelion seed which disintegrates when we try to remove just one of its silky hairs, the forest is fragile. Its capacity for regeneration is not unlimited. Moreover, Batu Lawi is, like Mt. Kinabalu, Mt. Murud, and other mountains of the region, an island of biological diversity which is known to harbour unique species of plants and animals, even if not all of these have been discovered yet. As such, Batu Lawi is part of the heritage of Sarawak, of Malaysia, and of the world. Should the area be logged? It does not take a scientist to note that there are actually few trees of a commercial size in the Pulong Tau area. The extraction of so few trees in such a remote and rugged terrain is unlikely to be commercially viable. Experience gained elsewhere in the country shows that driving the logging roads in would cause large-scale top-soil erosion and landslides. The headwaters of the Limbang and the Baram rivers would become silty and milky. The entire economy of the region and the regions down stream would be affected indeed – negatively and for the long term. In contrast, carefully managed eco-tourism could have a long term positive effect, in a world where areas of such pristine beauty are becoming increasingly rare.

had to pick almost every step among the twisted roots which crossed our path. My numerous stumbles paid tribute to the desire to drink in as much as possible of the captivating plants, birds and animals around me. On the road, things were different – I could take my time and look more at my surroundings. We saw and identified many birds along the road, having extra time to view them before they disappeared among the trees. The irony is that the hunters have too - I saw a used shotgun cartridge showing that roadside shooting has now started. And after so many days of hauling a heavy pack over the rough terrain, the enjoyment of some easy walking inspired feelings of guilt. Was it right to enjoy a relaxed few hours trekking to Ba'Kelalan at the expense of the area?

In steep mountainous terrain, to extract timber in this way clearly scars the landscape. And these were just the access roads we were seeing, with the actual logging not yet started. Landslides and erosion into the rivers had already begun. I had recently seen news stories where China identified watershed deforestation as a prime cause of the flooding affecting a quarter of its population. Preservation of the forest will always have to be balanced against the need for government income from timber in order to provide funds for the community. However, the trees seemed to be small compared with typical lowland forest species and presumably of lower monetary value. My overall feeling is that in this area of such ecological value, religious significance and tourism potential, an alternative land use is clear.

7. Expedition Members

All members of the expedition team are currently residing in the region and are members of the Malaysian Nature Society, Miri Branch.

Stephen Hart

Steve Hart (33) is an English geologist/geophysicist with degrees from the Universities of Durham (BSc) and Oxford (D.Phil.). Whilst currently working for Shell International, Steve is a committee member and vice-chairperson of the Malaysian Nature Society's Miri branch. His work in the field of oil and gas exploration has led to assignments in Burma, the UK & Malaysia. He has a strong interest in eco-tourism, having visited national & marine parks in South & Central America, Africa & Asia. His previous expedition experience involved geochemical sampling of active volcanoes in Ecuador & Colombia during the 1990 Oxford University Expedition to the Northern Andes.

"I felt that I had been in Borneo some one and a half years, taking in numerous exciting and enjoyable experiences, but not offering much in return. The expedition fitted in with my attempts to support the local Malaysian Nature Society branch committee and seemed to be a most worthwhile project. I was especially attracted by the fact that the national park proposal had come from the local Kelabit community and the Sarawak Forest Department and was not an attempt to 'force' a national park on a group of people who did not really want it. While essentially being 'soft' rather than 'hard' science (mainly observationally driven), the main revelation for me was the diversity in species that we managed to record. This was not just in plants and birds, which I half-expected, but also in mammals. With such a large number of mammals recorded in just a few days, this argues for the importance of Pulong Tau as a real centre of biodiversity."

Clare Mandeville

Clare Mandeville is a 30 year old English geologist with degrees from Oxford (D.Phil.) and Cambridge (B.A.) Universities. Currently, Clare lectures in technical communication at Ecotech Technical Institute, Miri. Her previous expedition credentials include the Cambridge Kenya Study Group 1989 (working with rural communities in Kenya), Oxford University Expedition to the Northern Andes 1990

(sampling active volcanoes) and the Grantham Venturers' Expedition to Namibia 1992 (with Save the Rhino and local schools).

"Before I came to Miri, I imagined that Borneo would be one huge primary rainforest and that orang-utans and hornbills would easily be spotted as I travelled around. I was disappointed when I realised the scarcity of rainforest around Miri and felt I wouldn't really experience the best that Borneo has to offer if I didn't spend some time in an area of rainforest which remained untouched by man. I was the last member to join the expedition. When the expedition was first planned, I thought I would not be able to get leave from Ecotech. I only joined one week before it was due to start when I heard that someone had dropped out, but his flight reservations had not yet been cancelled and also it was confirmed that the dates coincided with exams at Ecotech. At 11.30 p.m. on the night I heard this information, I suddenly realised I would always regret it if I missed this opportunity, so I sent an e-mail expressing my desire to go. Parts of the expedition were tough physically and I became aware that I did not have the fitness and stamina that I had at 20. Mentally, however, I was determined not to fail at any of the challenges we faced including the climbing of both Batu Lawi and Gunung Murud. Overall, I feel I gained so much knowledge from the guides, the other expedition members and the forest itself about this splendid area which is so rich in cultural and natural history. Unforgettable."

Mike Shanahan

Mike Shanahan is a 24 year old graduate student from Jersey in the Channel Islands. Having completed B.Sc. and Master's degrees in biology and biodiversity & conservation at the University of Leeds, he is currently studying the ecology of seed dispersal by Bornean fruit eating birds and mammals towards his doctorate. Mike's previous experience of tropical forests includes visits to Sri Lanka, India, Peruvian Amazonia and long periods in Lambir Hills National Park, Sarawak.

"To me, the expedition represented not only a physical challenge and a chance to see a new part of Sarawak, but an opportunity to do something worthwhile for the State's plants and animals which have so enchanted me over the past couple of years. By recording and publicising the area's beauty and biodiversity

we can make a contribution towards securing protection for what is surely one of the most ecologically and culturally important parts of Sarawak."

Michiko Nakagawa

Michiko Nakagawa is a 23 year-old Japanese graduate student. She joined the Center for Ecological Research in 1998 after graduating with a B.A. in Forestry from Kyoto University. Currently, she is studying the seed predators and seedling demography of Dipterocarp trees, in terms of their ecology. This was the first expedition for her. However, she has a special interest in conservation and recovery of tropical forests.

Rhett D. Harrison

Rhett is a 29 year old British graduate student currently studying for a PhD at the Center for Ecological Research, Kyoto University on the ecology of figs at Lambir Hills National Park, Sarawak. He took a BSc in Zoology at the University of Durham, U.K.; and a MSc at Kyoto University. Previous expedition experience includes a Durham University Expedition to Peru 1990, which conducted biological surveys in the Tambopata-Candamo Reserve Zone, and a voluntary research project on mercury and the gold mining industry in Bolivia.

"In early 1995 approximately six months after arriving at Lambir Hills National Park I was introduced to the then fledging MNS group in Miri – actually I was asked to give the society a slide talk. However, I was keen to do so as I felt that, being under the auspices of a respected national society, it would be the ideal opportunity to become involved with local conservation activities. Quite early on the idea of an expedition arose; and Pulong Tau became the obvious destination, given its value to conservation and the fact that it was a local issue but of national import. In addition, ever since first arriving in Sarawak I had wanted to get a real 'wild Borneo' experience. Lambir Hills, beautiful as it is, was a bit too soft, what with showers, beds and a canteen, and of course Miri just down the road. Pulong Tau was that experience. It was amazing.

Walter Wuertz

Walter Wuertz is a 40 year old German national. After 7 years of studies in a wide range of natural sciences he graduated with 'Diplom Geologe' from the Johannes Gutenberg

Universitaet Mainz (Germany) in 1984. During his student years he was involved in short term geological studies and jobs in Germany, Sweden, Greece and South Africa. In 1985 he joined Shell and worked as Geologist/Geophysicist in the Netherlands, the UK and Vietnam. Currently he is a production geophysicist in Sarawak Shell Berhad (Miri, East Malaysia). He has a strong interest in nature and conservation and travelled, besides most European countries, to Africa, North and South America and Asia, often off the beaten track, and to areas of conservation importance. He is a member of the National Geographic Society, the WWF, the BUND and the Malaysian Nature Society. His special attention within natural history is in habitat/species conservation and in entomological aspects.

Mariafe Nunez

Maria Felecitas L. Nunez is a 22 year old Filipino national, born and raised on the island of Palawan, often called 'the last frontier', due to its bounty of natural treasures and lack of infrastructure. She holds a Diploma in Fisheries Technology with a major in Fish Processing from the State Polytechnic College of Palawan (Institute of Marine Sciences). Her main interests are healthy nutrition and natural history along with conservation issues.

Patrick Allman-Ward

Patrick Allman-Ward is a 43 year old geologist working for Brunei Shell Petroleum. He joined Shell in 1982 after graduating with a PhD in Mining Geology from the Royal School of Mines, Imperial College and has subsequently worked in the Netherlands, Malaysia and Nigeria before arriving in Brunei in 1997. Whilst always maintaining a keen interest in outdoor life and activities, he became hooked on the tropical rainforest when he joined a Zoo Negara expedition to the Taman Negara in 1990. This was followed up by numerous trips to other Malaysian National Parks and Wildlife areas including Bako, Kinabalu, Mulu, Danum Valley and Pulong Tau where he climbed Gunung Murud in 1992 and Batu Lawi in 1993. Subsequently further trips were made in Africa to national parks in Nigeria, Zimbabwe and Tanzania. He is an enthusiastic (if untalented) amateur photographer and contributed to the book "Wildlife Watch in Brunei Darussalam". He has also submitted various articles on ecological issues to local and international journals with varying degrees of success.

Martin Storey

Martin Storey is a 35 year-old French engineer living and working in South-East Asia, and a member of the Malaysian Nature Society since 1995. Since his first visit to Malaysia in 1987, he has travelled all over Peninsular and East Malaysia, usually accompanying his uncle, Malaysian entomologist Hugh Storey. He developed a private interest in nature and conservation by eco-touring the world, often on foot, working as a volunteer in the Congo (lowland gorilla behavioural study) and in Costa Rica (leatherback turtle conservation), and recently as a member of this MNS Pulong Tau Expedition. He is a co-author of the book "Wildlife Watch in Brunei Darussalam" (published 1998) and can be contacted by email at: mstorey@stanfordalumni.org.

The Guides

A significant part of the expedition's success is due to the knowledge, dedication and resourcefulness shown by the six guides and porters that made up part of the expedition team. The experience and wisdom of the main guide, Pang Ayu, was a crucial factor in the accomplishment of many of our objectives, especially the section of the trek where we cut our own path from Camp 1 to Gunung Murud rather than follow the forest trails used by others.

Pang Ayu Kpg. Pa'Ukat

Pang Ayu is a local Kelabit community leader and was our lead guide. He assisted in the daily planning of the route and timing, organised the other guides/porters and made the decisions regarding the setting up of the camps. His knowledge of local trees and plants was invaluable in the identification required in the vegetation survey.

Lim Tinggang Kpg. Pa'Ukat

Lim works for the Bario Forestry Department and was Pang Ayu's second-in-command. He would sometimes take the lead from Pang Ayu and showed responsibility and initiative when organising the other guides/porters. He was also very helpful in the measurement of the trees included in the vegetation survey.

Johnson Puding Kpg. Arur Dalaw

Johnson was gregarious and energetic and showed great humour and friendship to everyone. He was able to produce quantities of simple camp food in a short space of time. He was also talented in the collection and spotting

of specimens of many different species, including frogs, crabs, beetles and orchids. He managed to catch a small fish by hand from a forest stream.

Edwin Radu Kpg. Pa'Lungan

Edwin also lives and works in Miri. He was helpful and will be remembered for sharing a local Kelabit dance with us on the night of the farewell party.

Jelly Akup Kpg. Pa'Ukat

Jelly showed his strength by carrying around 50 small mammal traps and assisting in their daily re-assembling and packing.

Lisa Barur Kpg. Pa'Ramapu

Lisa was a helpful guide, a little more reserved. He put in a lot of effort into his portering.

8. Acknowledgements

Firstly we wish to thank the Forest Department, Sarawak for permission to undertake the expedition and co-operation in the efforts we made to record the natural history of Pulong Tau. Thanks also to the Wildlife Department Offices in Kuching and Miri for their assistance and to the Resident of Miri for permission to enter the area (Permit No. RMD/45/98).

The Malaysian Nature Society members who participated in the expedition are indebted to the tremendous help and friendship offered by the guides. Needless to say, without their considerable enthusiasm and assistance we would never have managed a fraction of what was achieved. Thanks also to John Tarawe for his encouragement and for helping organise the logistics from the Bario end. In Miri we would like to thank the other members of Kelabit community and the Malaysian Nature Society who supported our efforts both before and after the expedition.

Rob Stuebing and Indraneil Das helped with the identification of frogs and snakes. Anthony Lamb assisted with the identification of some of our slides. Thank you for your assistance and to all those who commented on drafts of this report.

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MNS Miri Branch Pulong Tau site : <http://www.geocities.com/RainForest/Andes/2949/>

Appendix I: Additional bird species recorded from the Kelabit Highlands. Data from MacKinnon (1993) and Gregory-Smith (1998).

| Family | Common name | Scientific name |
|----------------|---------------------------------|-----------------------------------|
| ARDEIDAE | Purple Heron | <i>Ardea purpurea</i> |
| | Intermediate Egret | <i>Egretta intermedia</i> |
| | Yellow Bittern | <i>Ixobrychus sinensis</i> |
| ACCIPITRIDAE | Brahminy Kite | <i>Haliastur indus</i> |
| | Crested Serpent-Eagle | <i>Spilornis cheela</i> |
| | Besra | <i>Accipiter virgatus</i> |
| PHASIANIDAE | Ferruginous Partridge | <i>Caloperdix oculea</i> |
| | Bulwer's Pheasant | <i>Lophura bulweri</i> |
| RALLIDAE | White-breasted Waterhen | <i>Amaurionis phoenicurus</i> |
| | Watercock | <i>Gallixrex cinerea</i> |
| | Common Moorhen | <i>Gallinula chloropus</i> |
| SCOLOPACIDAE | Wood Sandpiper | <i>Tringa glareola</i> |
| | Common Snipe | <i>Gallinago gallinago</i> |
| COLUMBIDAE | Thick-billed Green-Pigeon | <i>Treron curvirostra</i> |
| | Ruddy Cuckoo-Dove | <i>Macropygia emiliana</i> |
| | Spotted Dove | <i>Streptopelia chinensis</i> |
| CUCULIDAE | Emerald Dove | <i>Chalcophaps indica</i> |
| | Large Hawk-Cuckoo | <i>Cuculus sparverioides</i> |
| | Bay-banded Cuckoo | <i>Cacomantis sonnerati</i> |
| CENTROPODIDAE | Lesser Coucal | <i>Centropus bengalensis</i> |
| STRIGIDAE | Brown Hawk-Owl | <i>Ninox scutulata</i> |
| PODARGIDAE | Dulit Frogmouth | <i>Batrachostomus harterti</i> |
| CAPRIMULGIDAE | Short-tailed Frogmouth | <i>Batrachostomus poliophilus</i> |
| | Malaysian Eared Nightjar | <i>Eurostopus temminckii</i> |
| APODIDAE | White-throated Needletail | <i>Hirundapus caudacutus</i> |
| | Fork-tailed Swift | <i>Apus pacificus</i> |
| HEMIPROCNIDAE | Grey-rumped Treeswift | <i>Hemiprocne longipennis</i> |
| ALCEDINIDAE | Blue-banded Kingfisher | <i>Alcedo euryzona</i> |
| | Stork-billed Kingfisher | <i>Pelargopsis capensis</i> |
| | Collared Kingfisher | <i>Todirhamphus chloris</i> |
| BUCEROTIDAE | White-crowned Hornbill | <i>Aceros comatus</i> |
| | Wreathed Hornbill | <i>Aceros undulatus</i> |
| CAPITILIONIDAE | Red-throated Barbet | <i>Megalaima mystacophanos</i> |
| | Bornean Barbet | <i>Megalaima eximia</i> |
| PICIDAE | Olive-backed Woodpecker | <i>Dinopium rafflesii</i> |
| EURLAIMIDAE | Hose's Broadbill | <i>Calyptomena hosii</i> |
| PITTIDAE | Blue-banded Pitta | <i>Pitta arquata</i> |
| | Banded Pitta | <i>Pitta guajana</i> |
| HIRUNDINIDAE | Barn Swallow | <i>Hirundo rustica</i> |
| CAMPEPHAGIDAE | Bar-winged Flycatcher-Shrike | <i>Hemipus picatus</i> |
| PYCNONOTIDAE | Straw-headed Bulbul | <i>Pycnonotus zeylanicus</i> |
| | Black-crested Bulbul | <i>Pycnonotus melanicterus</i> |
| | Ashy Bulbul | <i>Hypsipetes flavala</i> |
| DICRURIDAE | Greater Racket-tailed Drongc | <i>Dricrurus paradiseus</i> |
| IRENIDAE | Asian Fairy-Bluebird | <i>Irene puella</i> |
| TIMALIIDAE | Temminck's Babbler | <i>Pellorneum pyrrogenys</i> |
| | Mountain Wren-Babbler | <i>Napothera crassa</i> |
| | Eye-browed Wren-Babbler | <i>Napothera epilepidota</i> |
| | White-necked Babbler | <i>Stachrys leucotis</i> |
| | Black Laughingthrush | <i>Garrulax lugubris</i> |
| | White-browed Shrike-Babbler | <i>Pteruthius flavicapis</i> |
| | Brown Fulvetta | <i>Alcippe brunneicauda</i> |
| | White-Browed Shortwing | <i>Brachypteryx montana</i> |
| | Magpie-Robin | <i>Copsychus saularis</i> |
| | White-crowned Forktail | <i>Enicurus leschenaulti</i> |
| MUSCICAPIDAE | Sunda Whistling-Thrush | <i>Myiophonus glaucinus</i> |
| | Rufous-tailed Jungle-Flycatcher | <i>Rhinomyias ruficauda</i> |
| | Eye-browed Jungle-Flycatcher | <i>Rhinomyias gularis</i> |
| | Asian Brown Flycatcher | <i>Muscicapa dauurica</i> |
| | Indigo Flycatcher | <i>Eumyias indigo</i> |
| LANIDAE | Rufous-chested Flycatcher | <i>Ficedula dumetoria</i> |
| | Maroon-breasted Philentoma | <i>Philentoma velatum</i> |
| | Brown Shrike | <i>Lanius cristatus</i> |
| ZOSTEROPIDAE | Pygmy White-eye | <i>Oculoncinta squamifrons</i> |