SURVEY OF FLORA AND FAUNA OF LIMESTONE HILLS
IN KELANTAN
WITH RECOMMENDATIONS FOR CONSERVATION

A report to WWF Malaysia
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1. General Section

This report describes a survey of the flora and fauna on limestone hills in Kelantan, Peninsular Malaysia. The survey was contracted by World Wide Fund for Nature (Malaysia) within the context of the Conservation Strategy Kelantan project and carried out by Dr G W H Davison and Dr Ruth Kiew with field assistance from Mr S Anthonysamy. The work was conducted from 7th to 25th May 1990, using a four-wheel drive rented vehicle. With this, access to most limestone hills was possible, and some others were visited by boat down the Nenggiri river.

There are about 210 limestone outcrops in Kelantan (Appendix 1). The figure can never be precise because there is difficulty in defining exactly what is meant by one hill. Some hills break up into ever smaller outcrops, petering out some distance from the main massif. Some outcrops are so tiny that they are biologically (but not geologically) insignificant.

There are also problems in deciding the importance of particular hills. Some hills are important because they support a good all-round biodiversity. Some hills are important in their own right. Others are of value mainly within a larger context, for instance as part of a spectacular landscape. Gua Musang town would be an unmemorable place, if not for the presence of the three hills Gua Musang, Gua Serai and Gua Batu Boh.

The highest limestone massif in Peninsular Malaysia is Gua Peningat in Taman Negara, Pahang, which is 2,342 feet (714 m) high. (But see below). The largest cave system in Peninsular
Malaysia is Gua Tempurong, Perak. Although Kelantan limestone does not hold these records, Kelantan has far more limestone than any other state. Perak is said to contain about 50 limestone hills. Kelantan limestone includes some of the most spectacular massifs, notably along the Sungai Nenggiri, Gua Setir, and in the Sungai Ciku area. Furthermore, if Gunung Sakam (3,493 feet, 1,065 m) and Gunung Hering (3,130 feet, 954 m) in Ulu Sungai Jenera are truly limestone as they appear to be from topographical maps, then they are by far the highest altitude exposures of limestone in the Peninsula, though at most 1,100 feet (335 m) of limestone is actually exposed there.

During this survey we obtained information on about 120 of the 210 outcrops (57%). We visited, climbed, skirted or entered 40 of them, while obtaining information on the others from a distance. A full list of the outcrops was compiled from topographical maps and our surveys, and is given in Appendix 1 with notes on each hill.

Our itinerary was as follows:

7 May Kuala Lumpur to Gua Musang. Preliminary survey of Batu Neng, Batu Tapah, Batu Papan.

8 May Survey Kuala Betis limestone. Preliminary survey, Gua Batu Boh.

9 May Visit RPS Kuala Betis to arrange boats for Nenggiri trip. Survey Batu Papan.

10 May Boat from K. Betis to Kuala Jenera. Survey of Gua Cha, Gua Jaya, Gua Palda.

11 May Survey of Batu Kenorig at Kuala Bering.

12 May Survey Batu Raba, Hill '15', Batu Baloh.
13 May Survey Gua Jaya. Return to Gua Musang.

14 May Survey of Gua Ikan and neighbouring hills, and Sungai Tias.

15 May Survey of Hills '1' - '21' between Gua Musang and Kampung Star.

16 May Survey Gua Nenek, Gua Panjang, Gua Bechah Kelubi.

17 May Survey Gua Musang, Gua Serai, Gua Batu Boh.

18 May Survey Hills '30' - '51' between Gua Musang and Sungai Sam. Survey Gunung Reng, Jeli.

19 May Survey Gua Setir, Gua Maka.

20 May Survey Bertam to Kemubu hills, Sendok, Ban Chaun to Batu Balai.

21 May Tanah Merah to Gua Musang. Survey Gua Gagak.

22 May Survey Hills '66' - '81', Pulai, and visit Gunung Rabong.

23 May Survey Gua Tok Kong massif, Hills '82' - '89'.

24 May Survey of Relai and Ciku areas, Hills '90' - '100'.

25 May Return to Kuala Lumpur.

In addition, one of us (GWHD) visited Gua Cha and Gua Jaya in August 1985, Gunung Reng in October 1986, Gua Henderik and Gua Renayang in June 1988, and Gua Ikan in February 1989.

1.1. Major problem - Accessibility

For fifty years after the railway line between Kuala Lipis and Kuala Krai was opened, it remained the only access to the limestone hills in Kelantan. Disturbance to these hills included clearing the surrounding vegetation for the establishment of estates (see 1.2.1) and a low level of quarrying (e.g. at Gua Kawan) presumably to provide chippings for the railway track.

The opening of the road between Kuala Lipis and Kuala Krai
saw extensive land schemes develop over large areas on both sides of the road, which in many cases have opened up roads which pass close to limestone hills. In addition, logging activities have made other hills (e.g. Sua Setir) accessible along logging tracks.

The result of this activity is that the great majority of limestone hills can now be reached by road. The limestone along the Sungai Nenggiri between Kampong Star and Kuala Jenara is the only limestone accessible only by boat.

This accessibility has placed them at risk from human disturbance, which includes clearing the surrounding forest (1.2.1), burning (1.2.2), guano collecting (1.2.3), quarrying (1.2.4), and visitor pressure (1.2.5).

1.2. Risks

1.2.1. Clearing of vegetation.

The soil weathered from the limestone is the Terra Rossa type, which is more friable than laterite and is therefore used for agriculture. As a result many accessible hills have been cleared right to their base.

The plant assemblage at the base of limestone hills includes many endemic, rare and local species that grow in damp, shaded conditions and which are extremely vulnerable to changes in their environment. These include plants which grow on large detached boulders or screes, the most notable of which are the balsams and Epithema species; and those that grow at the base of hills,
around cave mouths or in cracks in the limestone rock face shaded by the forest canopy. These latter habitats are home to many rare species of Gesneriaceae, some of which are especially vulnerable to extinction being confined to a single limestone hill, e.g. the new species of Paraboea from the Gua Gagak hills.

Another habitat threatened by clearance is the small shallow streams that issue from the base of the hills and whose pebbly bed is carpeted with Cryptocoryne species. Clearing eventually eliminates these species as it causes siltation, which settles in a thick layer over the extremely crinkly Cryptocoryne leaves, and increased exposure which leads to a growth of algal slime which grows over them.

Clearing for the cultivation of bananas causes the most damage. A crop of bananas has an incomplete canopy, which leads to invasion by weeds such as lalang and Eupatorium, both of which pose a fire risk as their dead leaves and stems readily catch fire. Since bananas are a short-lived crop, burning to clear the land before replanting is frequent. Burning is especially damaging as it threatens the entire limestone flora not just that at the base of the hill (see 1.2.2).

On the other hand, rubber and oil palm provide a more shaded environment beneath their canopy and clearing and burning occur at much longer intervals, which to a certain extent allows the reestablishment of the shade and damp-loving species, provided that they have not been totally eliminated in the first place. Unfortunately both these crops, particularly oil palm, are
planted to the very base of the hill, which in some cases does not allow a remnant of the original flora to survive.

1.2.2. Burning

Under natural conditions, burning is a rare event caused by lightning strikes in drought periods when the vegetation is partly dry. However, its effects are extremely local as the lightning is usually accompanied by torrential rain and so the burning affects only a small area on the summit, which can recover.

Nowadays burning results from human activities, usually the cutting and burning of vegetation prior to planting crops or to accidental causes, where limestone hills are close to human habitation. This type of burning is extremely damaging as it eliminates the damp and shade loving flora found at the base of hills (see 1.2.1), and by sweeping up the cliff face eliminates the sparse and probably slow-growing species that can grow in crevices in the rock face, as well as burning much of the vegetation on the summit.

This elimination of the original flora is followed by the establishment of weedy pioneer species, such as wild bananas *Musa acuminata* and the massive aroid *Colocasia gigantea*, and later *Arenga westerhoutii* and creepers. These creepers are an especial problem as they cover complete cliff faces smothering plants that have survived, preventing regeneration and their fallen leaves accumulate as a deep layer of dry leaf litter, which is an additional fire risk. Summit vegetation is at first replaced by
the large grass *Neyrandia reynaudiana* and mahang species as can presently be seen on the summit of Batu Kurap.

Burning is undoubtedly the most serious threat to the limestone flora and has increased dramatically as hills have become accessible. In 1939 Henderson was able to report that he had "seen only one instance of damage by fire on limestone hills in the Peninsula and in this case there is very little doubt that the fire was started, accidentally or not, by human agency."

During this survey we encountered 4 hills (Batu Kurap, Cave Hill Ciku 5, Batu Serai, and hills north of Gua Musang) out of 120 that were very severely burned but many others showed signs of former burning around the base or of part of the summit (as judged from the presence of creepers and *Arenga* and thin plant cover on the summit).

For small isolated hills, such as Gua Kurap, there is little hope that they can recover after a severe burn as only a small remnant of the original flora survives and the hill is too far from others for the dispersal of species.

For the larger hills, such as Gua Musang, recovery of the flora appears possible. Chin (1977) reported that all the vegetation on Gua Musang was destroyed by fire in 1969. He observed very few species that survived, namely *Cratoxylon maingayii* and *Podocarpus polystachys*, both of which have thick bark, and *Radermachera labbiij*, which although burned to the ground had two years later recovered and produced sucker shoots.
that were already flowering.

Otherwise these first two years saw an invasion of herbaceous weeds, such as *Neyraudia reynaudiana*, *Colocasia gigantea*, *Solanum ferox* and the fern *Nephrolepis biserrata*. Herbaceous elements of limestone flora that recolonised rapidly after burning included only species of *Paraboea* and *Chirita* (both of which produce large populations of seedlings under natural conditions), and the fern *Schizaea inopinata*.

Now, twenty years later, there is little evidence of the severe 1969 burn on the summit apart from the continued presence of *Neyraudia*. Gua Musang is however characterised by a deep peat soil that covers much of the summit and surviving pockets of the original flora as well as those deeply rooted species such as the tuberous *Amorphophallus* and *Arisaema* species or seeds in the soil, could contribute to the renewal of the original vegetation. In addition, many of the summit species are bird dispersed so that the neighbouring hills could also provide a source of propagules. However, it should be pointed out that as there was no checklist of species prior to the fire, it is not possible to know which species, if any, were eliminated by fire.

This contrasts with the recovery of the vegetation on the rock faces and hill base. Although *Paraboea* species appear to benefit from the more open conditions after other vegetation has been eliminated, it is noticeable that the woody element of the flora remains sparse. This could be due to these species being slow growing, or to the narrow crevices in which they root suffering from severe soil erosion once they are exposed to the
elements so they can no longer provide a toehold for more deeply rooted species.

The base of Gua Musang, by its close proximity to human dwellings built right up to its base continually suffers from disturbance which no doubt is a further reason why there is none of the original flora left on the side facing the town.

1.2.3. Guano collecting.
Guano is extracted from caves wherever it is found, theoretically under license, and sold as fertilizer. Large amounts of guano are found in few caves, those inhabited by large numbers of fruit-bats. Much more seriously, people believe (without much evidence) that any earth found within caves or close to limestone hills also has fertilising quality similar to guano itself. This means that any cave or overhang accessible to people is likely to be dug out, and this activity is virtually impossible to control.

This has two main destructive effects. One is biological - the destruction of vertebrate and especially invertebrate populations within caves. Animals like bats, trapdoor spiders, cave cockroaches, centipedes and crickets can be wiped out of particular caves, though bats are more resilient since they can fly away and return later.

The other effect is the destruction of sites potentially important for archaeology. Archaeological remains are irreplaceable resources, easily damaged, and often found within cave mouths and rock shelters away from flooding. The digging out
of cave earth (rather than guano) has destroyed or damaged hundreds of such sites in Peninsular Malaysia, nearly always before they could be investigated scientifically. Examples of this were found at Gua Setir and Gua Sendok Utara during our survey. These losses are important not merely to historians but also to biologists, geologists, social scientists, museums and members of the public.

1.2.4. Quarrying.
Quarrying for cement, road and railway chippings, terrazo and marble can have effects as serious as guano extraction, burning and so on, i.e. the eventual destruction of entire communities and sites, but quarrying is usually more controlled, more gradual, more confined, and it is easier to spot infringements. On the other hand its effects, such as pollution from dust and noise from machinery and vehicles, are more immediately disturbing to people.

As quarrying eventually results in total loss of the flora, fauna, geological and archaeological resources, it is important to be certain from the beginning that the particular hill to be quarried is not of special value from any of these aspects.

1.2.5. Visitor Pressure.
The flora of cave mouths and the summit are particularly prone to disturbance by trampling by visitors. In Kelantan this as yet seems relatively light. More extensive damage to cave mouths is caused by the extraction of guano.
Disturbance around cave mouths does not appear yet to have caused the elimination of the fragile plant community, composed mainly of herbaceous species such as aroids, begonias, chiritas, monophyllaes and elatostemmas. However, it has led to the establishment of weedy species such as cili padi Capsicum frutescens and Colocasia gigantea, both of which are common in this situation.

Disturbance on the summit of Sua Musang is caused by cutting trees to provide a look-out point and concentrated trampling in this area. This trampled area is now covered by a number of invading grasses such as carpet grass Axonopus compressus, love grass Chrysopogon aciculatus, crab grass Digitaria, Dropseed Sporobolus as well as cili padi, Eupatorium odoratum, Lantana camara and the fern Nephrolepis biserrata.

At present damage to the limestone vegetation is slight and these weedy species are not able to invade the shaded understorey. However, there is no room for complacency as many of the 'adventure' type of groups of visitors, who make up most of those who climb these hills, cannot resist chopping trees with parangs so that damage is likely to become more extensive until it outstrips the vegetation's ability to regenerate.

Some effects of visitors are not especially damaging but merely unsightly, like graffitti and littering. Graffitti is always ugly. People are remarkably agile in climbing to daub paint over a wide and high area. Graffitti is often obscene and could ultimately ruin the tourist potential of particular caves.
The main aspects of littering are the accumulation of plastic bags and drink cans, which do not add to the fire risk but encourage mosquitos. Other common items of litter are newspapers, batteries, clothing, cigarette packets, timber and bamboo.

Worse than this is the cutting of vegetation to make trails or camps, and the picking of rare flowers. A stage worse again is the potential for the accidental spread of fires. One or more of these effects can be seen wherever people visit limestone. By a process of slow accumulation they can eventually ruin the recreational potential of a site, besides damaging the flora and fauna. Examples of animal introductions, which compete with native species on and around limestone are the giant African snail *Achatina fulica*, and household cockroaches like *Blatta* and *Periplaneta*. 
2. Results of the survey

This section presents preliminary scientific results as time has not permitted the complete identification of the material collected. However, further identification is unlikely to materially alter the results outlined below or to affect the recommendations.

2.1. Flora

2.1.1. Introduction

It is well-known that the flora of limestone is rich in species and harbours many endemic species that are not found in other habitats. For Peninsular Malaysia, Chin (1977) records a total of 1,216 species of vascular plants of which 272 are endemic to Peninsular Malaysia and 129 are restricted to limestone.

Compared with other states, the limestone flora of Kelantan is poorly known and it is not surprising that previous to this study only five species or varieties were reported as confined to limestone in Kelantan and of these only one was considered endangered (Kiew, unpublished). This compares with 30 species endemic to Langkawi of which 12 are endangered and 28 for Perak of which 14 are endangered.

Previous floristic studies carried out in Kelantan are few and are relatively recent as well as being confined mainly to the Gua Musang area. The first botanical specimens were collected from Gua Musang by Foxworthy and Nur in 1924. Henderson in his survey of Malaya’s limestone flora climbed to the top of Gua Musang and Gunung Panjang in 1927 and visited Gua Teja and Gua
Lambok on the Sungai Betis in 1935. Since then there have been more detailed surveys in the Gua Musang area, most notable of which are the UNESCO Limestone Expedition of 1962 and those by Chin in 1969-71. The UNESCO Expedition also visited limestone at Sg. Bertam and Whitmore collected from the Gua Jaya limestone at Kuala Jenera.

2.1.2 General results

In this survey, at least one hill in each of the major groups of hills was explored, although the summit was reached on only four of them. However, as it is the vegetation around the base of the hill that is most vulnerable (see 1.2.1 and 1.2.2) special attention focused on this assemblage of species.

A total of about 150 species were recorded of which 60 (37%) were found on the most hills (Appendix 2). While the majority of these are typical of Peninsular Malaysian limestone, they include several interesting groups of species:

2.1.2.1 The Kelantan element

This includes species endemic to Kelantan. At present the following four species fall into this category:

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
<th>Locality</th>
<th>Conservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begonia sp. nov.</td>
<td>Begoniaceae</td>
<td>Gua Jaya &amp; Sg. Bering</td>
<td>V</td>
</tr>
<tr>
<td>Epithema sp. nov.</td>
<td>Gesneriaceae</td>
<td>widespread</td>
<td>V</td>
</tr>
<tr>
<td>Ophiophriza longepennis</td>
<td>Rubiaceae</td>
<td>Batu Boh</td>
<td>E</td>
</tr>
<tr>
<td>Paraboela sp. nov.</td>
<td>Gesneriaceae</td>
<td>Gua Gagak hills</td>
<td>E</td>
</tr>
</tbody>
</table>

(E endangered; V vulnerable to extinction).

As all four species belong to the damp and shade-loving...
component, they are particularly vulnerable to extinction by disturbance to their habitat from clearing or burning. The new Epithema species is common on every hill visited. Its populations mostly consisted of seedlings or immature plants (out of the hundreds of plants seen only three were fertile). This may account for its previously being overlooked in spite of being so widespread.

The other three species, however, have extremely local distributions, which makes them especially vulnerable to extinction. At present Batu Bok is threatened by cultivation around its base, and Gua Gagak from illegal logging. Ophiorrhiza longeepens and Paraboea sp. nov. must both therefore be regarded as endangered species.

2.1.2.2. The Kelantan-Pahang element.

If the geographic distribution of limestone species is considered, the Kelantan limestone flora shows most affinity with the Pahang flora with which it shares 15 species:

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amorphophallus praenii</td>
<td>Araceae</td>
</tr>
<tr>
<td>Begonia foxworthyi</td>
<td>Begoniaceae</td>
</tr>
<tr>
<td>Begonia nurii</td>
<td>Begoniaceae</td>
</tr>
<tr>
<td>Boea chinii</td>
<td>Gesneriaceae</td>
</tr>
<tr>
<td>Carex speciosa</td>
<td>Cyperaceae</td>
</tr>
<tr>
<td>Forrestia monosperma</td>
<td>Commelinaceae</td>
</tr>
<tr>
<td>Impatiens opinata</td>
<td>Balsaminaceae</td>
</tr>
<tr>
<td>Oberonia transversiloba</td>
<td>Orchidaceae</td>
</tr>
<tr>
<td>Pandanus irregularis</td>
<td>Pandanaceae</td>
</tr>
<tr>
<td>Paraboea brachycarpa</td>
<td>Gesneriaceae</td>
</tr>
<tr>
<td>Paraboea speciosissima</td>
<td>Gesneriaceae</td>
</tr>
<tr>
<td>Pteroceras tanypellatum</td>
<td>Orchidaceae</td>
</tr>
<tr>
<td>Spatholirion ornatum</td>
<td>Commelinaceae</td>
</tr>
<tr>
<td>Thelesia succosa</td>
<td>Orchidaceae</td>
</tr>
<tr>
<td>Tylophora calcicola</td>
<td>Asclepiadaceae</td>
</tr>
</tbody>
</table>

These include two species (Paraboea brachycarpa and Pandanus
irregularis) that Chin reported only from Kelantan but which have since been reported from Pahang as well (Kiew, 1985).

2.1.2.3 New records for Kelantan

In view of the paucity of botanical work in Kelantan and its concentration in the Gua Musang area, it is not surprising that a considerable proportion (9-10%) of the species collected are new records for limestone in the state:

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Arenga hookeriana</td>
<td>Palmae</td>
</tr>
<tr>
<td>2. Benonita curtisii</td>
<td>Begoniaceae</td>
</tr>
<tr>
<td>3. Biophytum adiantoides</td>
<td>Oxalidaceae</td>
</tr>
<tr>
<td>4. Chirita lacunosa</td>
<td>Gesneriaceae</td>
</tr>
<tr>
<td>5. Chirita sericera</td>
<td>Gesneriaceae</td>
</tr>
<tr>
<td>6. Curanga amara</td>
<td>Scroptularieae</td>
</tr>
<tr>
<td>7. Elatostema subscabrum</td>
<td>Urticaceae</td>
</tr>
<tr>
<td>8. Hoya citrina</td>
<td>Asclepiadaceae</td>
</tr>
<tr>
<td>9. Impatiens vaughanii</td>
<td>Balsaminaceae</td>
</tr>
<tr>
<td>10. Paraboea speciosissima</td>
<td>Gesneriaceae</td>
</tr>
<tr>
<td>11. Peperomia dindingulensis</td>
<td>Piperaceae</td>
</tr>
<tr>
<td>12. Pinaeda scortechinii</td>
<td>Palmae</td>
</tr>
<tr>
<td>13. Saurocos suberosus</td>
<td>Euphorbiaceae</td>
</tr>
<tr>
<td>14. Spatholirion ornatum</td>
<td>Comelinaeceae</td>
</tr>
</tbody>
</table>

2.1.2.4 Rare species.

Apart from those species listed in 2.1.2.1., some extremely rare species were encountered during the course of this survey and for which measures should be taken to provide some form of protection.

1. *Impatiens vaughanii* (Balsaminaceae), an extremely beautiful balsam with large purple flowers, was discovered on Gua Ikan where it grows in profusion on boulder screes. This area is currently threatened by clearing which appears to be proceeding at the present time. Vaughan's balsam was previously known only
from Perlis and southern Thailand.

ii. *Spatholirion ornatum* (Commelinaceae) grows in profusion on the deeply shaded slopes on Gua Setir. This is apparently only the second record of this species since first collected near Kuala Lipis, Pahang in 1896. It is a handsome plant well worth introducing into cultivation.

iii. *Cryptocoryne* species (Araceae). Chin (1983) reported that the UNESCO Expedition collected *C. minima* from Gua Batu Boh and *C. purpurea* from Gua Panjang. Both these species are rare. *C. minima* is known from only one other locality (Tapah, Perak) and *C. purpurea* is known from streams in Johore. We were unable to relocate either of these two species but streams in these areas have suffered severe degradation from clearing and are likely to be endangered (see 1.2. and 7.2).

iv. *Berassodendron machadonis* (Palmae) is a rare palm known only from Peninsular Malaysia and one locality in southern Thailand. It has a patchy distribution being recorded from only six areas in the Peninsula: one each in Kedah, Kelantan and Pahang and three from Perak (Whitmore, 1977). The Kelantan locality he cited is Batu Boh. Our survey shows that this population is in good condition and consists of a reasonably large population which includes individuals that are fruiting freely as well as many seedlings and young plants. This population that grows in the wangi on Batu Boh is currently threatened by nearby cultivation (see 3.2.2.-5).

In addition, we located another population on the Sg. Bering
limestone. This remote population while safe from clearing for cultivation may be endangered by future logging activities.

v. *Strobilanthes polyphyllus* (Acanthaceae) is a shrub with fine large lilac flowers with horticultural potential. Previously known from a single collection from Perak made more than a hundred years ago, it forms thickets along the banks of the stream that flows past Gua Setir.

2.1.2.5 Polymorphic species.

Another special interest group of plants are those that show polymorphism, with distinctive differences between populations from different hills.

These populations represent evolution in action and conservation of the various forms is necessary to conserve their full genetic complement. The two notable groups that show polymorphism are the balsam, *Impatiens ooinata*, and begonia species. Since all these species have horticulture potential and their polymorphism is expressed in different colour forms, their conservation is of especial importance.

<table>
<thead>
<tr>
<th>Species</th>
<th>Colour Form</th>
<th>Locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. <em>Impatiens ooinata</em></td>
<td>canary yellow with red spots</td>
<td>Pulau Raba, Gua Gagak, Ciku 8</td>
</tr>
<tr>
<td></td>
<td>pale yellow with red spots</td>
<td>Ciku 5 (main block), Gua Sendok Utara</td>
</tr>
<tr>
<td></td>
<td>peachy orange</td>
<td>Gua Renayang</td>
</tr>
<tr>
<td></td>
<td>claret-red</td>
<td>Gua Jaya, Sg Bering</td>
</tr>
<tr>
<td></td>
<td>white</td>
<td>Ciku 5 (cave hill)</td>
</tr>
<tr>
<td>ii. <em>Begonia kingiana</em></td>
<td>variegated leaves and pink flowers</td>
<td>G. Renayang, Batu Papan</td>
</tr>
<tr>
<td></td>
<td>unvariegated leaves and white flowers</td>
<td>Gua Pald, Sg Bering, G. Gagak</td>
</tr>
</tbody>
</table>
iii. *B. foxworthyi*  
leaves green  
Pulau Raba, Elephant Cave, G. Panjang, G. Gagak  
leaves bronze-coloured  
Gua Setir

iv. *B. nurii*  
leaves green  
Gua Musang  
leaves bronze-coloured  
Gua Ikan, Gua Batu Baloh, G. Peha Kerbau

v. *Regonia* sp. nov.  
leaves green  
Gua Chawan  
leaves bronze-coloured  
Sg. Bering

2.1.3 Recommendations for the protection of the limestone flora

Two aspects should be considered in recommending conservation action to protect the flora. One is to protect hills that possess a representative flora in pristine condition, the other is to protect hills that harbour rare and/or endangered species.

2.1.3.1 Hills with a representative flora

These hills should be chosen because they have their ground vegetation intact and therefore protect all limestone plant habitats including the stream systems.

Of the hills we surveyed, four stand out:

1. Gua Ikan  
2. Gua Jaya  
3. Batu Bch  
4. Gua Setir

2.1.3.2 Hills that protect particular species.

<table>
<thead>
<tr>
<th>Hill</th>
<th>Vulnerable/Endangered/Rare Species</th>
</tr>
</thead>
</table>
| a. Gua Gagak (the area adjacent to the Wildlife Reserve) | i. *Paraboea* sp. nov. — endemic to this hill and considered endangered  
ii. *Boea chinii* only Kelantan locality for this species  
iii. White form of *Impatiens opinata* of two sites known, this is the only site in Kelantan |
| b. Gua Ikan | i. *Impatiens vaughanii* — only Kelantan locality, the other is in Perlis |
ii. variegated population of *Begonia nurii*

c. Gua Jaya

i. *Begonia* sp. nov. – endemic to this hill & Sg. Bring

ii. claret-coloured form of *Impatiens opinata* – endemic to this locality and Sg. Bring

iii. *Biophytum adiantoides* – only locality in Kelantan

d. Batu Boh

i. *Ophiophriza longerepens* – endemic to this locality, considered endangered

ii. *Borassodendron machadonis*, only one of two known sites in Kelantan

e. Gua Setir

i. *Spaltholirion ornatum* – only locality known in Kelantan, the other in Pahang

ii. *Strobilanthes pachyphyllus* – only locality known from Kelantan, the other in Perak

iii. variegated *Begonia foxworthyi*

f. Gunung Reng is of particular botanical interest as among all the Kelantan limestone hills, it shows more affinities to the northern limestone flora of Kedah, Perlis and Langkawi than to the 'typical' Kelantan limestone flora of the rest of the hills. Thus on G. Reng, *Pandanus irregularis* is absent (it is a constant feature of Kelantan limestone elsewhere) and *Begonia curtisi* and *Chirita sericea*, elements of the northern flora, are present. These are new records for the state and *B. curtisi* is not found elsewhere on Kelantan limestone.

2.2. Fauna

2.2.1 Introduction

Three kinds of animal communities can be distinguished in association with limestone, but there is a great deal of interchange between them.

a. There are animals which actually live on the limestone surface, and in the vegetation growing immediately on the limestone. The most important examples are the snails which live on limestone cliffs and boulders.

b. There are animals living within caves in the limestone, either for part of each day (bats) or for their entire lives (trapdoor
spiders, cave cockroaches, crickets and others).

c. There are animals which make rather more casual use of limestone caves and overhangs. These include serow, elephants, deer and various rodents, mainly using the limestone for shelter, and birds like peregrine falcons, swifts and swallows using it for nesting. Some of these species are rare.

Blurring of these categories occurs not only at cave mouths, where the cave fauna merges gradually into the open air fauna, but by movement of animals (mainly vertebrates like birds, elephants, serow and monkeys) to and away from the limestone, and by animals like snails actually falling off the limestone and falling into caves. The moral is that the limestone hill fauna is heavily dependent on the surrounding forest. Some animal species which are elsewhere uncommon seem to be particularly common or conspicuous around limestone, and the bases of limestone hills are often fruitful sites for the discovery of vertebrate remains.

2.2.2 Snail fauna

The snails living on the limestone include many endemic species, and the endemism is much more extreme than that found amongst plants. They are major examples of evolution in action.

The main work on endemic limestone snails was carried out by Tweedie (1961), whose collections formed the basis for a long series of taxonomic papers by Laidlaw (1949) and van Bentheim Jutting (1949, 1952, 1954, 1961a, 1961b). This work demonstrates that, for those genera most strictly dependent on limestone, many species are confined to single hills or hill clusters. Of 7
Peninsular Malaysian species of *Discartemon* 5 were found only on single hills, and equivalent figures are 6 out of 6 *Oophana*, 17 out of 24 *Sinepenna*, 23 out of 35 *Opisthostoma*, and 8 out of 16 *Diplommatina*. Our survey will modify these figures considerably.

Collections were also made by Hendrickson and analysed by Berry (1965), from Gua Jaya and five hills near Kuala Betis. These collections were of value in demonstrating, for a few species, that distributions in Kelantan are wider than had been supposed, and in their approach towards full species lists for particular hills.

However, snails in Kelantan have been less studied than elsewhere, for Tweedie (1961) listed collections only from Gua Nenek and from the hills between Gua Musang and Batu Tongkat. Kelantan is important for such studies because of:

(a) the large number of limestone hills there,
(b) the fact that even with current developments, many of these hills are less disturbed than on the west coast plains, and
(c) the closeness of the hills in extensive ranges, meaning they are biologically less isolated, and should demonstrate interesting transitional faunas.

As these snails present so many examples of rare and endemic species the main effort of the faunal survey was expended in their study. Samples were collected from about 30 hills, and some results of preliminary analysis are given in Appendix 3. Since species can be missed in sampling, gaps do not necessarily mean absence of a particular species from a particular place, but
records of presence are authoritative.

The following general points can be made about the snail fauna.

a. Overall diversity per hill. Diversity is apparently greatest on those hills surrounded by undisturbed forest such as at Gua Jaya (32 species) or Batu Pulau Raba (25 species), or where forest has only recently been disturbed (Gua Setir, 26 species). Diversity tends to be less on and around absolutely smaller hills with lesser microhabitat diversity and in long disturbed areas.

b. The typical species diversity, acknowledging that some hills like Gua Palda and Gua Sendok Utara were poorly sampled, can be estimated as about 25 to 30 species per hill.

c. The existence of a previous survey is no guarantee that the snail fauna of a hill is well known. A clear example of this is Gua Jaya. Gua Jaya was sampled by Hendrickson, and Berry (1965) listed 17 species. During our survey three of those species were not found, but another 15 were found which Berry did not record. Of these 15, three are species new to science.

d. Kelantan faunal element. The present survey shows that in Kelantan, where limestone hills are thick on the ground, some species or species groups are quite widely distributed. Examples are:-

i. *Daiosthoma laidlawi* complex. The type locality was given as 'Kelantan', and the only precise localities are five hills at Kuala Betis and at Gua Jaya. During our survey it
was found that nearly every hill supports a population morphologically close to O. laidlawi, but with local differences in size, spire shape and height, and placement of the aperture. Some of these variations may need to be recognized as new species, and the situation invites quantitative analysis.

ii. Discartemon collingei. Till now D. collingei has been the only one of its genus known from more than one hill. Tweedie (in van Benethen Jutting 1954) suggested this was because of human introduction. Its discovery on several other hills now shows that its wide distribution in Kelantan is natural.

iii. Sinoennea crumenilla complex. Forms resembling S. crumenilla were found on several hills and it is evidently widely distributed, but a detailed taxonomic study will be hampered by small sample sizes.

e. New species. Forms so far considered to be new in the present survey are:

1. Opisthostoma (Opisthostoma) sp. (Gua Jaya)
2. Diplommatina sp. a (Ciku 4 massif)
3. Diplommatina sp. b (Gua Jaya, Gua Tampah, Ciku 4 massif)
4. Diplommatina sp. c (Gunung Reng)
5. Sinoennea sp. a (Gunung Reng)
6. Sinoennea sp. b (Gua Setir)
7. Sinoennea sp. c (Gua Ikan)
8. Sinoennea sp. d (Batu Tampah)
9. Sinoennea sp. e (Ciku 5 caves)
10. Sinoennea sp. f (Gua Henderik)
11. Discartemon sp. (Gua Setir)
12. Ophana sp. a (Gua Setir)
13. Ophana sp. b (Gua Jaya)

It is expected that others may be found amongst the remaining
samples yet to be examined.

f. Rare and vulnerable species. All of the snail species endemic to single hills can be considered rare, and vulnerable to the threat of extinction. In each case the main risks are land clearance to the hill base, fire, and competition with invasive snails from cultivation.

These rare species confined to single hills include 12 of the above 13 new species (but some may lose their exclusive status, as samples from further hills are examined), plus *Sincennea attenuata* (Gua Musang-Gua Madu) and *Byliotracella modesta* (Gua Musang).

Species which have now been shown not to be endemic to single hills, and are therefore less vulnerable than Tweedie's (1961) summary implies, are *Sincennea crumenilla*, *Dascartemon piatymorphus*, *Diplommatina pentaechma*, *D. maduana* and *D. tweedieii*.

In addition, *Amphidromus cruentatus*, though found on several hills, appears to be rare on all of them and possibly suffers from competition with introduced *Achatina fulica*.

2.2.3 Vertebrates

Evidence of elephants was found at Gua Jaya, Gua Tampah, Gua Pulau Raba, Batu Balah, Hill 5, Hill 18, the Ciku 4 massif, and on the northeast slope of Gunung Rabong at 330 m in logged forest.

Elephants used limestone edges as travel routes through the
forest, and as sleeping sites. They were found to enter the cave at Gua Jaya, which implies they cross the Nenggiri at this point, since the cave has an almost exclusively riverine frontage. In June 1988 elephants were seen on the walking route from Cameron Highlands to Kuala Betis, on the south side of the Sungai Nenggiri due north of Gunung Bedong. In early 1989 at least one elephant was in evidence on the east face of Gunung Stong.

Serow droppings were found at Gua Jaya, Gua Palda, Gua Tampah, Batu Pulau Raba, Batu Baloh, Gua Batu Boh, Gua Setir, Gua Maka, Gua Sendok Utara, Ciku 4 massif, Hill 94 in Ciku Felda scheme 7-8, Hill 15, Hill 17, Batu Lesong and Gua Renayang. (In 1976 and 1977 serow were seen and droppings found on Gunung Rabong at 1250 m).

Peregrine falcons were seen at Gua Setir and may have been nesting. No views with binoculars were obtained, but both birds looked rusty beneath. Predated Blue Whistling Thrushes were found outside two cave entrances, possibly taken by peregrines.

Crag Martins were noticed at Gua Setir, Gua Musang, Gua Tampah and Batu Baloh. Blue Whistling Thrushes were found at Gunung Reng, Gua Setir and Gua Jaya. Blue Rock Thrushes were found at Gunung Reng, Gua Musang, and Gua Batu Boh. All of these are limestone specialists. The avifauna in vegetation growing directly on limestone (rather than in the forest round the base) was impoverished. The species of Wren-babbler *Napothena* sp. was not identified; the limestone Wren-babbler *N. crispifrons* could be sought.
2.2.4 Recommendations for protection of limestone fauna

2.2.4.1 Hills with a representative fauna

a. Gua Jaya. This massif supports at least 32 species of snails, including three new species of which two are endemic. It is also frequented by elephants and serow. It is surrounded to the base by extensive undisturbed forest.

b. Gua Setir. This long limestone wall supports at least 26 species of snails (and probably more, as Diplommatina species seem to have been missed), including three new species, all of them endemic. Peregrines and other limestone inhabiting birds occur there. Although some of the surrounding forest has been cleared recently, enough remains especially in the southern part to make a valuable continuum between the limestone and forest faunas.

c. Gua Panjang. This massif is sufficiently large and varied that, though disturbed round much of its base, it retains a diverse invertebrate fauna. Despite its closeness to Gua Musang town it is under-explored, and more faunal discoveries could be expected.

d. Gua Ikan. With forest round much of its base, Gua Ikan retains a reasonably varied fauna despite visitor pressure, and more intensive surveys would probably demonstrate that the whole complex (Gua Ikan, Tembakau, Pagar, Mastu and Buat) support a great diversity of limestone snails. However, like Gua Panjang,
encirclement by cultivation has probably reduced visits by large mammals.

2.2.4.2. Hills that support particular species

The following hills are known to support endemic species. The number of endemics, given in brackets, could be taken as a guide to the relative importance of each hill.

| Gua Setir | (3) | Ciku 5 caves | (1) |
| Gua Jaya  | (2) | Ciku 4 massif | (1) |
| Gunung Reng | (2) | Gua Henderik | (1) |
| Gua Musang | (2) | Gua Tampah | (1) |
| Gua Ikan  | (1) | Gua Madu | (1) |

It should be emphasised, however, that endemic species will in future be found on other hills as samples continue to be examined. The above are also minimum figures because species may have been missed in sampling.

2.3 Caves and Archaeology

2.3.1 Living Caves

A thorough search for all caves in a single hill could take weeks. All that can be done is to point out the more obvious ones. Any cave supporting large numbers of bats should be considered important for conservation. ‘Living caves’ with diverse communities supported by the guano of Cave Fruit-bats Eonycteris spelaea were found at:

| Gua Setir       | (about 2,000 bats) |
| Gua Musang      | (700 bats)         |
| Gua Nenok       | (500 bats)         |
| Gua Renayang    | (500 bats)         |
| Gua Ikan        | (400 bats)         |
Gua Batu Boh (200 bats)
Gua Sendok Utara (100 bats)
Hill 1B (100 bats)

The locations of these nine caves are marked on Figure 1. This list is definitely far from complete. Each of these caves should be protected in some way, and any others protected as and when found. Such protection would include strict enforcement of licencing for any form of guano or cave earth extraction, and possibly restrictions on visitor access in some caves.

No caves were found supporting major colonies of insectivorous bats, but such caves are likely to exist with the very extensive Kelantan limestone. Small caves supporting a few insectivorous bats each were found on the east face of Gua Setir, and the north-west face of Gua Ikan, and several of the caves listed above also contained insectivorous bats.

Appendix 4 lists the bat species which have been found along the Pergau and Nenggiri rivers. Only a few of these rely on cave roost sites, but nearly all would make opportunistic use of limestone crevices. Considering the total amount of limestone with caves, crevices and overhangs, the number of bats supported must be enormous.

2.3.2 Archaeological potential

In seeking archaeological remains, rock shelters (open-fronted overhangs) and bright, shallow, wide-mouthed caves are more important than deep dark caves. True archaeological value can only be assessed by excavation, but the following sites at least
Figure 1. Locations of major roosts of the Cave Fruit-bat Eonycteris spelaea 0 with 20 km radius foraging ranges indicated. These bats are major pollinators of durian, petai and other forest trees, and can fly up to 80 km in a night. Many other cave roosts may exist within Kelantan.
demand attention.

a. Gua Cha. This has been considered the most important of all archaeological sites in Peninsular Malaysia (Adi 1981), partly because of the abundance and variety of animal remains and cultural objects, partly because of the number of complete, well-preserved human burials. The known occupation period is in the range 0-9000 years before present (BP). Although it has been well excavated in three separate efforts (Noone 1939; Sieveking & Sieveking 1955; Adi 12931) the site is still of great value because of the area not yet excavated, and because of the contextual information. Loss of this site, for example by flooding for hydropower, would be a disastrous loss to the historical sciences. This alone is a major point against construction of a dam on the Sg Nenggiri.

An additional point is that this is one of the few known sites with breccia deposit (see d. below).

b. Gua Jaya and Gua Chawan. The potential of these sites has been reviewed in the report by Universiti Kebangsaan Malaysia (1986). In retrospect I feel the importance of Gua Jaya was overstated, but Peacock (1964) was overly disparaging about Gua Jaya and Gua Chawan. Gua Jaya itself contains pottery and evidence of limited quantities of animal bone. According to Peacock (1964) pottery shards show no evidence of cultural trends with depth, but the deposits as a whole do show stratification.

Gua Jaya has extra value as a record of high floods, because
Periodic floods have brought in sediment and trapped leaf litter in discernable layers. These organic layers are visible to the naked eye near the top, and may be detectable chemically lower down. With care the layers might be correlated with floods such as those of 1970, 1926-27 and earlier, yielding climatic data prior to written records.

Another shallow cave, also known as Gua Jaya, lies at the corner of the limestone massif about 200 m downstream. The open nature of this cave and the condition of its floor suggest it may have minor archaeological potential.

c. Gua Serai. At the south end of Gua Serai, in rubber estate, is one large rock shelter and several small sites of which the earth appears to be relatively undisturbed and always dry. These probably have archaeological potential.

d. Gua Tampah. This site, immediately opposite Kampung Kuala Bering, has been excavated. The space available for trenches is very small, but other caves were reported in the vicinity by local residents.

In addition, a rock shelter about 500 m up the Sungai Bering, on its north bank and up the earth slope, contains breccia deposits, similar to but more extensive than that at Gua Cha.

e. Gua Dala. Considering its proximity to Gua Cha, about 3 km downstream, this site deserves a survey.

f. Gua Bukit Perching. This site is near Kuala Yai, and was
investigated briefly by Williams-Hunt (1951). It again deserves study in view of its proximity to Gua Cha.

g. Gua Kurap. Although the surface of this hill is very damaged, and it stands in cultivation to its base, it is pierced right through by a level floored cave of which the earth is hardly disturbed. Archaeological potential can therefore be expected.

h. Gua Setir. Recent removal of guano and cave earth from the spectacular cave here must have severely damaged its archaeological worth. Nevertheless there are several overhangs along the west wall which would repay study, though some are damp. In addition there is a small circular cave on the east side of the hill, south of the main bat cave; its earth floor has been little disturbed and it may have archaeological potential.

i. Hill 99. The cave piercing the north end of this hill is heavily used by local people, is covered with graffiti and is very dirty. Parts of the cave floor are subject to damp, but other sections have archaeological potential.

j. Gua Peha Kerbau. A small rock shelter facing the railway is used as a timber store. Its earth floor is apparently undisturbed and may be worth examining.

k. Gua Bechah Kelubi. This hill stands in cacao plantation. On its southeast side are rock shelters, parts of which are now occupied by permanent wooden homes. Other parts of the floor are undisturbed and have archaeological potential.

This is merely a selection of the large number of sites which
must exist and which could be found by a complete traverse round each hill. All of the above are at about ground level (Gua Jaya is a bit of a scramble), but it has been found that even caves high up slopes can be rich in historical material. It should certainly never be assumed that a hill lacks archaeological interest, until a thorough survey has been done.

3.1. Importance of a buffer zone.

As a general recommendation all hills should be surrounded by a buffer zone of forest at least 200 m from the cliff face if it is vertical or from the outer slope or edge of scree (see Figure 2). In the ideal situation this buffer zone will consist of primary forest, but where this has already been destroyed or disturbed secondary forest should be allowed to grow up and form the protection zone.

This buffer zone is necessary:

i. to prevent burning*

ii. to protect the vulnerable assemblage of shade loving plants that grow at the base of the hill (see 1.2.1)

iii. to protect the stream system.

* A firebreak as suggested by the Project Team (1989) would have the opposite effect as in Malaysia a cleared area would quickly become covered by weeds such as lalang and Eupatorium which are a fire hazard as they readily catch fire and burn. A buffer zone of forest, provided it is wide enough and has not suffered disturbance, can halt even a fierce fire. In addition, the clearing of a firebreak would eliminate the shade-loving flora found at the base of limestone hills.

3.2. Protection Status

Various possibilities exist for providing legal protection to these limestone hills. These include protection in forest
Figure 2. Recommended width of buffer zone of undisturbed vegetation, 200 metres wide at a (round base of steep slope $a'$), 200 metres wide at b (round scree and boulder slope $b'$), and 200 metres wide at c (round base of sheer cliff $c'$).
reserves or in virgin jungle reserves (VJR); as town parks, historic monuments or even as state parks.

Forest Reserves do not give sufficient protection to accessible areas in Kelantan where illegal clearing and burning within forest reserves appears to take place on a larger than in any other state.

Virgin Jungle Reserves on paper are more strongly protected as no disturbance is permitted within them. However, in practice unless the local forest rangers regularly patrol the VJRs they are subject to illegal hunting, cutting of wood, collecting of forest products and so on. As the area of permanent forest estate dwindles, these VJRs become more important and the forest department will have to take a more active role in their protection.

Town Parks are suitable for the limestone hills close to administrative centres and that have amenity value for the local community, e.g. the Gua Musang hills and the Gua Ikan complex (see 3.3. below). These parks are administered by the district office, which has the power to protect them from illegal cultivation and other forms of damaging exploitation and to maintain the surroundings.

Legislation exists which theoretically protects archaeological sites at limestone hills: permits are issued by the relevant district office and Muzium Negara. In practice this is almost unenforceable, as cave earth can be dug out within a few weeks or days without anybody knowing.
Extra protection for known sites could be provided physically, by erecting a fence with warning or explanatory notice. If possible, specially important sites should be given a higher level of legal protection, such as being declared an historic monument or state park (see 3.3.b below).

3.3. Hills recommended for protection.

Except for a few hills of minor importance that have been earmarked for quarrying (see 6 below), all the other limestone hills warrant protection which includes a buffer zone surrounding them. However, among the 200 odd hills in Kalantan the following are outstanding for various reasons given below and should be given top priority for protection. They are listed alphabetically, not in any order of priority.

(a) Batu Baloh

Importance: * scenic value,

* elephant sleeping site

This is one of the most imposing natural features in Peninsular Malaysia. Batu Baloh rises as a sheer white cliff about 500 m high above the Nenggiri River and stretches for about 2 km.

Threat: * proposed Nenggiri Dam would submerge part of this hill.

Protection: Forest Reserve.

Note: An agency such as Kijang Mas Sdn Bhd might devise and promote an adventure tourism package as follows:-

Day 1: Gua Musang to Kuala Betis; boat to Kuala Jenera, camp.
Day 2: Orang asli events at Kuala Jenera, camp.

Day 3: boat to Kampung Star, with limestone scenery and shooting rapids, return by road to Gua Musang.

Side options could be offered to Kuala Bering or Kuala Puian, or visits to the salt lick downstream of Kuala Betis or (carefully supervised) to Gua Cha. A tour could be designed to provide direct cash income to local villagers. Equipment could be recycled overland (Kg. Star to Gua Musang to Kuala Betis) or back-to-back tours could be organised with one going downstream and the next upstream. This could become a moneyspinner for the state, and protect limestone by offering one alternative to the proposed Menggiri Dam.

(b) Gua Cha

**Importance:** *most important archaeological site in Kelantan and of national importance*

* breccia-like deposits (see 7.3 below)

**Threat:** *looting and damage to the site by visitors and campers*

* erosion and disturbance to natural vegetation by logging

**Protection:** Historic Monument or State Park

**Note:** The archaeological remains are deposited in the dry earth floor of an overhang in a limestone cliff above the river bank. This cliff is not part of a free-standing limestone outcrop and it appears to have been exposed by river erosion. The top of the cliff is therefore level with the soil surface of the forest. This means that should the surrounding forest be disturbed and water runoff and soil...
erosion occur, the archaeological deposits will be threatened by water movement down the rockface and onto the earth floor of the overhang. At present a logging road runs parallel to the river above the overhang and it would be wise to protect the primary forest between the road and the river at Gua Cha.

(c) Gua Gagak

Importance: * new species of Paraboea, endemic to this hill
  * rare Boea chinii
  * rare white form of balsam
  * pristine stream system

Threat: * Illegal logging
  * Fire, if burning around the Deer Farm is not controlled

Protection: Extend Wildlife Reserve Boundary to include Gua Gagak and the surrounding forest.

(d) Gua Ikan

Importance: * good representative flora of the base of hill
  * rare balsam, Impatiens vaughanii
  * variegated form of Begonia nuri
  * two bat caves
  * one new snail species, endemic to this hill
  * pristine stream system
  * scenic cave with a stream running through it
  * tourist value

Threats: * encroaching cultivation
  * burning
  * visitor pressure from chopping saplings to make camps, and driving cars into the cave
  * management practice of clearing the undergrowth
around the cave mouth which has destroyed the limestone flora and allowed the invasion of weeds.

Protection

1. It is suggested that this be made a town park administered from Dabong. The district office can therefore take responsibility for rubbish collection, grass cutting etc. If possible a 24-hour guard should be appointed to supervise visitors and ensure the safety of child campers at night.

2. The area should be treated as a unit to include not only Gua Ikan but also the adjacent hills (Gua Tembakau, Gua Fagar, Gua Buat and Gua Mastu) and the surrounding forest, especially that at the back of Gua Ikan which is still primary forest. In addition a buffer zone of forest around the entire unit should strictly be protected.

3. The cave floor should be protected from disturbance so that it can be investigated for its archaeological potential.

4. For health reasons, piped water should be provided for bathing and cooking as at present stream water is used after it has flowed through the cave and guano.

5. Electric lights in the cave are unnecessary and could be removed. Part of the adventure is in exploring the enormous dark cave. Visitors should be reminded to bring a torch.
Gua Jaya

Importance: * new species of *Begonia*, endemic to area
* 3 new snail species, 2 endemic to these hills
* good representative limestone flora
* claret-coloured form of balsam, endemic to this area
* good representative fauna
* frequented by elephants
* pristine stream system
* archaeological potential around Gua Jaya caves and rock shelters

Threats: * logging
* flooding by proposed Nenggiri Dam

Protection: At present logging has not extended to the east bank of Sungai Jenera, so protection as a forest reserve may be adequate. However, if logging is planned for this area the stronger protection of a WJR is recommended.

In addition, special protection should be given to the caves and rock overhangs to prevent disturbance before their archaeological potential has been investigated.

Gua Tampah at Kuala Bering on the Sungai Jenera shares many features in common with Gua Jaya, with the addition of the presence of breccia deposits and a population of the fan palm *Cerassodendron machadianum* (only the second locality known in Kelatan). However, it is more threatened than Gua Jaya as logging proceeds up the west side of Sungai Jenera. It is therefore
recommended that the Gua Tampin hills (including Gua Tagoeh, Gua Lahoi and Batu Kenong) be declared a VJR.

(f) Gua Musang

Importance: * scenic value

* recreational potential (unique in the entrance to the cave being a narrow fissure in the cliff face. It is also an easy and safe climb to the top with fine views of the town and surrounding countryside).

* cave with fruit bats (important as pollinators of fruits trees planted around the town)

* archaeological site in the Railway Cave

Threats: * burning

* visitor pressure

Protection: It is recommended that Gua Musang and the adjacent hills, Batu Serai and Batu Soh, be treated as a unit and be given protection as a town park.

Note: The town of Gua Musang gains its name from the limestone massif which towers over above it. For historic as well as scenic reasons steps should be taken to preserve the integrity of these three hills, which have suffered severe burning in the past. (Batu Serai at present has not recovered from a recent fire).

Gua Musang is a fast expanding town but at present has very few green or open areas. A town park if imaginatively created would provide a recreational area for the urban population as well as enhancing the beauty and tourist potential of the town.
From a long-term viewpoint it makes sense to acquire the small area of rubber estate between Batu Serai and Batu Boh and allow this area to return to secondary forest. Such an acquisition would forestall future commercial development of the area, e.g. for housing or industry and control access to the hills (at present an estate track passes through it). Delineation of the boundary needs careful consideration in view of its proximity to squatter settlements, logging yards and an Indian temple (see 7.2 below).

Maintenance for a town park is low entailing:
- ensuring that the buffer zone remains intact and is extended where tree cover has been eliminated,
- clearing up rubbish from the cave and path to the summit, obliterateing graffitti by whitewashing,
- putting up signboards to remind visitors not to litter, paint their names or otherwise damage the area
- informing local schools and youth groups of its value as part of Malaysia’s heritage so that local people are more aware of its value.
- the floor of the cave should be protected from disturbance until it has been thoroughly investigated for archaeological remains.

In addition, a metal ladder to the narrow fissure of the cave entrance (such as those at Gua Panching and Kota Belangi in Pahang) is recommended as at present access is by an extremely steep earth slope which is slippery in wet weather.
VJR status of Batu Boh (see below) would also be strengthened by the creation of such a town park as increased surveillance would prevent illegal cultivation.

Batu Serai

Importance: * as an integral part of the Gua Musang limestone
* rock shelter with possible potential as an archaeological site
* roosting site of a troop of dusky leaf monkeys

Threats and Protection: as for Gua Musang.

Batu Boh

Importance: * the primary importance of Batu Boh is the hidden valley in its centre, obviously the site of a collapsed cave. This harbour:
  - *Opiorrhiza longerepens*, endemic to these hills
  - a population of the fan palm *Horassodendron*
  - rich flora of the damp and shading element.
* cave with fruit bats

Threat: * burning (see 4.1 below).

Protection: Batu Boh should also be protected as a VJR whether or not it is included in a town park as it harbours rare and endangered plant species.

(g) Gunung Reng

Importance: * scenic value
* only site with elements of the northern limestone flora
* 2 new snail species, both endemic to this hill
* fine cave with easy access
* together with Sg. Pergau has recreational
value
* cultural value for its association with local legends
* cave with fruit bats

Threats: * burning
* visitor pressure

Protection: A buffer zone is urgently required in view of its close proximity to a village and because of disturbance by visitors. In addition, if not already in practice, a local villager should be appointed to jaga the hill to prevent encroachment into the buffer zone, the painting of graffiti, and to clear litter etc.

(h) Gua Setir

Importance: * good representative flora
* rare and beautiful Spatholirion ornatum
* variegated form of Begonia foxworthyi
* rare and beautiful Strobilanthes pachyphyllus
* 3 new snail species, all endemic to these hills
* fine caves with bats
* stream deserving protection

Threats: * Logging following by burning associated with illegal cultivation
* guano digging
* gold prospecting

Protection: Although the area has been logged and the vegetation in front of the accessible cave
severely disturbed by the activities of guano diggers, this area should be declared a VJR because of the value of its flora and fauna. The VJR should be as extensive as possible to include at least a 500 m buffer zone of forest around Gua Setir itself as well as the adjacent Gua Maka.

In addition, further guano digging should be preventing to protect potential archaeological sites in a small cave still undisturbed in Gua Setir and in the rock shelter on Gua Maka.

3.4 General Safety

Building housing estates and individual houses close to limestone outcrops should be strongly discouraged by the district office in view of tragedies that have occurred elsewhere due to falling rocks.

At present a housing estate is being developed right up to the foot of Batu Papan and houses are built into the rock shelter under Batu Becah Kelubi.
4. Urgency

Threats from human disturbance are very real and can take place with rapidity. Four areas are likely to suffer in the immediate future if some kind of action is not taken:

4.1. Gua Batu Boh

The wang which harbours one of the two Borassodendron populations in Kelantan and which is the only sure home of the Kelantan endemic Ophiorrhiza longeopensis is under threat from cultivation which was actually in progress while we were in Kelantan. The low slope up to the wang has already been treated with herbicide and once the vegetation is dry will be burned prior to cultivation. This is likely to burn up the slope and exterminate part of the Borassodendron population. Seedlings are particularly vulnerable. In dry weather the effects of burning will be more extensive.

4.2. Gua Ikan

This recreational area and the limestone vegetation is threatened by widespread clearing on the side away from the road which threatens to extend to the very foot of this massif.

This will not only reduce the aesthetic appeal of the area but will seriously threaten the rich plant assemblage that grows around the base of the hill. In particular this includes the extremely rare balsam, Impatiens vauchanii, which is a species especially sensitive to the loss of damp and shady conditions.

4.3. Gua Gagak

Most of this hill is cleared to the base and cultivated with banana, cacao and rubber. In these areas none of the original
vegetation remains around the base.

The part adjacent to the PERHILITAN Deer Farm is therefore particularly important although it has unfortunately already suffered from illegal logging. Not only is there a stream issuing from the massif, but its shaded rock faces are home to a new species of Paraboed, known only from this hill, and Boea chinii, which is known only from two other sites in Pahang.

4.4 Gua Setir

Logging in the area has opened up logging tracks which now allow access by motorbike to the remaining forest. While we were there, we could see many small areas of forest recently cleared and with burning in progress, which the local forestry staff told us was illegal cultivation by villagers laying claiming to land.

In view of this activity which was taking place on quite a large scale, action should be taken in the near future to provide stronger protection to the remaining forest around Gua Setir and Gua Maka.
5. Legislation

As far as we can ascertain none of these hills has any legal protection under either the jurisdiction of the Forest Department or the Department of Lands and Mines. Even Gua Gagak appears to fall outside the boundary of the wildlife reserve.

Because of the precarious status of these hills, steps should be taken to give them some type of legal protection, as VJRs, wildlife reserves, town or state parks or historical monuments or at the very least as forest reserves (see Sections 3 and 4 above).
6. Recommendations for quarrying

Our survey showed that the impact of limestone quarrying in Kelantan has been slight. Gua Nasi Setakun has been reduced to a stump. Gua Kawan has been hollowed out. At the northeast base of Batu Neng basement limestone has apparently been extracted in chunks from a pit. Kuari Dinar Sdn Bhd at Hill 14 south of Kampung Star is a low impact operation subsisting on limestone from a largely soil-covered hill and therefore not disturbing limestone vegetation. There is another active quarry, Quarry Damai Sdn Bhd at Hill 38.

There are some hills already so damaged that they could be quarried without great loss. Examples (using numbers according to Appendix 1) are Hills 39, 40, 41, 42; Hill k at Sungai Tias and nearby outcrops; Hills 7, 8 and 11 on the Gua Musang to Kampung Star road; Hill 71 in the Gua Musang new industrial zone; Hills 86 and 87 east of Kampung Tupai on the railway and Hills 74, 75 and 76 in Chin Teck oil palm estate; and Hill bn near Fort Lambok. It is suggested that any application for a quarrying licence received by the Department of Land and Mines should be checked against this list, and the applicant offered the nearest alternative site out of the suitable ones listed.

It is recommended that a proper geological survey should be conducted on any hill before a decision is made to issue a quarrying licence. Such a survey should include a complete traverse; a search for caves or rock shelters, preferably in conjunction with Muzium Negara or a trained archaeologist; a spot
height determination and estimate of limestone volume; a
determination of age, chemical composition, physical
characteristics and fossil content.

It is recommended that hills physically and chemically
suitable for high quality products such as marble should not be
wasted in allowing low-grade use like cement production; in
other words surveys should identify which use will yield the
highest return consistent with a particular hill's limestone
quality.

The Department of Land and Mines should always consult both
the State Museum and Muzium Negara before issuing any licence for
quarrying or excavation.
7. Recommendations for future work or research

This survey was cursory as it concentrated on covering as many hills as possible in the time available. Many of these groups of hills are extensive and would repay further more detailed study.

7.1. Survey of the base of hills

In line with the suggestion in 3.1 that all limestone hills should be surrounded by a buffer zone 200 m wide, it will be necessary to prepare ground maps for all hills such as has already been done for a few (Figure 3). Such a survey should provide the exact extent of the limestone including the steep slope up to the cliff face or the outer perimeter of the boulder screes. The outer limits of this buffer zone should be clearly marked and the relevant authorities informed about the necessity of leaving this area untouched and in particular the importance of taking steps to prevent illegal cultivation within them.

7.2. Feasibility study for a town park at Gua Musang

Should the concept of the Gua Musang Town Park as outlined in Section 3.3(f) above be accepted, a management plan would then be helpful. This should examine the objectives of the town park, which would be most beneficial if it were multipurpose. This would require careful delineation of areas to be exploited for recreation balanced with the conservation and protection of the hills and their flora and fauna. Existing land use would have to be taken into account in drawing up the boundaries.

7.3. Cave Surveys

Most limestone hills in Kelantan deserve detailed surveys for
caves, in view of their biological, recreational, speleological and historic interest. Hills particularly in need of such surveys include:

- all those within the Felda Ciku schemes, because these are large and extensive hills and almost unknown despite their present accessibility;
- the Gua Jaya/Gua Cawan/Gua Padla massif, in view of their position at the heart of present-day Temiar culture, and their archaeological potential.

7.4 Archaeological Work

Some form of government funding should be made available for archaeological work. This is necessary in view of the many limestone hills which have archaeological potential, and the immediacy of the threats they face.

Such finance need not be on a grand scale. It could be in the form of annual grants from the State (or Federal) government to the State Museum or Muzium Negara, or on a contract basis for surveys of particular areas.

Without such finance, no organisation in Malaysia would be able to cope with the scale of meticulous work required in Kelantan, and many sites of great historic importance would be lost before discovery.

The nature of geological and archaeological work could usefully be expanded. It has already been suggested (2.3.2b) that cave deposits in Gua Jaya could be used to trace back the history of major floods along the Nenggiri river. There are other
possibilities for the imaginative use of natural features.

For example, breccia or breccia-like deposits have been found at Gua Cha and Gua Tampah. These are conglomerates of secondarily deposited earth and rock fallen and hardened, within collapsed caves. They are likely to be Pliocene or older, they have apparently not been studied, and they might yield vertebrate fossils from a little known period.

Where prehistoric boulder falls have been sufficiently big, they have prevented incursion of roots into the underlying soil, later soil accumulation, and subsequent weathering. The soil beneath big boulders thus represents an unchanged prehistoric soil surface preserved intact since the boulder’s fall, which should be of soil science research interest.

7.5. Investigations of the Stream Systems.

The stream systems around the limestone massifs appear fragile and subject to deterioration if the canopy is removed. Since streams with a high concentration of calcium salts are unusual in Malaysia (most are acidic), it would be interesting to carry out ecological studies on this habitat. In particular to ascertain, by comparison between pristine and disturbed sites, whether any invertebrate species in particular are threatened by habitat destruction. Search should also be made for the rare Cryptocoryne species, which appear to have been lost from former sites in the Gua Musang area (see 2.1.2.4.-3).
B. References


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APPENDIX

List of limestone outcrops in Kelantan Darul Naim, with site notes

<table>
<thead>
<tr>
<th>Coordinates&lt;br&gt;5° 43' 00&quot;N 101° 44' 55&quot;E</th>
<th>Map name&lt;br&gt;Gunung Rong</th>
<th>Alternative names&lt;br&gt;Gunung Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nearest road: metalled, 50 m.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Burning: some creepers burnt round base, not on sides or top.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surroundings: scrub; village with gardens; school fields.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Facilities: stalls, information notice, shelters.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tourism: good potential overall.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Caves: one main cave with several exits, one easy access at ground level; light, attractive, with 600-300 bats and cave invertebrates; small archaeological potential. Other minor caves and one high inaccessible entrance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Camp sites: suitable sites by river</td>
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<tr>
<td></td>
<td></td>
<td>Comments: boundary between present scrub and gardens forms distinct line which could be declared limit of buffer zone, continuing in front of cave round edge of road. Note importance of bats for fruit tree pollination.</td>
</tr>
</tbody>
</table>

60
5°40'00"N 101°55'40"E  Gua Setir

Nearest road: unmetalled, 150 m.
Burning: little or none
Exploitation: guano and cave-earth digging, May 1939 to May 1940.
Surroundings: northwest, a few trees amongst scrub and lalang; northeast, a strip of logged forest then Macaranga and Melastoma scrub; around southern half logged forest.
Facilities: none
Tourist potential: fine cave, fine scenery, fair water supply, but inaccessible.
Caves: one huge cave, easy access, light, attractive, with fruit-bats and others, invertebrates, but damaged by guano digging. One small cave 200 m south on east face with Hipposideros, minor archaeological potential. Inaccessible caves in northern and central eastern face.
Buffer: should extend from earth road on west to the face, and as wide as possible on east side to include substantial forest area.
Comments: proper cave and archaeological surveys required. Important bat site for fruit tree pollination; gold prospecting has occurred by caves on west face; spectacular scenery; deserves stringent protection.

5°38'55"N 101°55'35"E  Gua Naka

Nearest road: unmetalled, 500 m.
Burning: none; creeper growth seems natural.
Surroundings: logged forest with logging in progress, and patches of unlogged forest on unsuitable terrain.
Caves: collapsed cave forms arch piercing hill; others may exist.
Buffer: urgently needs declaring and marking on ground, as for Gua Setir.
Comments: buffer should include forest up to the existing logging track on southeast and east side, including Didymocarpus site and steep unloggable terrain. Try to make protected zone contiguous with that round Gua Setir.

5°21'12"N 102°01'10"E Gua Bust

Nearest road: metalled, 400 m.
Burning: yes.
Surroundings: scrub.

5°21'20"N 102°01'35"E Gua Tembakau

Nearest road: metalled, 0 - 50 m.
Burning: severe on north corner nearest road, with creepers.
Surroundings: clearing and burning behind (west), Macaranga scrub to south; some recent rubber planting to west.

5°21'10"N 102°01'40"E Gua Ikan

Nearest road: metalled, 0 metres (can drive in to cave mouth.
Burning: no.
Surroundings: lowland forest, but for camp site and greasewards road.
Facilities: camp site, toilets, shelters, road.
Tourism: generally good potential.
Caves: rock shelters probably too wet for archaeological potential. One big low-roofed cave with St. Nampelam flowing through; easy access, light, attractive, many bats, few invertebrates. Dark small cave on northwest, Hipposideros bats, some invertebrates.
Comments: Cave-earth exploitation would ruin tourism. Prevent vehicles entering cave mouth. Plant some bamboo so campers don't cut down all pole-sized trees for camping. Advise campers on treatment of drinking water: the river flows through cave, receives bat faeces, then reaches camp-site. Provide a caretaker. Weakening of vegetation beside concrete access road is causing invasion by weeds; stop gardening and planting of ornamentals. Lighting already wired into cave not necessary; a guide rope would be better. Cultivation reaches dangerously close to rear face of Gua Ikan, and buffer zone needs urgent attention, as we saw red boundary markers up to the limestone. Do NOT cultivate, and therefore use pesticides, behind Gua Ikan, as chemicals may enter stream and kill campers. Ensure proper sewage disposal.

Nearest road: metalled, 10 metres.

Burning: recent burning with tree skeletons to top, mainly on northwest; older burning all along road frontage to 6 metres high.

Surroundings: rubber planted on northwest; scrub, secondary forest and banana on road frontage.

Tourism: no special potential.

Caves: cave with fruit-bats on south corner, entered by ladder; difficult access, dark, narrow, no tourist potential; already exploited for guano.
5°21'12"N 102°01'55"E  Gua Rastu

Nearest road: metalled, 50 m.
Burning: older burning with regrowth.
Surroundings: lalang up to road, and some scrub.
Comments: From Gua Dua to Gua Rastu, reserve and protect all vegetation from both sides of tarmac road to the foot of each hill, including all present banana, lalang etc. On sides away from road, provide reserve at least 200 m wide. All five hills face imminent threat of burning.

5°13'15"N 102°01'20"E  Gua Sulawar

Nearest road: at Komuba, 2 km, but railway line runs about 300 m away.

5°13'30"N 102°01'20"E  Gua Batu Balai

Nearest road: 2 km; railway 300 m away.
Burning: some on north and east; creepers and tree skeletons.
Surroundings: durian seedlings and banana up to sheer face on east; Macaranga on southeast; secondary forest behind.
Caves: numerous groundwater undercuttings but no large caves.
Comments: buffer could be established on south and west.

5°13'29"N 102°01'22"E  Gua Sasi Satakun

Nearest road: unmetalled, 1.7 km; railway 20 metres.
Comments: a tiny remaining creeper-covered fragment, blasted to make way for railway about 1932.

5°13'25"N 102°01'20"E  Gua Kawan

Nearest road: quarry access from railway to base.
Burning: probably old burning.
Surroundings: newly burnt and cleared land to west does not quite reach base; grass and banana.
Comments: entire inside of hill scooped out by quarry, no longer active.
Gua Urap

Nearest road: unmetalled, 100m.

Burnings: serious and repeated; all vegetation very degraded, with grass on top.

Surroundings: banana to base on south, grass and creepers to north.

Caves: an arch right through hill, with slightly sloping floor hardly disturbed, of minor archaeological potential.

Comments: impressive cycads survive on cliffs.

Gua Urap

For Gua Kerbau, see 5°18'20"N 102°01'22"E.

Nearest road: 1km; railway 200 m.

Burnings: disturbance round base, with cultivation and some creepers. Top undisturbed.

Surroundings: cultivation; grass up to base on the railway side. Narrow strip of forest on northeast.

Tourism: known cave on north tip.

Caves: Rock shelter on east corner nearest railway, used as timber store, minor archaeological potential. Chimney cave on north corner, difficult entry, graffiti, said to reach up to top of hill. Poor tourism potential.

Batu Ban Chuan a

Nearest road: unmetalled, 200 m.

Burnings: round base.

Surroundings: banana all round, very disturbed with creepers.

Caves: many clefts, no big caves. Top vegetation intact.

Batu Ban Chuan b

Nearest road: unmetalled, 200 m.

Burnings: none seen; good forest on top.

Comments: visible only with difficulty from road; a large hill apparently undisturbed.
5°15'30"N 102°02'10"E  Batu Ban Chuan

5°11'40"N 102°02'05"E  (5 m不受影响)


5°10'55"N 102°02'10"E  Gua Sedok Salatan  Nearest road: unmetalled, 200 m. Burning: north and badly burnt, with creepers. Top undamaged.

Surroundings: secondary forest.

5°10'15"N 102°01'55"E  Gua Natchang  Nearest road: unmetalled, 300m; railway 50 m. Burning: some on north part nearest railway.

Surroundings: secondary forest.

Comments: Gua Natchang; on the railway is an exposed fragment of which other tiny bits outcrop higher on adjacent soil hills to south.

5°09'10"N 102°03'10"E  Gua Bortan

5°11'00"N 102°03'05"E  e

5°13'55"N 102°03'05"E  f

5°13'50"N 102°03'05"E  g

5°13'10"N 102°03'02"E  h

5°13'10"N 102°03'12"E  i

5°13'00"N 102°03'12"E  j
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<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
<th>Comments</th>
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<td>5°17' N</td>
<td>102°11' E</td>
<td></td>
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<tr>
<td>5°13'35&quot;N</td>
<td>102°10'55&quot;E</td>
<td>Nearest road: unmetalled 500m, metalled 1000m. Burns: severe, with heavy creepers. Surroundings: rubber estate. Comments: unburned fragments at Pelora Sg. Tias, on road from Sungai Sam to Dabong.</td>
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<tr>
<td>5°13'25&quot;N</td>
<td>102°10'55&quot;E</td>
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<tr>
<td>5°01'50&quot;N</td>
<td>102°13'25&quot;E</td>
<td></td>
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</tbody>
</table>

51 Comments: half burnt, with creepers
50 Comments: burnt, and covered by creepers
19 Comments: base burnt, with creepers.
48 Comments: a fragment, burnt with creepers.
47 Comments: a fragment, burnt with creepers.
46 5°05'25"N 102°13'20"E  Comments: base burned on north and on side facing road (east); creepers to halfway up; top vegetation undisturbed; round base, burned secondary forest.

47 5°04'25"N 102°13'05"E  y

u

x

91 5°04'00"N 102°11'45"E  Ciku 4 massif. Comments:  north tip burnt, with lots of creepers; high earth base, with limestone outcropping patchily at top; Next section south badly burnt to top. Southern section with sheer walls, disturbed scrub and patchy burning round base, but sides and top undisturbed. Surroundings: oil palm.

90 5°03'00"N 102°12'00"E  Comments: this hill and last in Ciku 4 oil palm scheme. Little disturbed round base, top vegetation not disturbed. Surroundings: oil palm almost to base.

45 5°02'30"N 102°14'40"E  Comments: lies 2 km east of highway at Km 133 from Kota Bharu. Forested with only few rock faces visible. Oil palm between road and hill.

44 5°01' N 102°13'30"E  Comments: Not located on topo map, and coordinates approximate. Lies west of highway at Km 137. East end burnt; a little vegetation left on top. Surrounded by oilpalm.
Ciku 5 Caves

Nearest road: unmetalled, 20 m in oil palm.
Burning: 2 small outcrops bally burnt all over, and east part of main block burnt to top.
Surroundings: oil palm

Comments: burnt. Surrounded by secondary forest.

Comments: not located on ground

Comments: not located on ground

Comments: not located on ground

Comments: within Taman Negara

Comments: within Taman Negara

Comments: within Taman Negara

Comments: within Taman Negara

Comments: within Taman Negara

Comments: within Taman Negara

Nearest road: unmetalled, 100m
Burning: round base only, top untouched.
Surroundings: young oil palm.
Comments: in Ciku scheme 7-8.
5°02'15"N 102°09'35"E

Nearest road: 10 m, unmetalled
Burning: round base; creepers
Surroundings: young oil palm, Ciku 7-8.

5°03'00"N 102°09'20"E

Nearest road: unmetalled, 200 m
Burning: round base; creepers on sides.
Surroundings: young oil palm, Ciku 7-8.

5°04'00"N 102°09'00"E

Nearest road: unmetalled, 150 m
Burning round base, especially south end.
Surroundings: young oil palm, Ciku 7-8.
Comments: this hill and the last have some striking
pinnacle formations. This hill has several isolated
crystallizations high on earth hill.

5°04'35"N 102°08'45"E

Comments: severely burnt off. A tiny hill.

5°04'30"N 102°09'00"E

Comments: severely burnt. A tiny hill, north tip of 95.

5°04'45"N 102°09'00"E

Comments: burnt with creepers.

5°05'00"N 102°09'32"E

Nearest road: unmetalled, 100 m.
Burning: round base and sides, with creepers.
Surroundings: young oil palm, Ciku 7-8.
Caves: north end of hill pierced through by tunnel with
soil liable to wetting. A lot of graffiti, clothing
and bedding reveal cave's present use.

5°05'30"N 102°09'00"E

Nearest road: unmetalled, 150 m.
Burning: round base and sides.
Surroundings: young oil palm, Ciku 7-8.
4°56'10"N 102°06'05"E

30 Comments: slightly burned round base, big trees on top.

4°55'55"N 102°06'25"E

31 Comments: creepers to halfway up, top untouched.

4°55'25"N 102°05'00"E

ah

32 Comments: secondary forest on earth slopes round base.

4°55'35"N 102°06'37"E

33 Comments: cleared to base, with bananas; top untouched.

4°55'00"N 102°06'40"E

33 Comments: tree, multi-peaked massif, the northwest end with creepers and burning round base, large trees on top; huge northeast face totally burnt to top (prior to 1986).

4°54'08"N 102°07'15"E

34 Comments: sides burnt but not top; surrounded by oil palm with rubber behind. A tiny hill not marked on maps.

4°53'10"N 102°07'15"E

35 Comments: some burning on north end, top undisturbed.

4°53'35"N 102°07'40"E

36 Comments: creepers at base, top undisturbed.

4°53'50"N 102°07'50"E

37 Comments: base burnt; surrounded by scrub.

4°53'45"N 102°07'55"E

39 Comments: cleared to base with scrub regrowth at back; Quarry Damai Sin 3rd beginning to quarry edge of hill.

4°54'00"N 102°08'13"E

39 Comments: badly burnt on sides facing highway. Creepers at base and surrounded by scrub. Connected by low saddle to hill 40.

4°53'45"N 102°08'13"E

40 Comments: badly burnt on sides facing highway; creepers at base, top undisturbed; surrounded by scrub and oilpalm. 150 m from metalled highway. Connected by low saddle to hill 39.
4°45'40"N  102°00'40"E  Gua Tok Kong  85  Nearest road: metalled, 50 m (west side); unmetalled, 100 m (east side).
 Burning: lots of good forest on top, secondary forest on west side along highway with evidence of patchy old burning; village cultivation with banana and lalang to east, extensive creepers as evidence of burning.
 Surroundings: besides the above, rubber and oil palm to south.
 Buffer: edge of road should form edge of buffer on west.
 Comments: a tiny section was blasted to make room for K. Lipis - Gua Nasang highway. This hill connected to next by a low saddle.

4°46'10"N  102°00'35"E  Gua Tok Kong  84  Nearest road: metalled 100m (west); unmetalled, 100 m (east).
 Burning: Base and parts of sides burnt with creepers and Aranga on west; base and parts of sheer faces burnt on east; good forest on top.
 Surroundings: secondary forest on west; banana, cocoa and lalang on east and north.
 Caves: inaccessible cliffs and caves high up. One stream channel pierces northern end.
 Comments: Pelora scheme on east. All vegetation to road on west should be a buffer zone.

4°45'55"N  102°00'15"E  83  Nearest road: metalled, 150 m.
 Burning: some creepers round base, top undisturbed.
 Surroundings: logged forest all round, except some parts cleared to base with banana and Nacaranga.

4°46'05"N  102°00'10"E  82  Nearest road: metalled, 100 m.
 Burning: burnt on east face nearest road with creepers.
 Surroundings: banana to base on east; logged forest behind; illegal clearing between this hill and hill 83.
4°46'30"N 102°00'05"E

26

Nearest road: metalled, 150 m.
Burning: burnt round base and sides, with creepers.
Surroundings: secondary scrub.

4°46'00"N 102°01'05"E

36

Comments: east of railway. Daily burnt on parts of sides, with creepers; top undisturbed, poorly maintained cultivation and secondary forest round it.

4°46'30"N 102°01'00"E

87

Comments: east of railway. Good forest on top. Burnt round base with a few creepers at south end. Secondary forest to north, oil palm to south.

4°46'19"N 102°00'35"E

33

Comments: sheer faces burnt all round, with creepers. Top degraded. Amongst cocoa, banana and lalang.

4°47'10"N 102°00'20"E

39

Comments: sheer faces burnt all round with creepers. Top undisturbed. Amongst cocoa, banana and lalang.

4°48'00"N 102°00'45"E

23

Nearest road: metalled 1.5km, unmetalled 100m.
Burning: surroundings burnt to base and partway up sides, with creepers.
Surroundings: banana, recently burnt off and planted.
Comments: these are minor outcrops at south end of Gua Panjang massif, of little conservation value in themselves; within Pelora Lepah Jaya.

1°43'00"N 102°30' E

Gua Panjang

Nearest road: various unmetalled roads to bases, and a logging road to top; railway to within 50 m.
Burning: some sectors burnt with creepers, especially along railway.
Surroundings: great variety of village gardens, estates and forest.
Caves: see Gua Manek, below; probably others exist.
Comments: a huge and complex massif petering out gradually to west; active logging between limestone.
Gua Nanek

Nearest road: unmetalled, 30 m.

Hanging: old burning damage with creepers, especially on NE corner nearest railway, and rear cave entrance.

Surroundings: tall oil palm, Chin Tack estate.

Caves: One big, high cave, dangerous access; moderately bright, with two large exits and fine portal. No archaeological potential within cave, as exploited (repeatedly?) for guano. Fruit and insectivorous bats; few invertebrates.

Comments: Gua Nanek represents the northernmost end of Gua Panjang.

Gua Nanek

Nearest road: unmetalled, 50 m.

Hanging: round extreme base only, with few creepers. Top undisturbed.

Surroundings: mature oil palm.

Gua Nanek

Nearest road: unmetalled, 100 m.

Hanging: some creepers round base, some damage to top.

Surroundings: mature oil palm.

Gua Nanek

Nearest road: unmetalled, 60 m.

Hanging: many creepers, and damaged on top.

Surroundings: mature oil palm.

Gua Nanek

Nearest road: unmetalled, 150 m.

Hanging: old burning on some faces only, with creepers. Not disturbed on top.

Surroundings: secondary forest, except banana to base on west side.

Buffer: secondary forest could be a buffer zone.
4°49'42"N 101°53'55"E 72
Nearest road: unmetalled, 50 m.
Burning: damaged round base, with creepers.
Surroundings: oil palm fragments.
Comments: next to timber yard in industrial zone.

4°50'02"N 101°59'00"E 71
Nearest road: unmetalled, 150 m.
Burning: recently and completely burnt.
Surroundings: oil palm.
Comments: next to industrial zone. This is Ang's Hill SW.

4°46'00"N 101°58'20"E Gua Gagak 65a
Nearest road: metalled, 20 m.
Burning: none seen.
Surroundings: tall forest, illegally and recently logged on southeast to base.
Facilities: P.H.R.LITAN deer farm at base.
Caves: Gua Kijang is said to be a bat-filled cave, now faced by the illegally logged forest.
Comments: this is the most southerly of a group of about 5 hills, and the biggest; it has good forest on top. Entire hill could be made a Wildlife Reserve. Make tarred access road one boundary to east, and other boundaries as extensive as possible. Ensure that repeated burning of pasture at Deer Farm does not gradually eat away at forest round base.

4°46'30"N 101°58'40"E
Comments: not located on ground. Standing on N.E. bank of Sungai Hugah near Deer Farm.

4°46'15"N 101°57'50"E 65b
Comments: tall forest on top and to southwest; secondary forest between 65b and 65a; rubber on northwest. Could be included in Wildlife Reserve.
4°47'10"N 101°57'50"E  650  Comments: surrounded by scrub, cocoa and banana. Base and sides damaged by burning. Shallow lifeless cave on corner 10 m from tarred road.

4°47'20"N 101°57'40"E  650  Comments: middle sector of hill badly burnt to top; burnt entirely round base and partway up sheer faces. Cocoa and banana to east, rubber to east. Possibly this is the 'true' Gua Gagak.

4°47'40"N 101°57'35"E  650  Comments: burnt to mid level all round; scrub to west, cocoa and banana to east.

4°48'35"N 101°59'05"E  Bechah Kelubi 24  Nearest road: metalled 300 m, cycle track 20 m. Burning: damaged all round, severe creeper cover on north with patchy burning to top. Surroundings: cocoa all round except for swamp and scrub on north and northeast sides. Caves: small clefts in vertical fault-lines. Rock shelters with permanent wooden dwellings of farmers.


4°37'30"N 101°45'10"E  Gua Senurat  Comments: summit ridge forms Kelantan-Pahang border, with bulk of hill in Pahang; probably forested all round.

4°40'00"N 101°44'00"E  Gua Tungkol  Comments: probably surrounded by forest.
Comments: probably surrounded by forest.

Comments: probably surrounded by forest.

Comments: probably surrounded by forest.

Comments: forms a natural group with 4 tiny hills in Pahang.

Nearest road: unmetalled, 300 m.

Nearest road: unmetalled, 400 m.

Comments: unmapped comb of limestone along crest of soil-covered hill, across river from Batu Itek.

Nearest road: unmetalled, 400 m.

Burning: parts of main hill and all of two northern outcrops burnt, with creepers.

Surroundings: scrub, secondary forest, banana.
4°43′20″N 101°56′15″E  Buitong Gong  67
Nearest road: unmalled, 400 m.
Burning: possibly old burning; no tall trees on top, no pandans.
Surroundings: secondary forest all round.

4°43′40″N 101°57′10″E  Batu Tongkat  66
Nearest road: unmalled, 400 m.
Burning: completely burnt, covered with creepers long ago. Some pandans survive.
Surroundings: fruit trees with cocoa; rubber.
Comments: consists of three hills; the northern one is completely burnt with creepers, some pandans, and surrounded by jasun. The biggest central hill is burnt with creepers on north, undisturbed on top, with cocoa to east and rubber to west. The smallest southern hill is covered with creepers, with grass and Macaranga to base.

4°50′00″N 101°57′15″E  Gua Hadu  70
Nearest road: 40 m, unmalled but soon to be malled. Burning: round base, with creepers half to most of way up. Top undisturbed.
Surroundings: old rubber, with secondary forest on north and west.

4°50′05″N 101°57′10″E  Gua Hadu  79
Nearest road: malled, 300m.
Burning: fully forested except very recent burn on southeast face to halfway up.
Surroundings: rubber, some secondary forest.
Comments: Tweedie's excavation site should be located and protected.

4°50′30″N 101°57′20″E  Gua Batu Papan  73
Nearest road: malled, to about 100m.
Burning: on extreme north tip. Some creepers on lower third of some sheer faces. Good forest on top.
Exploitation: old quarry on one of northern tips.
Surroundings: secondary forest; wild bananas on east.
Land clearance for building at northern tip and on northeast side next to highway.
Comments: besides increased fire risks, danger of falling rocks to future buildings. Caves need searching for.

Nearest road: metalled, 100 m.
Burning: burnt and creeper-covered on east and west to a way up. Top undisturbed with pandan, cycads.
Surroundings: secondary forest and few durian trees.
Comments: a tiny hill.

Nearest road: metalled, within 50 m.
Burning: old burning on north end to top, and on some sheer faces to halfway up. Good forest on top.
Surroundings: Rubber all round, except secondary forest fringe along highway.
Comments: make highway one boundary for buffer, on west.

Nearest road: metalled, 50 m at clinic (no access), 200 m along highway.
Burning: Some damage on northwest face, not reaching top. Good forest on top.
Exploitation: removal of basement limestone from pits on northeast corner.
Surroundings: mainly rubber; secondary forest on east; cleared to base with lalang on north.
Caves: clefts for bats.

Nearest road: unmetalled, 10 m.
Burning: probably repeatedly round base, parts thick with creepers.
Surroundings: dirt road; scrub; rubber on east, a little banana on west.
Caves: several overhangs in use along dirt road on west.
Within the central 'wang', a small dark cave with
fruit and sheathtailed bats; possibly minor archaeological significance.

Comments: entire base could be fenced off along dirt road on railway side. Central 'wax' (collapsed cave system) with Borassodendron dell to be protected urgently, including cave.

Nearest road: metalled, 50m; unmetalled 20 m.

Burning: Top, especially towards south, seriously burnt; burnt round base, many creepers.

Surroundings: scrub, rubber estate and timber yard.

Caves: one bipartite rock shelter on south end in rubber estate, archaeological potential. Hill riddled with small clefts following vertical fault lines.

Comments: rockshelter excavation might be undertaken as a State Museum project. Dusky leaf-monkeys sleep in clefts. Barn owl site.

Nearest road: metalled, 50m.

Burning: repeatedly, last serious burn in 1969, but small ones may have occurred since.

Surroundings: squatter housing, creepers and scrub; rubber.

Tourism: cave frequently visited especially by youths.

Caves: One huge cave passing through entire hill. Steep slippery access through squatter housing; reasonably light cave, impressive formations. One section (Railway Cave) excavated by Tweedie. Fruit bats important for fruit-tree pollination but few invertebrates. Cave earth formerly dug out.

Comments: Lots of graffiti and litter on climb up, in cave, and at top of hill. Suggest Batu Bob, Sarai and Musang be all included in one Town Park; youth-group clean-up projects; 'Remove Litter' signs; provide steps. Can be promoted as a major site (views of town) and as fun (the entrance squeeze).
<table>
<thead>
<tr>
<th>Coordinates</th>
<th>Location</th>
<th>Nearest road</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4°55'10&quot;N 101°56'3&quot;E</td>
<td>Gua Nantu</td>
<td>not seen</td>
<td>burned on sides and top, severely. Surroundings: some forest, cleared to south, with some rubber and secondary forest on southwest.</td>
</tr>
<tr>
<td>4°56'40&quot;N 101°56'00&quot;E</td>
<td>Gua Subong</td>
<td>nearest road: unmetalled, 150m.</td>
<td>no. Surroundings: cleared to base and surrounded by rubber. Comments: the following hills 3 - 20 have little tourist potential individually, but as a group or as several sub-groups should be protected by a reserved buffer zone. Hill 18 has caves, to be protected, and probably so do several of the others. The entire range is a striking landscape feature. The range could form a natural boundary to the Bukit Lalat area wildlife reserve proposed in the 1960's. If that fails, the next range to the west (hills ai to av) could form a fall-back as choice for a natural boundary. Hill 3 = Hill ST of Ang's geological report.</td>
</tr>
<tr>
<td>4°59'10&quot;N 101°57'30&quot;E</td>
<td></td>
<td>nearest road: unmetalled, 1 - 2 km.</td>
<td>unburned, surrounded by forest.</td>
</tr>
<tr>
<td>4°59'25&quot;N 101°57'05&quot;E</td>
<td></td>
<td></td>
<td>this is Hill SU of Ang's geological report.</td>
</tr>
<tr>
<td>4°59'50&quot;N 101°53'10&quot;E</td>
<td></td>
<td>nearest road: unmetalled, 400m.</td>
<td>no. Good forest on top. Surroundings: forest, but rubber and scrub between hill/road.</td>
</tr>
<tr>
<td>4°59'50&quot;N 101°53'20&quot;E</td>
<td></td>
<td></td>
<td>not seen</td>
</tr>
<tr>
<td>Latitude</td>
<td>Longitude</td>
<td>Comments</td>
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<tr>
<td>5°00'15&quot;N</td>
<td>101°58'30&quot;E</td>
<td>6 Comments: base creeper-covered, top OK. Banana and fruit-trees round base.</td>
<td></td>
</tr>
<tr>
<td>5°00'30&quot;N</td>
<td>101°58'45&quot;E</td>
<td>7 Comments: a little outcrop, the base creeper-covered.</td>
<td></td>
</tr>
<tr>
<td>5°00'31&quot;N</td>
<td>101°58'45&quot;E</td>
<td>8 Comments: a little outcrop, the base creeper-covered.</td>
<td></td>
</tr>
<tr>
<td>5°00'35&quot;N</td>
<td>101°58'25&quot;E</td>
<td>9 Comments: a large long ridge, the northern end badly burnt and the southern end not seen.</td>
<td></td>
</tr>
<tr>
<td>5°00'40&quot;N</td>
<td>101°58'10&quot;E</td>
<td>10 Comments: a very long ridge running behind (west of) hills 5, 6, 9, and almost connecting to north with hill 12. Apparently not burned, and surrounded by forest.</td>
<td></td>
</tr>
<tr>
<td>5°00'45&quot;N</td>
<td>101°58'50&quot;E</td>
<td>11 Comments: a small hill, the top OK but the base with secondary vegetation; standing in cleared and abandoned land.</td>
<td></td>
</tr>
<tr>
<td>5°01&quot;N</td>
<td>101°58'20&quot;E</td>
<td>12 Comments: a very long ridge, forested on top and base.</td>
<td></td>
</tr>
<tr>
<td>5°03'05&quot;N</td>
<td>101°58'30&quot;E</td>
<td>13 Comments: strikingly domed hill when viewed from road to its east, but west side is sheer. Not burnt and almost covered by low trees. Wild banana to base on north.</td>
<td></td>
</tr>
<tr>
<td>5°03'50&quot;N</td>
<td>101°58'30&quot;E</td>
<td>14 Comments: site of Kuari Dinar, quarrying limestone from beneath soil hill. Half hill burnt. Some burning of forest close to west side.</td>
<td></td>
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<tr>
<td>Latitude</td>
<td>Longitude</td>
<td>Comments</td>
<td>Nearest Road</td>
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<tr>
<td>5°04'00&quot;N 101°58'45&quot;E</td>
<td>16</td>
<td>north end burnt, bare with creepers; top undisturbed. Surrounded by scrub, banana and burnt forest. Unmetalled road to 100m.</td>
<td>unmettalled, 5m.</td>
</tr>
<tr>
<td>5°04'25&quot;N 101°58'30&quot;E</td>
<td>18</td>
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<td></td>
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<tr>
<td>5°04'30&quot;N 101°53'45&quot;E</td>
<td>17</td>
<td></td>
<td>unmettalled, 15 m.</td>
</tr>
<tr>
<td>5°04'40&quot;N 101°53'55&quot;E</td>
<td>19</td>
<td></td>
<td></td>
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<tr>
<td>5°05'05&quot;N 101°53'35&quot;E</td>
<td>20</td>
<td>Batu Iesong</td>
<td>metalled, 50m.</td>
</tr>
</tbody>
</table>
5°05'30"N 101°53'10"E  Batu Bong  Comments: vegetation on top undisturbed. Cliff frontage directly on river; second hill on north bank of Jenggiri upstream of Pulau Setulu.

5°05'40"N 101°58'30"E  Batu Setulu  Nearest road: metalled, 30 m
Burnings: all round to high level with Cupatorium.
Surroundings: banana, rubber; bamboo on west side.
Caves: none.
Comments: first hill north of Jenggiri upstream of P. Setulu; almost within village.

5°04'35"N 101°58'15"E  Batu Pintu  Nearest road: unmetalled, 500 m.
Exploitation: formerly, for guano.
Burnings: none visible on river frontage.
Surroundings: forest between cliff and river; rubber estate behind.
Caves: long horizontal cleft high above river (gives this hill its name); once exploited for guano, but halted after a man fell and died; a rope remains in front of cave.
Buffer: should include all land from cliff to river (a narrow strip), and a zone in rubber estate.
Comments: with ladder and safety features, could be made into a visitor feature.

5°04'25"N 101°58'02"E  Hill 15  Nearest road: unmetalled, K3, Star.
Burnings: part of east end probably burnt, creepers.
Surroundings: rubber on east, forest to west and on top.
Leguminous cover crop from rubber estate has invaded outlying block on river.
Comments: one limestone ring of cliffs, forested earth on top, with a smaller central outcrop on top of that; smaller outcrop reaches bank of Jenggiri. White-flowered Farabose.
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<tr>
<th>Latitude</th>
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<tr>
<td>5°04'00&quot;N</td>
<td>101°57'00&quot;E</td>
<td>ai (Hills ai to av form a north-south range parallel and west of Hills 3 to 20.)</td>
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<tr>
<td>5°03'40&quot;N</td>
<td>101°56'45&quot;E</td>
<td>aj</td>
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<td>4°59'35&quot;N</td>
<td>101°55'30&quot;E</td>
<td>av</td>
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<td>5°04'25&quot;N</td>
<td>101°56'50&quot;E</td>
<td>Batu Baloh</td>
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</table>

Nearest road: Unmetalled, Kg. Star.

Burning: None.

Surroundings: Forest from sheer slope down to river.

Secondary forest on river bank; forest on top.

Caves: None seen; elephants habitually travel along the base, and use various spots for sleeping.

Suflor: All forest from base to river should be
reserved; difficult to define boundary to south, but ought to fall within proposed Bukit Lalat wildlife reserve.

Comments: although not of major biological importance as known so far, it is one of the most spectacular massifs in the country.

Balok extension
Comments: a continuation of the Batu Balok cliff-face, which snakes southwest through forest for 4 km. Undisturbed, and deserves exploration.

Batu P. Raba
Nearest road: Kampung Star.
Burning: none.
Surroundings: undisturbed forest from sheer face down slope to river. Top undisturbed.
Caves: none, but overhangs used by elephants.
Comments: an unique mud stalagmite found below sheer face where muddy water from high up face drips over; snails are embedded.
No map name, this hill is first south of river downstream of Pulau Raba on Menjiri.

ax
Comments: small double hill, disturbed round base.

Bukit Koldong ay
Not seen on ground.

Batu Gabong
Not seen on ground, and no outcrop marked on map; only the name suggests there may be a small outcrop locally.
5°05'10"N - 5°08'30"N
101°45'20"E - 101°46'30"E  Gua Jaya complex

5°05'40"N  101°46'25"E  Gua Jaya

Burning: none.
Surroundings: extensive primary forest.
Comments: Peacock's trenches in Gua Jaya still visible.
The name refers to several shallow caves and rock shelters round base. See extensive comments in main report.

5°06'00"N  101°45'50"E  Gua Cawan

Comments: Peacock's trenches still visible. Gour pools.

5°06'45"N  101°45'30"E  Gua Palda

Comments: cave about 10 m deep; two rapids upriver from Gua Cawan.

5°08'00"N  101°46'15"E  Gua Kelawar

Comments: northeast part of Gua Jaya massif

5°08'10"N  101°46'15"E  Bukit Ronting

Comments: north end of the massif.

5°08'30"N  101°46'50"E  az

Comments: 1.5 km long outlier of the massif.

5°09'10"N  101°47'10"E  Batu Perawie

Comments: 300 m long outlier of the massif.

5°09'00"N  101°47'30"E  Batu Apit

Comments: a map name possibly referring to unmapped outlier.

5°07'20"N  101°44'25"E  Batu Yantul

Comments: a small river-exposed limestone face, 6 m x 10 m, on true left bank of Sungai Jeners, 200 m upstream from Kg. K. Puian.

5°11'30"N  101°42'20"E  Gunung Sakam

Comments: not seen, and may not be limestone; if it is, would be highest in Peninsula at 3493 feet.

5°12'20"N  101°42'30"E  Gunung Herring

Comments: not seen, and may not be limestone; if it is, would be second highest in Peninsula at 3130 ft.
Batu Tampah

*Surroundings:* undisturbed forest, and old cultivation.
*Caves:* one small deep cave with Hippidiosum armiger, *Umbalamura* and fruit bats. Guano digging in small quantity in past.
*Comments:* rock shelter on corner nearest Kuala Bering, opposite village, has small excavation, by Muzium Negara. A rock shelter 500 m up Sg. Bering contains breccia.

Batu Kenong

*Comments:* mixed primary and secondary forest round base.

Batu Tagoeh

*Comments:* as for Batu Kenong.

Batu Lahoi

*Comments:* not seen; spot height 1447 ft. This may be Batu Lapang, which villagers said was a big hill two hours up the Sungai Bering, and is possibly the huge rock face glimpsed from boat going up Sg. Jenara.

Gua Dala

*Comments:* a map name 3 km down the Nenggiri from Gua Cha, may refer to sub-canopy limestone cutover.

Gua Cha

*Nearest road:* unmetalled, 200 m.
*Burning:* none.
*Surroundings:* tall forest; river frontage hidden by a lotus and grass island.
*Comments:* contains small amount of breccia. See comments in main report, and references.

Gua Bukit Percing, Kuala Yai.


Gua bb

*Comments:* not visited. Could this be Gua St. Percing?
\[4^\circ57'10''N \quad 101^\circ45'40''E\]
\[4^\circ56'50''N \quad 101^\circ45'50''E\]
\[4^\circ56'00''N \quad 101^\circ45'05''E\] Gua Bdong

Comments: a 3 km long narrow ridge.

\[4^\circ55'10''N \quad 101^\circ45'50''E\]
\[4^\circ55'00''N \quad 101^\circ45'45''E\]
\[4^\circ54'40''N \quad 101^\circ45'55''E\]

Comments: be, bf, and bj combined into one hill under the name Gua Beluru by Berry (1965).

\[4^\circ54'20''N \quad 101^\circ45'30''E\] Gua Cenarut

Nearest road: unmetalled, 1 km.

Burning: none seen.

Surroundings: primary and secondary forest.

\[4^\circ54'20''N \quad 101^\circ45'50''E\]
\[4^\circ54'20''N \quad 101^\circ46'00''E\]
\[4^\circ53'40''N \quad 101^\circ45'50''E\]

Surroundings: rubber, dusun and secondary forest.

Comments: domed to east, sheer face to west. Called Gua Pasuk by Berry (1965).

\[4^\circ54'00''N \quad 101^\circ46'15''E\]
\[4^\circ53'40''N \quad 101^\circ46'15''E\]
\[4^\circ53'35''N \quad 101^\circ46'35''E\]

Surroundings: dusun.

4°53'20"N 101°46'05"E  
Gua Senarip  Nearest road: unmetalled, 200 m.
 Burning: eastern third, and along top, by 
vegetable farmers squatting nearby.
Surroundings: vegetables, banana, huts.
Caves: apparently none.
Comments: Gua Senarip is name used by Berry (1965).

4°53'00"N 101°45'40"E  
Gua Renayang  Nearest road: unmetalled, 100m.
 Burning: none.
Exploitation: cave earth digging in spots in past.
Surroundings: forest, cleared on parts of north and 
west sides to within 5 m of base.
Caves: a little graffitied-daubed cave on northwest 
tip known as Gua Tragat or Tragap. A larger 
dark cave 100 m to east with nice geological 
features, and access to top of hill via chimney 
if ladder used. A big, very high cave with fruit-
bats, and stream running right through hill, not 
entered during this survey (but in 1985).
Buffer: ought to be declared soon, especially needed 
along road to north.

4°52'10"N 101°45'40"E  
Gua Betau  Comments: a massive sheer face south of Gua Renayang, 
with forest on top and round base, for which a 
buffer zone could be established.

4°54'00"N 101°41'10"E  
bn  Comments: about 2 km from unmetalled road, two severely 
burnt areas on crest of earth hills (not karst); 
small exposed area of limestone but high. Could 
be quarried in preference to any of the other 
limestone karst around Fort Laubok area.
Comments: not visited.

Comments: lies entirely within Kelantan, but state border with Pahang runs along southeast face. Visited in June 1933; then nearest road about 2 km, no burning, surroundings a mosaic of logged and unlogged forest; no caves located; trapdoor spiders found round base.

a All limestone outcrops are listed according to latitude and longitude, whether visited or not.

b Coordinates for big massifs generally refer to some point about the middle, rather than attempting to set the north-south and east-west limits.

c Alternative names include some names referred to in publications, some names according to local informants, and otherwise to our number or letter notation used in the field or on our maps.
Appendix 2. Distribution of Plant Species on 17 Limestone Hills

5. Gua Ikan 12. Gunung Rang
6. Gua Tampah

(a) Species common to several hills:

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| Family              | Species                                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---------------------|----------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Liliaceae           | Peliosanthes tetra                           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Moraceae            | Morus sp.                                    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Oleaceae            | Olea sp.                                     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Jasminum curtisii   |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Orchidaceae         |                                               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Calanthe triplicata |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Palmae              | Arecaceae                                    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Arenga hookeriana   |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Arenga obtusifolia  |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Arenga westerhoutii |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Caryota mitis       |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Iguanura polymorpha |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| I. wallichiana      |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Pandanaceae         | Pandanus irregularis                         |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Piperaceae          | Peperomia dindigulensis                      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Piper kurzii        |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Rubiaceae           |                                               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ixora nigricans     |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Morinda elliptica   |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ophiophriza sp. a   |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ophiophriza sp. b   |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Scrophulariaceae    |                                               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Duranta amara       |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Solanaceae          | Solanum biflorum                            |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Scrophulariaceae    |                                               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Elatostema latifolium|                                             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| E. subscabrum       |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fimia fruticosa     |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Poikilospermum suaveolens |                                       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Procis pedunculata  |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Zingiberaceae       |                                               |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Phaeomeria maingayi |                                              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

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